

Project Manual
& Specifications



XAVIER
UNIVERSITY

**Gallagher Student Center
Renovation**

ISSUED FOR BID & PERMIT

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TABLE OF CONTENTS

DIVISION 01 - GENERAL REQUIREMENTS

Not Used

DIVISION 02 - EXISTING CONDITIONS

024119 Selective Demolition

DIVISION 03 – CONCRETE

Not Used

DIVISION 04 - MASONRY

Not Used

DIVISION 05 - METALS

Not Used

DIVISION 06 - WOOD, PLASTICS AND COMPOSITES

061053 Miscellaneous Rough Carpentry

062023 Interior Finish Carpentry

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

078413 Penetration Firestopping

079200 Joint Sealants

079219 Acoustical Joint Sealants

DIVISION 08 – OPENINGS

081113 Hollow Metal Doors and Frames

081416 Flush Wood Doors

087100 Door Hardware

088000 Glazing

088113 Decorative Glass Glazing

DIVISION 09 - FINISHES

092216 Non-Structural Metal Framing

092900 Gypsum Board

095113 Acoustical Panel Ceilings

095426 Wood Panel Ceilings

096513 Resilient Base and Accessories

096519 Resilient Tile Flooring

096813 Tile Carpeting

099123 Interior Painting

099300 Staining and Transparent Finishing

DIVISION 10 – SPECIALTIES

102600 Wall and Door Protection

DIVISION 11 - EQUIPMENT

Not Used

DIVISION 12 – FURNISHINGS

122413 Roller Window Shades

DIVISION 13 - SPECIAL CONSTRUCTION

Not Used

DIVISION 14 - CONVEYING EQUIPMENT

Not Used

DIVISION 21 – FIRE SUPPRESSION

210500 Common Work Results for Fire-Suppression
210503 Submittals for Fire-Suppression
210517 Sleeves and Sleeve Seals for Fire-Suppression
210518 Escutcheons for Fire-Suppression Piping
211313 Wet-Pipe Sprinkler Systems

DIVISION 22 – PLUMBING

Not Used

DIVISION 23 – HEATING VENTILATING AND AIR CONDITIONING

230170 Operation and Maintenance of HVAC Systems
230501 Common Requirements for HVAC
230503 Submittals for HVAC
230505 Existing Conditions and Demolition
230529 Hangers and Supports for HVAC Piping and Equipment
230553 Identification for HVAC Piping and Equipment
230593 Testing, Adjusting and Balancing for HVAC
230713 Duct Insulation
230900 Building Automation Systems
233113 Metal Ducts
233300 Air Duct Accessories
233600 Air Terminal Units
233713 Diffusers, Registers and Louvers

DIVISION 25 – INTEGRATED AUTOMATION

Not Used

DIVISION 26 – ELECTRICAL

260501 Common Requirements for Electric
260502 Common Electric Materials and Methods
260503 Submittals for Electrical Systems
260505 Existing Conditions
260519 Low-Voltage Electrical Power Conductors and Cables
260526 Grounding and Bonding for Electrical Systems
260529 Hangers and Supports for Electrical Systems
260533 Raceways and Boxes for Electrical Systems
260553 Identification for Electrical Systems
260584 Mechanical Equipment
260923 Lighting Control Devices
262416 Panelboards
262726 Wiring Devices
262813 Fuses
262816 Enclosed Switches and Circuit Breakers
265100 Lighting

DIVISION 27 – COMMUNICATIONS

Not Used

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

Not Used

DIVISION 31 – EARTHWORK

Not Used

DIVISION 32 – EXTERIOR IMPROVEMENTS

Not Used

DIVISION 33 – UTILITIES

Not Used

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of selected portions of building.
 - 2. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
 - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

1.3 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control and, for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of selective demolition activities with starting and ending dates for each activity.
- C. Predemolition photographs or video.

1.5 CLOSEOUT SUBMITTALS

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

1.6 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

1. Before selective demolition, Owner will remove the following items:
 - a. As indicated on Drawings.
 - C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
 - D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 1. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.
 - E. Storage or sale of removed items or materials on-site is not permitted.
 - F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 1. Maintain fire-protection facilities in service during selective demolition operations.
 - G. Arrange selective demolition schedule so as not to interfere with Owner's operations.
- 1.7 WARRANTY
- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Inventory and record the condition of items to be removed and salvaged.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
 - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
 - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
 - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

3.3 PROTECTION

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

3.4 SELECTIVE DEMOLITION

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - 1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.

2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
 4. Maintain fire watch during and for at least two hours after flame-cutting operations.
 5. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 6. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Removed and Salvaged Items:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
 2. Pack or crate items after cleaning and repairing. Identify contents of containers.
 3. Protect items from damage during transport and storage.
 4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- E. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 CLEANING

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
1. Do not allow demolished materials to accumulate on-site.
 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.
- C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 024119

SECTION 061053 - MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood blocking.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.

1.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Fire-retardant-treated wood.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. Fire-Retardant-Treated Lumber by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
 - 1. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 - 2. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.

- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
- C. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.

2.3 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate blocking and similar supports to comply with requirements for attaching other construction.
- B. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
 - 2. ICC-ES evaluation report for fastener.

3.2 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061053

SECTION 062023 - INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior trim.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each type of paneling.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber, mark grade stamp on end or back of each piece.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: ANSI A135.4.

2.2 INTERIOR TRIM

- A. Hardwood Lumber Trim:
 - 1. Species and Grade: Match existing.
 - 2. Finger Jointing: Not allowed.
- B. Hardwood Moldings for Transparent Finish (Stain or Clear Finish): MMPA HWM 4, N-grade wood moldings made to patterns included in MMPA's "HWM/Series Hardwood Moulding Patterns."
 - 1. Species: Match existing.
 - 2. Maximum Moisture Content: 9 percent.
 - 3. Finger Jointing: Not allowed.
- C. Molding Patterns:
 - 1. Match existing.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
 - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
 - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
 - 3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.

3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

END OF SECTION 062023

SECTION 078413 - PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Penetrations in fire-resistance-rated walls.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.
 - 1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:
 - a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.
 - 1) UL in its "Fire Resistance Directory."
 - 2) Intertek Group in its "Directory of Listed Building Products."
 - 3) FM Global in its "Building Materials Approval Guide."

2.2 PENETRATION FIRESTOPPING SYSTEMS

- #### A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. 3M Fire Protection Products.
 - b. Hilti, Inc.
 - c. Specified Technologies, Inc.
- #### B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg (2.49 Pa).
1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- #### C. Penetrations in Smoke Barriers: Penetration firestopping systems with ratings determined per UL 1479, based on testing at a positive pressure differential of 0.30-inch wg (74.7 Pa).
1. L-Rating: Not exceeding 5.0 cfm/sq. ft. (0.025 cu. m/s per sq. m) of penetration opening at and no more than 50-cfm (0.024-cu. m/s) cumulative total for any 100 sq. ft. (9.3 sq. m) at both ambient and elevated temperatures.
- #### D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.
- #### E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
 - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
 - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
 - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches (76 mm) high and with minimum 0.375-inch (9.5-mm) strokes.
 - 1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet (4.57 m) from end of wall and at intervals not exceeding 30 feet (9.14 m).
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches (150 mm) of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:
 - 1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Contractor's name, address, and phone number.
 - 3. Designation of applicable testing and inspecting agency.
 - 4. Date of installation.
 - 5. Manufacturer's name.
 - 6. Installer's name.

3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 078413

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Urethane joint sealants.
 - 2. Latex joint sealants.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 URETHANE JOINT SEALANTS

- A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Pecora Corporation.
 - c. Sherwin-Williams Company (The).
 - d. Sika Corporation; Joint Sealants.
 - e. Tremco Incorporated.

2.3 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. BASF Corporation; Construction Systems.
 - b. Pecora Corporation.
 - c. Sherwin-Williams Company (The).
 - d. Tremco Incorporated.

2.4 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with ASTM C 1193 and joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 1. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.3 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Locations:

- a. Control and expansion joints on exposed interior surfaces of exterior walls.
- b. Other joints as indicated on Drawings.

2. Joint Sealant: Urethane, S, NS, 25, NT.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

B. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.

1. Joint Locations:

- a. Control joints on exposed interior surfaces of exterior walls.
- b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
- c. Other joints as indicated on Drawings.

2. Joint Sealant: Acrylic latex.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079219 - ACOUSTICAL JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical joint sealants.

1.2 ACTION SUBMITTALS

- A. Product Data: For each acoustical joint sealant.
- B. Samples: For each kind and color of acoustical joint sealant required.
- C. Acoustical-Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.

1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

1.4 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace acoustical joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish acoustical joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide acoustical joint-sealant products that effectively reduce airborne sound transmission through perimeter joints and openings in building construction, as demonstrated by testing representative assemblies according to ASTM E 90.

2.2 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex acoustical sealant complying with ASTM C 834.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. GE Construction Sealants; Momentive Performance Materials Inc.; RCS20 Acoustical.
 - b. Pecora Corporation; AC-20 FTR.
 - c. Tremco Incorporated; Tremco Acoustical Sealant.
 - 2. Colors of Exposed Acoustical Joint Sealants: As selected by Architect from manufacturer's full range of colors.
- B. Primer: Material recommended by acoustical-joint-sealant manufacturer where required for adhesion of sealant to joint substrates.
- C. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- D. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing acoustical joint sealants to comply with joint-sealant manufacturer's written instructions.
- B. Joint Priming: Prime joint substrates where recommended by acoustical-joint-sealant manufacturer.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces.

3.2 INSTALLATION OF ACOUSTICAL JOINT SEALANTS

- A. Comply with acoustical joint-sealant manufacturer's written installation instructions unless more stringent requirements apply.

- B. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical joint sealant. Install acoustical joint sealants at both faces of partitions, at perimeters, and through penetrations. Comply with ASTM C 919, ASTM C 1193, and manufacturer's written recommendations for closing off sound-flanking paths around or through assemblies, including sealing partitions to underside of floor slabs above acoustical ceilings.

- C. Acoustical Ceiling Areas: Apply acoustical joint sealant at perimeter edge moldings of acoustical ceiling areas in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.

END OF SECTION 079219

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes hollow-metal work.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required.
- E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ceco Door; ASSA ABLOY.
 2. Curries Company; ASSA ABLOY.
 3. Steelcraft; an Allegion brand.

2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and 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 or UL 9.

2.3 INTERIOR DOORS AND FRAMES

- A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
 - 1. Physical Performance: Level B according to SDI A250.4.
 - 2. Doors:
 - a. Type: As indicated in the Door and Frame Schedule.
 - b. Thickness: 1-3/4 inches (44.5 mm).
 - c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch (1.0 mm).
 - d. Edge Construction: Model 2, Seamless.
 - e. Core: Manufacturer's standard.
 - 3. Frames:
 - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch (1.3 mm).
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: Full profile welded.
 - 4. Exposed Finish: Prime.

2.4 BORROWED LITES

- A. Hollow-metal frames of uncoated steel sheet, minimum thickness of 0.042 inch (1.0 mm).
- B. Construction: Full profile welded.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
- D. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- E. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- F. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- G. Glazing: Section 088000 "Glazing."

2.7 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 metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
 - 1. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.
- C. Hollow-Metal Frames: 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.
 - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however.
 - 4. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
 - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
 - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
 - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.

5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
 1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
 3. Provisions for Electrical Devices: Provide steel conduit, boxes and other necessary devices required for the installation of electrical hardware in doors and frames.

- E. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 4. Provide loose stops and moldings on inside of hollow-metal work.
 5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 1. Shop Primer: SDI A250.10.

2.9 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, borrowed lites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

- a. At fire-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, square, and twist of frames as walls are constructed. 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 postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
 4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
1. Non-Fire-Rated Steel Doors:
 - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
 - c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
 - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
 2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

3.2 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 Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For factory-finished doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Marshfield DoorSystems, Inc.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."

B. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.

- C. Fire-Rated Wood Doors: Doors 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 NFPA 252 or UL 10C.
1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
 3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
- D. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2, made with binder containing no urea-formaldehyde.
 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
- E. Structural-Composite-Lumber-Core Doors:
1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf (3100 N).
 - b. Screw Withdrawal, Edge: 400 lbf (1780 N).
- F. Mineral-Core Doors:
1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.
 3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
1. Grade: Premium, with Grade AA faces.
 2. Species: Match existing.
 3. Cut: Match existing.
 4. Match between Veneer Leaves: Match existing.
 5. Core: Particleboard
 6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
 7. Construction: Seven plies, either bonded or nonbonded construction.

2.4 LIGHT FRAMES

- A. Wood-Veneered Beads for Light Openings in Fire-Rated Doors: Manufacturer's standard wood-veneered noncombustible beads matching veneer species of door faces and approved for use in doors of fire-protection rating indicated. Include concealed metal glazing clips where required for opening size and fire-protection rating indicated.
- B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
 - 1. Light Openings: Trim openings with moldings of material and profile indicated.
 - 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
 - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors that are indicated to receive transparent finish.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards". Match existing.
 - 3. Staining: Match existing.
 - 4. Sheen: Match existing.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."

- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
 - 1. Install fire-rated doors according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
 - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
 - a. Comply with NFPA 80 for fire-rated doors.
- D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 081416

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mechanical door hardware for the following:
 - a. Swinging doors.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings.
- C. Samples: For each exposed product in each finish specified.
- D. Door hardware schedule.
- E. Keying schedule.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedule.

- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
- B. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.
 - 1. Door hardware is scheduled on Drawings.

2.3 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hager Companies.
 - b. McKinney Products Company; an ASSA ABLOY Group company.
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 - 2. Deadbolts: Minimum 1.25-inch (32-mm) bolt throw.
- C. Lock Backset: 2-3/4 inches (70 mm) unless otherwise indicated.
- D. Lock Trim:
 - 1. Description: As indicated on Drawings.
 - 2. Levers: Cast.
 - 3. Escutcheons (Roses): Cast.
 - 4. Dummy Trim: Match lever lock trim and escutcheons.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
- F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

2.5 EXIT DEVICES AND AUXILIARY ITEMS

- A. Exit Devices and Auxiliary Items: BHMA A156.3.

2.6 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver. Provide cylinder from same manufacturer of locking devices.
- B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.7 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock.
 - 1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
 - 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

- a. Notation: "DO NOT DUPLICATE."

2.8 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release; and with internal override.
- B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: BHMA A156.22.

2.9 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

2.10 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.

2.11 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.12 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

2.13 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's 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. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Replace construction cores with permanent cores as directed by Owner.
- E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- 3.2 ADJUSTING
- A. 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.

END OF SECTION 087100

SECTION 088000 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Glass for doors and interior borrowed lites.
 - 2. Fire-protection-rated glazing.
 - 3. Glazing sealants and accessories.

1.2 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches (300 mm) square.
- C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
- D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 WARRANTY

- A. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
 - 1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design glazing.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.2 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.

2.3 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.
- B. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) as indicated, Quality-Q3.

2.4 LAMINATED GLASS

- A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
 - 1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
 - 2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
 - 3. Interlayer Color: Match existing.

2.5 FIRE-PROTECTION-RATED GLAZING

- A. Fire-Protection-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on positive-pressure testing according to NFPA 257 or UL 9, including the hose-stream test, and shall comply with NFPA 80.
 - 1. Fire-protection-rated glazing required to have a fire-protection rating of 20 minutes shall be exempt from the hose-stream test.

- B. Fire-Protection-Rated Glazing Labeling: Permanently mark fire-protection-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name; test standard; whether glazing is permitted to be used in doors or openings; if permitted in openings, whether or not glazing has passed the hose-stream test; whether or not glazing meets 450 deg F (250 deg C) temperature-rise limitation; and the fire-resistance rating in minutes.
- A. Laminated Ceramic Glazing: Laminated glass made from two plies of clear, ceramic glass; 8-mm total thickness; and complying with 16 CFR 1201, Category II. Premium grade.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGC Glass Company North America, Inc.; Pyran Platinum L.
 - b. SAFTI FIRST Fire Rated Glazing Solutions; Pyran Platinum L.
 - c. Schott North America, Inc.; Pyran Platinum L.
 - d. Technical Glass Products; FireLite Plus.
 - e. Vetrotech Saint-Gobain; SGG Keralite FR-L.

2.6 GLAZING SEALANTS

- A. General:
 - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 - 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.

2.7 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
 - 1. AAMA 804.3 tape, where indicated.
 - 2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 - 3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:
 - 1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.

2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm).
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

- A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.
- B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.
- C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Apply heel bead of elastomeric sealant.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.
- G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- E. Install gaskets so they protrude past face of glazing stops.

3.4 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
 - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Glass Type: Clear fully tempered float glass.
 - 1. Minimum Thickness: 6 mm.
 - 2. Safety glazing required.

3.7 LAMINATED GLASS SCHEDULE

- A. Glass Type: Clear laminated glass with two plies of float glass.
 - 1. Minimum Thickness of Each Glass Ply: As indicated.
 - 2. Interlayer Thickness: 0.030 inch (0.76 mm).
 - 3. Safety glazing required.

END OF SECTION 088000

SECTION 088113 - DECORATIVE GLASS GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes the following decorative glass for interior applications:
 - 1. Backpainted.

1.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.
- B. Delegated Design: Design glass installed adjacent to walking surfaces, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
 - 1. Differential deflection of adjacent unsupported edges shall not exceed glass thickness when subjected to 50 lbf/ft. (730 N/m) applied horizontally to one panel at any point up to 42 inches (1067 mm) above the adjacent walking surface.
 - 2. Base design on thickness at thinnest part of the glass.

1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Test each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.
 - 1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
 - 2. Submit no fewer than three Samples of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
 - 3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 4. For materials failing tests, obtain sealant manufacturer's written instructions for corrective measures including the use of specially formulated primers.
 - 5. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.

1.4 ACTION SUBMITTALS

- A. Product Data: For each decorative-glass and glazing product indicated.
- B. Shop Drawings: For decorative glass. Show fabrication and installation details. Include the following:

1. Size and location of penetrations.
2. Glazing method.
3. Mounting method.
4. Attachments to other work.
5. Full-size details of edge-finished profiles.

C. Glass Samples: For the following products, 12 inches (300 mm) square:

1. Each type of decorative glass.
2. Each edge treatment on type of decorative glass.
3. Each applied coating on type of decorative glass.

D. Glazing Accessory Samples: For sealants and colored spacers, in 12-inch (300-mm) lengths.

E. Product Schedule: For decorative glass. Use same designations indicated on Drawings.

F. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Product Certificates: For each type of decorative glass, from manufacturer.

C. Warranty: Sample of special warranty.

D. Preconstruction Adhesion and Compatibility Test Reports: Based on evaluation and comprehensive tests performed by a qualified testing agency, for glass with decorative film overlay.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of decorative glass and each applied coating to include in maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under NGA's Certified Glass Installer Program.

B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

C. Source Limitations for Glass: Obtain each type of decorative glass from single source from single manufacturer.

D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer, for each product and installation method.

- E. Glazing Publications: Comply with published recommendations in GANA's "Glazing Manual" unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
- F. Safety Glazing: Where safety glazing is indicated, comply with testing requirements in 16 CFR 1201 for Category II materials.
 - 1. Labeling: Permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard that glass complies with.
- G. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
 - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- H. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect decorative glass and glazing materials according to manufacturer's written instructions and as needed to prevent damage to surfaces and edges.
- B. Retain packaging and sequencing numbers for decorative-glass units.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install decorative glass until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of openings and construction contiguous with decorative glass by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

- A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.
- B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with requirements indicated. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT

heat-treated float glass as needed to comply with requirements indicated. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.2 MONOLITHIC-GLASS PRODUCTS

- A. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I, complying with other requirements specified and with visible light transmission not less than 90 percent.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGC Glass Company North America, Inc; Krystal Klear.
 - b. Guardian Industries Corp.; UltraWhite.
 - c. Pilkington North America; Optiwhite.
 - d. PPG Industries, Inc.; Starphire.
 - e. SCHOTT Corporation; Amiran.
- B. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.
 - 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.3 DECORATIVE GLASS TYPES

- A. See Design Drawings, Finish Schedule.
- B. Decorative Glass: Silk-screened glass with decorative glass paint or ink applied to glass surface and cured according to manufacturer's standard process.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.
 - 2. Glass Type: Clear fully tempered ultraclear float glass.
 - 3. Glass Thickness: See Design Drawings.
 - 4. Comply with requirements for safety glazing.
 - 5. Colors and Patterns: As indicated.

2.4 GLAZING MATERIALS

- A. Glazing Gaskets, Sealants, Tapes, and Miscellaneous Glazing Materials: As specified in Section 088000 "Glazing."
 - 1. Elastomeric Glazing Sealants: ASTM C 920.
 - a. Color: As selected by Architect from manufacturer's full range.
- B. Joint Sealants: As specified in Section 079200 "Joint Sealants."

2.5 HARDWARE FOR GLASS INSTALLATION

- A. Hardware: See Design Drawings.
 - 1. Products: Subject to compliance with requirements, available Manufacturers that may be incorporated into the Work include, but are not limited to, the following:
 - a. CHMI Custom Hardware Manufacturing, Inc.
 - b. Laurence, C. R. Co., Inc..
 - 2. Dimensions: See Design Drawings.
 - 3. Material and Finish: See Design Drawings.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.
- C. Gaskets and Wedges: Manufacturer's standard, compatible with decorative glass type indicated.
- D. Anchors and Inserts: Provide devices as required for hardware installation. Provide toothed or lead-shield expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.6 DECORATIVE-GLASS FABRICATION

- A. Fabricate decorative glass and provide other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written recommendations of product manufacturer and with referenced glazing standard.
- B. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine decorative-glass framing members, with Installer present, for compliance with the following:
 - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
 - 2. Minimum required face or edge clearances.
 - 3. Effective sealing between joints of decorative-glass framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate orientation of outer surfaces as indicated on Drawings. Label or mark units as needed so that surface orientation is readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 INSTALLATION

- A. Set decorative-glass units in each series true in line with uniform orientation, pattern, draw, bow, and similar characteristics.
- B. Set glass lites with proper orientation so that each outer surface faces the direction indicated on Drawings.
- C. Set decorative glass in locations indicated on Drawings. Install glass with hardware and accessories according to hardware manufacturer's written instructions. Attach hardware securely to mounting surfaces.
- D. Set decorative glass in locations indicated on Drawings.

3.4 GLAZING, GENERAL

- A. Decorative Glass: Install glazing as specified in Section 088000 "Glazing."
- B. Comply with combined written instructions of manufacturers of gaskets, glass, sealants, tapes, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.
- C. Adjust glazing channel dimensions during installation as required by Project conditions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
- D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- H. Provide spacers for glass lites where length plus width is more than 50 inches (1270 mm).

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances, and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.5 SEALANT GLAZING (WET)

- A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.
- B. Force sealants into glazing channels and between glass-to-glass joints to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants smooth.

3.6 CLEANING AND PROTECTION

- A. Protect decorative glass from damage immediately after installation by attaching crossed streamers to framing and held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.
- C. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- D. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 088113

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for firestop tracks, post-installed anchors and power-actuated fasteners.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

2. Protective Coating: ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645.
1. Steel Studs and Tracks:
 - a. Minimum Base-Metal Thickness: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch (38-mm) minimum vertical movement.
 2. Single Long-Leg Track System: ASTM C 645 top track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches (305 mm) of the top of studs to provide lateral bracing.
 3. Double-Track System: ASTM C 645 top outer tracks, inside track with 2-inch- (51-mm-) deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) Blazeframe Industries; Bare Slotted Track (BST/BST 2).
 - 2) ClarkDietrich Building Systems; SLP-TRK Slotted Deflection Track.
 - 3) Steel Network, Inc. (The); VertiClip SLD.
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Blazeframe Industries; Intumescent Framing, Fire Stop System.
 - b. Steel Network, Inc. (The); VertiTrack VT.
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch (1.367-mm) minimum base-metal thickness, with minimum 1/2-inch- (13-mm-) wide flanges.
1. Depth: As indicated on Drawings.
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches (38 by 38 mm), 0.068-inch- (1.72-mm-) thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
 2. Depth: As indicated on Drawings.
- H. Resilient Furring Channels: 1/2-inch- (13-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 1. Asphalt-Saturated Organic Felt: ASTM D 226/D 226M, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior gypsum board.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each texture finish indicated on same backing indicated for Work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Continental Building Products, LLC.
 - b. Georgia-Pacific Building Products.
 - c. National Gypsum Company.
 - d. United States Gypsum Company.
 2. Thickness: 5/8 inch (15.9 mm).

3. Long Edges: Tapered.

2.4 SPECIALTY GYPSUM BOARD

- A. Gypsum Board, Type C: ASTM C 1396/C 1396M. Manufactured to have increased fire-resistive capability.
 1. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
 2. Long Edges: Tapered.

2.5 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - e. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
 1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C 840.
- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- E. Prefill open joints and damaged surface areas.
- F. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- G. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 2. Level 2: Where indicated on Drawings.
 3. Level 3: Where indicated on Drawings.
 4. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 5. Level 5: Where a non-flat paint is indicated on Drawings or in areas of critical lighting conditions. Areas requiring high level of finish must have a pre-installation meeting to assure Contractor understands contract requirements/expectations
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

3.2 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for interior ceilings.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 450 or less.

2.2 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.
- B. Acoustical Panel Standard: Manufacturer's standard panels according to ASTM E 1264.

- C. Color: As indicated on Drawings.
- D. Light Reflectance (LR): As indicated on Drawings.
- E. Ceiling Attenuation Class (CAC): As indicated on Drawings.
- F. Noise Reduction Coefficient (NRC): As indicated on Drawings.
- G. Edge/Joint Detail: As indicated on Drawings.
- H. Thickness: As indicated on Drawings
- I. Modular Size: As indicated on Drawings.

2.3 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.
- B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M.
- C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 (Z90) coating designation; with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.
 - 1. Structural Classification: Intermediate-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel.
 - 5. Cap Finish: Painted white.

2.4 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.5 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
- B. Perimeter Suspension Trim:
 - 1. Basis of Design: Axiom - Classic Perimeter Trim. Height as indicated on Drawings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.
- B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and manufacturer's written instructions.
- B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
 - 1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
 - 3. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 095426 - WOOD PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wood veneer ceiling planks.
 - 2. Concealed grid suspension system.
 - 3. Wire hangers, fasteners, main runners, wall angle moldings and accessories.
- B. Related Sections:
 - 1. Section 09 51 13 - Acoustical Panel Ceilings
 - 2. Division 23 Sections - HVAC
 - 3. Division 26 Sections - Electrical Work

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A 641 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - 2. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
 - 3. ASTM A 1008 Standard Specification for Steel, Sheet, Cold Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
 - 4. ASTM C 635 Standard Specification for Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
 - 5. ASTM C 636 Recommended Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.
 - 6. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 7. ASTM E 1264 Classification for Acoustical Ceiling Products.
- B. CISCA Seismic Zones (0-2) (3-4) Ceilings and Interior Systems Construction Association Guidelines for Seismic Restraint for Direct Hung Suspended Ceiling Assemblies

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical data for each type of ceiling unit and suspension system required.
- B. Installation Instructions: Submit manufacturer's installation instructions as referenced in Part 3, Installation.
- C. Samples: Minimum 3-1/2 inch or 5-1/2 inch samples of specified panel; 8 inch long samples of exposed wall molding and suspension system, including main runner.
- D. Shop Drawings: Layout and details of ceilings. Show locations of items which are to be coordinated with, or supported by the ceilings.
- E. Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- F. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide ceiling panel units and grid components by a single manufacturer.
- B. Fire Performance Characteristics: Identify ceiling components with appropriate markings of applicable testing and inspecting organization.
 - 1. Surface Burning Characteristics: As follows, tested per ASTM E 84 and complying with ASTM E 1264 for Class A products.
 - a. Flame Spread: 25 or less
 - b. Smoke Developed: 50 or less
 - 2. HPVA (Hardwood Plywood and Veneer Association) certification and audit program per ASTM E-84 tunnel test.
- C. Woodworking Standards: Manufacturer must comply with specified provisions of Architectural Woodworking Institute quality standards.
- D. Linear Wood, as with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern, or possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.
- E. Coordination of Work: Coordinate ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store ceiling components in a dry interior location in their cartons prior to installation to avoid damage. Store cartons in a flat, horizontal position. The protectors between the panels should not be removed until installation.
- B. Do not store in unconditioned spaces with humidity greater than 55 percent or lower than 25 percent relative humidity and temperatures lower than 50 degrees F or greater than 86 degrees F. Panels must not be exposed to extreme temperatures, for example, close to a heating source or near a window with direct sunlight.
- C. Handle ceiling units carefully to avoid chipped edges or damage to units in any way.

1.6 PROJECT CONDITIONS

- A. Wood veneer ceiling materials should be permitted to reach room temperature and have a stabilized moisture content for a minimum of 72 hours before installation.
- B. The wood veneer panels should not be installed in spaces where the temperature or humidity conditions vary greatly from the temperatures and conditions that will be normal in the occupied space.
- C. As interior finish products, the wood veneer panels are designed for installation in temperature conditions between 50 degrees F and 86 degrees F, in spaces where the building is enclosed and HVAC systems are functioning and will be in continuous operation. Relative humidity should not fall below 25 percent or exceed 55 percent.

1.7 WARRANTY

- A. Wood Veneer Panel: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to:
 - 1. Ceiling Panels: Defects in materials or factory workmanship.
 - 2. Grid System: Rusting and manufacturing defects.
- B. Warranty Period:
 - 1. Wood veneer panels: One (1) year from date of installation.

2. Grid: Ten years from date of installation.
- C. The Warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

1.8 MAINTENANCE

- A. Extra Materials: Deliver extra materials to Owner. Furnish extra materials described below that match products installed. Packaged with protective covering for storage and identified with appropriate labels.
 1. Ceiling Units: Furnish quantity of full-size units equal to 5.0 percent of amount installed.
 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 2.0 percent of amount installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Ceiling Panels:
 1. Basis-of-Design Manufacturer: Armstrong World Industries, Inc.
- B. Suspension Systems:
 1. Basis-of-Design Manufacturer: Armstrong World Industries, Inc.

2.2.0 WOOD VENEER CEILING UNITS

- A. Ceiling Panels:
 1. Surface Texture: Smooth
 2. Composition: Medium Density Fiberboard
 3. Finish: As indicated on Drawings.
 4. Species: As indicated on Drawings.
 5. Size: As indicated on Drawings.
 6. Reveal: 3/4 inch black fleece reveal
 7. Edge Banding and Trim: To match face veneer
 8. Noise Reduction Coefficient (NRC): ASTM C 423
 9. Flame Spread: ASTM E 1264; Class A.
 10. Dimensional Stability: Standard
 11. Acceptable Product: WoodWorks Linear, 6692W1, as manufactured by Armstrong World Industries or approved equal.
 12. Other Approved Products;
 - a. Norton Industries; NWLP-Linear Wood Plank Ceiling-Trapilinear Access Panel.
 - b. Architectural Components Group, Inc.; Linear Open Series 3, Modified Custom Tapered Plank.
 - c. Rulon Panelized Linear Open Style.

2.2.1 SUSPENSION SYSTEMS

- A. Components: All linear carriers shall be commercial quality hot dipped galvanized steel as per ASTM A 653. Linear carriers are double-web steel construction with 24 MM type concealed flange design. Exposed surfaces chemically cleansed, capping prefinished galvanized steel in baked polyester paint. Linear carriers shall have rotary stitching.
 1. Structural Classification: ASTM C 635, Heavy Duty.

2. Color: Black, unless noted otherwise.
 3. Clips: Integral, factory-applied, spring steel clips on linear carriers in sufficient number to receive 8 foot linear wood planks.
 4. Acceptable Product: HD Linear Carrier as manufactured by Armstrong World Industries, Inc. or approved equal.
- B. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung unless otherwise indicated.
- C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least three design load, but not less than 12 gauge.
- D. Accessories/Edge Moldings and Trim:
1. Linear Splices, Item #5843, for splicing planks together end-to-end
 2. RC2 Clip: Radius clip for creating faceted grid applications
 3. Wall Molding:
 - a. Angle Molding, Item #7805BL - 1-1/2 inch x 1-1/2 inch, Tech Black
 - b. Shadow Molding, Item #7823BL - 2 inch x 1-1/4 inch x 3/4 inch, Tech Black
 4. Perimeter Trim:
 - a. 4" Woodworks Trim #5659W1___ (with aluminum substrate, 4 inch x 10 feet)
 - b. 6" Woodworks Trim #5660W1___ (with aluminum substrate, 6 inch x 10 feet)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out.
- B. Proper designs for both supply air and return air, maintenance of the HVAC filters and building interior space are essential to minimize soiling. Before starting the HVAC system, make sure supply air is properly filtered and the building interior is free of construction dust.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders, and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.

3.3 INSTALLATION

- A. Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines; approved construction drawings; with the authorities having jurisdiction; and in accordance with the manufacturer's installation instructions, WoodWorks Linear Installation Instructions, LA-297076.
- B. Suspend linear carriers from overhead construction with hanger wires spaced 4 feet on center along the length of the linear carrier. Install hanger wires plumb and straight. Hanger wires shall not be installed in convenience holes. Install linear carriers 24 inches on center (or less).
- C. Install wall moldings at intersection of suspended ceiling and vertical surfaces.
- D. Follow the instructions found in "WoodWorks Linear Installation Instructions", LA-297076, for border treatment of the WoodWorks Linear planks.

3.4 ADJUSTING AND CLEANING

- A. Replace damaged and broken panels.

- B. Clean exposed surfaces of ceilings panels, including trim, edge moldings, and suspension members. Comply with manufacturer's instructions for cleaning and touch up of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095426

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches (300 mm) long.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - 1. Style and Location:
 - a. Style B, Cove.
- C. Thickness: As indicated on Drawings.
- D. Height: As indicated on Drawings.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed or preformed.
- G. Inside Corners: Job formed or preformed.
- H. Colors: As indicated on Drawings..

2.2 RUBBER MOLDING ACCESSORY

- A. Profile and Dimensions: As indicated on Drawings.

- B. Locations: As indicated on Drawings.
- C. Colors and Patterns: As indicated on Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are the same temperature as the space where they are to be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.2 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Form without producing discoloration (whitening) at bends.
2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches (76 mm) in length.
 - a. Miter or cope corners to minimize open joints.

3.3 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Solid vinyl floor tile.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
 - 1. Show details of special patterns.
- C. Samples: Full-size units of each color and pattern of floor tile required.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
 - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.
- B. Tile Standard: ASTM F 1700.
 - 1. Class: Class III, printed film vinyl tile.
 - 2. Type: B, embossed surface.
- C. Thickness: 0.120 inch (3.0 mm).

- D. Size: As indicated on Drawings.
- E. Colors and Patterns: As indicated on Drawings.

2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.
 - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
 - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
 - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
 - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
 - a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 - 1. Lay tiles in pattern indicated.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
 - 1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.
- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
- B. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply three coat(s).
- C. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or approved equal.
- B. Color: As indicated on Drawings.
- C. Pattern: As indicated on Drawings.
- D. Primary Backing: Polyester Felt Cushion.
- E. Size: As indicated on Drawings.
- F. Sustainable Design Requirements:
 1. Sustainable Product Certification: Platinum level certification according to ANSI/NSF 140.
- G. Performance Characteristics:
 1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D 7330.
 2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 3. Dimensional Tolerance: Within 1/32 inch (0.8 mm) of specified size dimensions, as determined by physical measurement.
 4. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
 5. Noise Reduction Coefficient (NRC): 0.30 according to ASTM C 423.
 6. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
 7. Colorfastness to Light: Not less than 4 AFU (AATCC fading units) according to AATCC 16, Option E.
 8. Electrostatic Propensity: Less than 3.0 kV according to AATCC 134.

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. (18.6 sq. m), and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
 - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 95 percent relative humidity level measurement.
 - c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

- A. General: Comply with CRI's "CRI Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm) unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns indicated on Drawings and recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

- H. Install pattern parallel to walls and borders.
- I. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on [interior substrates.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

- a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Benjamin Moore & Co.
 2. PPG Architectural Coatings.
 3. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."
- B. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
- C. Colors: As indicated on Drawings..

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

3.4 INTERIOR PAINTING SCHEDULE

- A. Steel Substrates:
 1. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:
 - a. Prime Coat: Primer, rust inhibitive, water based MPI #107.
 - 1) S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.
 - c. Topcoat: Latex, interior, institutional low odor/VOC, semi-gloss (MPI Gloss Level 5), MPI #147.
 - 1) S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
- B. Gypsum Board Substrates:
 1. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:
 - a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.
 - 1) S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

- c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.
 - 1) S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

END OF SECTION 099123

SECTION 099300 - STAINING AND TRANSPARENT FINISHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of wood stains and transparent finishes.

1.2 DEFINITIONS

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
- B. Samples: For each type of finish system and in each color and gloss of finish required.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of stain color selections will be based on mockups.
 - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Benjamin Moore & Co.
 - 2. PPG Architectural Coatings.
 - 3. Sherwin-Williams Company (The).

2.2 MATERIALS, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Stain Colors: Match existing.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Interior Wood Substrates: 9 percent, when measured with an electronic moisture meter.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with finish application only after unsatisfactory conditions have been corrected.
 - 1. Beginning finish application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

- B. Remove hardware, covers, plates, and similar items already in place that are removable. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and finishing.
 - 1. After completing finishing operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
 - 1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
 - 2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.

3.3 APPLICATION

- A. Apply finishes according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."
- B. Apply finishes to produce surface films without cloudiness, holidays, lap marks, brush marks, runs, ropiness, or other surface imperfections.

3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from finish application. Correct damage by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced finished wood surfaces.

3.5 INTERIOR WOOD -FINISH-SYSTEM SCHEDULE

- A. Wood Substrates: Wood trim and architectural woodwork.
 - 1. Water-Based Varnish over Stain System MPI INT 6.3W:
 - a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.
 - 1) Match existing.
 - b. First Intermediate Coat: Water-based varnish matching topcoat.
 - c. Second Intermediate Coat: Water-based varnish matching topcoat.
 - d. Topcoat: Varnish, water based, clear, MPI #128.
 - 1) Match existing.

END OF SECTION 099300

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Abuse-resistant wall coverings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For each type of wall and door protection showing locations and extent.
 - 1. Include plans, elevations, sections, and attachment details.
- C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
 - 1. Abuse-Resistant Wall Covering: 6 by 6 inches (150 by 150 mm) square.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of handrail.
- B. Material Certificates: For each type of exposed plastic material.
- C. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.
 - 1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F (21 deg C) during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F (21 deg C).

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
 - b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: 25 or less.
 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1.

2.3 ABUSE-RESISTANT WALL COVERINGS

- A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.
 1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - a. Construction Specialties, Inc.
 - b. InPro Corporation (IPC).
 - c. Pawling Corporation.

2. Size: As indicated on Drawings.
3. Sheet Thickness: As indicated on Drawings.
4. Color and Texture: As indicated on Drawings.
5. Height: As indicated on Drawings.
6. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
7. Mounting: Adhesive.

2.4 MATERIALS

- A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.
- B. Adhesive: As recommended by protection product manufacturer.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. **Installation Quality:** Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.
- B. **Accessories:** Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.
- C. **Abuse-Resistant Wall Covering:** Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

- A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.
- B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 122413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes roller shades and motorized shade operators.
 - 1. Single shades motorized.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
 - 1. Motorized Shade Operators: Include operating instructions.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other work, operational clearances, and relationship to adjoining work.
 - 1. Motorized Shade Operators: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
 - 2. Wiring Diagrams: Power, system, and control wiring.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members and attachment to building structure.
 - 2. Ceiling-mounted or penetrating items including light fixtures, air outlets and inlets, speakers, sprinklers, recessed shades, and special moldings at walls, column penetrations, and other junctures of acoustical ceilings with adjoining construction.
 - 3. Shade mounting assembly and attachment.
 - 4. Minimum Drawing Scale: 1/4 inch = 1 foot (1:48).
- D. Samples for Verification:
 - 1. Complete, full-size operating unit not less than 16 inches (400 mm) wide for each type of roller shade indicated.
 - 2. For the following products:
 - a. Shade Material: Not less than 3 inches (76 mm) square, with specified treatments applied. Mark face of material.
- E. Window Treatment Schedule: For roller shades. Use same designations indicated on Drawings.

- F. Product Certificates: For each type of roller shade, signed by product manufacturer.
- G. Qualification Data: For Installer.
- H. Product Test Reports: For each type of roller shade.
- I. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining roller shades and finishes.
 - 2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
 - 3. Operating hardware.
 - 4. Motorized shade operator.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Fabricator of products. Installer for roller shade system shall be trained and certified by the Manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- B. Source Limitations: Obtain roller shades through one source from a single manufacturer.
- C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. Flame-Resistance Ratings: Passes NFPA 701.
- D. Product Standard: Provide roller shades complying with WCMA A 100.1.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- F. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same designations indicated on Drawings and in a window treatment schedule.

1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace roller window shades that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure to meet performance requirements.
 - b. Faulty operation.
 - 2. Warranty Period:
 - a. Motorized Shades: 15 years from date of Substantial Completion.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units' operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 ROLLER SHADES

- A. Basis-of-Design Product: Subject to compliance with requirements, provide MechoShade Systems, Inc., or a comparable product by one of the following:
 - 1. Draper Inc.
 - 2. Hunter Douglas Contract.
 - 3. Nysan Solar Control Inc.; a Hunter Douglas company.
- B. Shade Band Material: See Design Drawings.
 - 1. Fabric Width: See Design Drawings.
 - 2. Pattern: See Design Drawings.
 - 3. Style: See Design Drawings.
 - 4. Colors: See Design Drawings.
 - 5. Material Solar-Optical Properties: See Design Drawings.
 - 6. Material Openness Factor: See Design Drawings.
 - 7. Material UV Blockage: See Design Drawings.
 - 8. Bottom Hem: Straight.
- C. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material. Provide

capacity for one roller shade band(s) per roller, unless otherwise indicated on Drawings. Any method of attaching shade band to roller tube that requires the use of: adhesive, adhesive tapes, staples, and/or rivets, does not meet the performance requirements of this specification and shall not be accepted.

- D. Direction of Roll: Regular, from back of roller.
- E. Mounting Brackets: Galvanized or zinc-plated steel. Provide shade hardware constructed of minimum 1/8-inch (3.18 mm) thick plated steel or heavier as required to support 150 percent of the full weight of each shade. Provide positive mechanical engagement of drive mechanism to shade roller tube. Friction fit connectors for drive mechanism connection to shade roller tube are not acceptable.
- F. Closure Panel and Wall Clip: Removable aluminum panel designed for installation at bottom of ceiling pocket and for snap-in attachment to wall clip without fasteners.
 - a. Closure-Panel Width: As indicated on Drawings.
- G. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.
- H. Mounting: As indicated on Drawings, mounting permitting easy removal and replacement without damaging roller shade or adjacent surfaces and finishes.
- I. Motorized Shade Operation: Motor operator.
 - a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 - b. Capable of interface with multiroom control system.
 - c. Capable of accepting input from building automation control system.
 - d. Override switch.

2.2 ROLLER SHADE FABRICATION

- A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.
- B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.
 - 1. Lifting Mechanism: With permanently lubricated moving parts.
- C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
 - 1. Shade Units Installed between (Inside) Jamb: Edge of shade not more than 1/4 inch (6 mm) from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
 - 2. Shade Units Installed Outside Jamb: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

- D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting fascia, headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.
- E. Installation Fasteners: No fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
- F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.
- G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

2.3 MOTORIZED ROLLER SHADE OPERATORS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mechoshade, ElectroShade System 1 with WhisperShade IQ2 Electronic Drive Unit (EDU or a comparable product by one of the following:
 - 1. Manufacturer of roller shade.
 - 2. Elero USA Inc.
 - 3. SIMU US, Inc.
 - 4. SOMFY Systems.
- B. General: Provide factory-assembled motorized shade operation systems designed for lifting shades of type, size, weight, construction, use, and operation frequency indicated. Provide operation systems of size and capacity and with features, characteristics, and accessories suitable for Project conditions and recommended by shade manufacturer, complete with electric motors and factory-rewired motor controls, remote-control stations, remote-control devices, power disconnect switches, enclosures protecting controls and all operating parts, and accessories required for reliable operation without malfunction. Include wiring from motor controls to motors. Coordinate operator wiring requirements and electrical characteristics with the building electrical system.
- C. Comply with NFPA 70.
- D. Control Equipment: Comply with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6 with NFPA 70, Class 2 control circuit, maximum 24-V ac or dc.
- E. Electric Motors: UL-approved or -recognized, totally enclosed, insulated motor, complying with NEMA MG 1, with thermal-overload protection, brake, permanently lubricated bearings, and limit switches; sized by shade manufacturer to start and operate size and weight of shade considering service factor or considering Project's service conditions without exceeding nameplate ratings.
 - 1. Service Factor: According to NEMA MG 1, unless otherwise indicated.
 - 2. Motor Characteristics: Single phase, 24 V, 60 Hz.
 - 3. Motor Mounting: Within manufacturer's standard roller enclosure.
- F. Remote Controls: Electric controls with NEMA ICS 6, Type 1 enclosure for recessed or flush mounting. Provide the following devices for remote-control activation of shades:

1. Control Stations: Maintained-contact, three-position, rocker-style, wall switch-operated control station with open, close, and center off functions.
 - a. Color: As indicated in a window treatment schedule.
 - b. Product: Subject to compliance with requirements, provide "Decora Plus" by Leviton Manufacturing Co. Inc. As indicated in a window treatment schedule.
 2. Microprocessor Controls: Electronic programmable means for setting, changing, and adjusting control features. Provide unit isolated from voltage spikes and surges.
- G. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop shade at fully raised and fully lowered positions.
- H. Operating Function: Stop and hold shade at any position.
 - a. Group switching with integrated switch control; single faceplate for multiple switch cutouts.
 - b. Capable of interface with multiroom control system.
 - c. Capable of accepting input from building automation control system.
 - d. Override switch.
- I. Operating Features: Include the following:
 1. Backup gear and crank operator for manual operation during power failures with detachable handle, length required to make operation convenient from floor level.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions, and located so shade band is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

- A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

- A. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

- B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.
- C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain roller shades. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 122413

SECTION 21 05 00.00 - COMMON WORK RESULTS FOR FIRE-SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for fire-suppression systems.
- B. Examine the drawings, specifications, and visit the site prior to submitting a bid.
- C. The base bid shall include furnishing all materials, labor, tools, equipment and installation of all work required to install complete fire-suppression systems as outlined in Division-21.
- D. Products and Topics in this Section Include:
 - 1. Definitions.
 - 2. Submittals.
 - 3. Supplemental Engineering Services.
 - 4. Interpretation of Documents.
 - 5. Electronic Files.
 - 6. Quality Assurance.
 - 7. Performance Qualifications.
 - 8. Performance Requirements.
 - 9. Permits and Fees.
 - 10. Warranty (Period of Correction).
 - 11. Record Drawings.
 - 12. Dielectric fittings.
 - 13. Fastener systems.
 - 14. Manufacturers.
 - 15. Coordination of Fire-suppression Work.
 - 16. Interruption of Utilities.
 - 17. Damage by Leakage.
 - 18. Emergency Repairs.
 - 19. Phasing.
 - 20. Supervision and Workmanship.
 - 21. Locations and Inspection of Site
 - 22. Product Delivery, Storage, and Handling.
 - 23. Substitutions.
 - 24. Explanation and Precedence of Drawings and Specifications
 - 25. Cutting, Patching, and Demolition.
 - 26. System Tests.
 - 27. Cleaning Premises.
 - 28. Maintenance, Operation Instructions, Etc.
 - 29. Project Site Safety
 - 30. Work in Existing Spaces.
 - 31. Fire Alarm Work Related to Fire-suppression Systems.
 - 32. Architectural Coordination Items

1.3 DEFINITIONS

- A. Acceptance Testing Authorities (ATA): The individuals and/or business entities that participate in Acceptance Testing and report to the Owner when work appears to be complete. These parties represent the interest of the Owner.
- B. Authority Having Jurisdiction (AHJ): The governmental agency or sub-agency having authority over the construction process and having the ultimate authority to enforce, uphold and rule on codes and safety compliance at the project site.
- C. Contractor: The entity(s) contractually responsible for performing work of this Division.
- D. Wherever the words "Site," "Project Site," or "Premises" appear in these specifications or related drawings, it shall be interpreted to mean real estate, buildings and structures where work shall be performed and where products shall be installed and reside.
- E. Commissioning Authority: An agent of the Owner, often independent of the design team, responsible for ensuring compliance with the Owner's project intent. The commissioning authority represents the interest of the Owner.
- F. Contractor of Record: A business entity entering into a contract for any element of work defined in the Project Documents directly with the Owner, directly with the Construction Manager or directly with a General Contractor.
- G. Designer: The Consultant(s) representing the Owner and directly responsible for specification of work within this Division, including related drawings. The Designer may or may not be affiliated with the architectural or an engineering firm of record for the Project. The Designer is a member of the project Design Team.
- H. Furnish: To supply product or labor (context dependent) including associated shipping, storage, travel, lodging, miscellaneous and warranty expenses.
- I. Install: To supply labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust a product in order to fulfill the requirements of the Project.
- J. Provide: To furnish and install, inclusive of accessories, modules, and ancillary items necessary to render the respective product and system fully operational and usable to the Owner for the intended purpose.
- K. Substantial Completion Division 21 only:
 - 1. The point in the Project where work of this Division that occurs at the project site has been completed. For work to be substantially complete, the following must be valid:
 - a. Products have been delivered and installed at the project site, and;
 - b. Systems have been installed, tested, adjusted and are operational for their intended purpose, and;
 - c. Products have been labeled in accordance with the Contract Documents, and;
 - d. Systems are performing in accordance with the design intent, and;
 - e. Systems have been demonstrated to the Owner as complete and working.
- L. Supply: Used interchangeably with "furnish." See "Furnish."
- M. This Division: This Section and each specification section beginning with the same two digit number.

- N. Work: The supply of products, materials, labor, incidentals and services necessary to fulfill the requirements of the Project.

1.4 SUPPLEMENTAL ENGINEERING SERVICES

- A. In the event that the Designer is required to provide additional services as a result of Contractor errors, omissions or failure to conform to the requirements of the Contract Documents, or if the Designer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Designer's expenses in connection with such additional services shall be paid by the Contractor and shall be deducted from any monies owed to the Contractor or billed separately, solely at the discretion of the Designer. Billable rates are the Designers standard rates, up to a maximum of \$150 per man-hour.

1.5 INTERPRETATION OF DOCUMENTS

- A. In the event of inconsistencies or conflict within or between the Contract Documents, provide the better quality, more costly or greater quantity of Work and comply with the more stringent requirements. Seek the direction of the Architect, Engineer or Designer for clarification of conflicts as soon as a conflict is identified.

1.6 ELECTRONIC FILES

- A. Drawings for this project were prepared using Revit software. Electronic files are available upon request for use by the successful contractor(s) for planning, coordination and installation.
- B. There will be a charge of \$100 per division group for projects prepared using Revit that must be converted to AutoCAD or Navisworks format. Divisions 21 and 22 are one group, Division 23 is a second group and Divisions 26, 27 and 28 are a third group. Revit model files will not be available.
- C. The Request Drawings form can be accessed, filled out and submitted at the following internet address (scroll down to bottom of home page): <http://www.klhengrs.com>.

1.7 QUALITY ASSURANCE

- A. General: Refer to Division 1 Sections for general administrative/procedural requirements related to compliance with codes and standards.
- B. Application: It is a general requirement that mechanical work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to extent more detailed and stringent requirements are indicated or required by governing regulations.
- C. Listing of Associations, Standards and Abbreviations Specific to Fire Suppression Work (in addition to standards specified in individual work sections), conform to following applicable standards:
 - 1. AWS American Welding Society, Inc.
 - 2. AWWA American Water Works Association, Inc.
 - 3. EPA Environmental Protection Agency
 - 4. FM Factory Mutual System
 - 5. NIST National Institute for Standards and Technology

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|----|------|--|
| 6. | NEC | National Electrical Code by NFPA |
| 7. | NFPA | National Fire Protection Association |
| 8. | OSHA | Occupational Safety and Health Administration (U.S. Department of Labor) |
| 9. | UL | Underwriter's Laboratories, Inc. |

D. Specifications

1. Specifications shall be interpreted in connection with the drawings hereinbefore described, and if anything is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both.
2. Furthermore, all materials and labor previously required to fully complete the work shall be included in the work even though each item necessarily involved be not specifically mentioned or shown. Such work and/or materials shall be of the same grade and quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

E. Plans

1. Plans are diagrammatic indicating required size, points of termination of piping and suggested routes. However, it is not intended that drawings indicate all necessary offsets. Install piping in such manner as to conform to the structure, avoid obstructions and preserve headroom.
2. Coordination Drawings: Provide coordination drawings and attend meetings as required to make sure all disciplines are coordinated and fit into specified spaces (i.e. ceilings, chases, and all others). The elevations of all disciplines shall be clearly marked throughout the drawings so that no interferences occur. Drawings shall depict actual clearances of installed equipment, penetration locations and service clearances. Indicate scheduling, sequencing, movement and positioning of large equipment during construction. Indicate where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. Conflicts in equipment and materials shall be corrected prior to installation.
3. All piping shall be run as straight as possible and symmetrical with architectural items.
4. Piping shall be concealed in pipe shafts, pipe spaces, and furring wherever possible.
5. Piping fabricated before coordination with the other trades will be done at one's own risk.

F. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.

G. Compatibility: Provide products which are compatible with other products of the mechanical work, and with other work requiring interface with the mechanical work. Provide products with the proper and correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.

H. Electrical Characteristics for Fire-Suppression 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. Additional costs to other contractors as a result of providing equipment with higher electrical characteristics shall be the responsibility of the contractor making the substitution. If minimum energy ratings or efficiencies are specified, equipment shall comply with those requirements.

1.8 PERFORMANCE QUALIFICATIONS

- A. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.
- B. Compatibility: Provide products which are compatible with other products of the mechanical work and with other work requiring interface with the mechanical work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.
- C. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- F. Electrical Characteristics for Fire Protection 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.

1.9 PERFORMANCE REQUIREMENTS

- A. Examine all Mechanical, Electrical, Architectural, Site and Structural Drawings, and available soil reports. Visit site and become acquainted with all conditions which may affect execution of work.
- B. Provide all work in accordance with State and Local Codes, Regulations and/or Ordinances, and meet approval of authorities having jurisdiction. Provide only new material and as specified.
- C. Furnish to the Owner, with a copy to the Owner a Certificate of Final Approval from governing authority prior to Owner's final acceptance, where applicable.
- D. General Outline: The facilities and systems of the mechanical work include all Division 21 Sections.
- E. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- F. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.10 PERMITS AND FEES

- A. Unless specifically described differently in another front-end specification section, all permits and fees of every nature required in connection with this work shall be obtained and paid for by contractor, including installation fees and similar charges.
- B. Laws and regulations which bear upon or affect the various branches of this work shall be complied with.
- C. All work which laws require to be inspected shall be submitted to the proper public officials for inspections and certificates of final approval must be furnished to the Owner before final acceptance will be given by the Engineer.

1.11 PROJECT CONDITIONS

- A. Where new fire protection systems are required to be connected to existing fire protection systems, it is the contractor's responsibility to verify the location, size, pressure, condition, and they shall verify that the existing fire protection system is indeed a fire protection system before any work is done. Provide all necessary labor, materials and equipment for testing as necessary. If there is any need for concern, if it is determined that the existing fire protection system is not a fire protection system or not connected to a fire protection system, if the condition of the existing fire protection system is not viable for re-use, or any other condition that would not allow the proper functioning of the fire protection system, the contractor shall notify the engineer in writing immediately via RFI and wait for direction before proceeding.
- B. Interruption of Existing Fire Protection Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
 - 1. Notify, Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's written permission.

1.12 WARRANTY (PERIOD OF CORRECTION)

- A. Where not specifically listed within each specific specification section, products and workmanship shall be covered by the Contractor for a period of (1) year from the date of Substantial Completion.
 - 1. Supplied products with manufacturer's warranties of less than the warranty term shall be extended and warranted by the Contractor for the full specified warranty term.
 - 2. Supplied products featuring a standard manufacturer's warranty whose term extends beyond the Contract Warranty term shall be facilitated by the Contractor for the full duration and under the terms and conditions of the manufacturer's warranty.
- B. The Warranty supplied shall be a full "System Warranty" that covers workmanship and products and includes coverage of onsite and off-site labor and related personnel transportation and product shipping expenses.
 - 1. During this period, the Contractor shall remedy (at no cost to the Owner) any problem with the system, or any of its related components that is the result of defective materials, equipment settings, workmanship, or loss of programming.
- C. Individual sections of this Division may feature more stringent requirements than those set forth in this Section. The most stringent of these requirements shall apply.
- D. Warranty work shall be performed at the Contractor's expense and to the satisfaction of the Owner.

- E. Incomplete work discovered after assertion of work completion is not subject to the (1) year warranty limit and shall be performed upon discovery over the life of the facility(s).
- F. Response Requirements:
 - 1. During the Warranty Period, the Contractor shall:
 - a. Respond by phone within four (4) business hours of notice by the Owner of a problem, and;
 - b. Supply qualified personnel onsite within one (1) business day to begin remediation of the problem, if the problem cannot be remediated over the phone in less time, and;
 - c. Supply "on-call" emergency response service labor (at the request and authorization of the Owner) at an hourly rate that does not exceed the Contractor's published emergency service rates, or two-times the Contractor's standard hourly rate, whichever is lower.

1.13 RECORD DRAWINGS

- A. Provide and maintain on the work site 1 complete set of Record Drawings for the Division 21 work. Carefully record on this set of drawings all work including fixtures, equipment, piping, fittings, components, etc which is installed differently from that indicated on the Drawings; locate dimensionally from fixed points all buried piping including depths relative to finish floor or finish grade elevations as applicable. The depth shall also be indicated for all plugged wyes, tees and capped lines. Mark all changes of location of piping, fixtures and equipment in accordance with Division 1 Sections.
- B. All existing lines discovered shall be indicated on these Drawings and located dimensionally from fixed points along with depths, if buried.
- C. The Record Drawings shall be continuously kept up-to-date and shall be available for inspection anytime during normal working hours.
- D. At completion of the work, provide a neat and legible reproducible set of the Record Drawings, which shall be individually signed and dated by the Contractor and Project Supervisor as to their accuracy.
- E. Such drawings shall be submitted to for acceptance and approval to the Owner before a final certificate of acceptance will be issued.

1.14 INTERIM LIFE SAFETY WORK

- A. Provide interim fire protection (sprinkler) work in all demolition and construction areas for full code coverage. Further definition will be provided in field if required.

PART 2 - PRODUCTS

2.1 DIELECTRIC FITTINGS

- A. Dielectric fittings shall be provided where two materials of different types of metal connect or come in contact with each other.

2.2 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Coordinate subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications.
- C. Manufacturers:
 - 1. Hilti, Inc.
 - 2. B-Line Systems, Inc.; a division of Cooper Industries.
 - 3. ITW Ramset/Red Head.
 - 4. Masterset Fastening Systems, Inc.
 - 5. MKT Fastening, LLC.
 - 6. Powers Fasteners.
 - 7. Empire Fastening, LLC

PART 3 - EXECUTION

3.1 MANUFACTURERS

- A. Provide products from manufacturers regularly engaged in the manufacture of products of quality, types and sizes required; and which have been in satisfactory use of not less than four (4) years in similar service, except as otherwise noted in specific sections of this division.

3.2 COORDINATION OF FIRE-SUPPRESSION WORK

- A. Refer to Division 1 Sections for general coordination requirements applicable to entire work. The contract documents are diagrammatic in showing certain physical relationships which must be established within mechanical work, and in its interface with other work, including utilities, control and electrical work.
- B. Arrange fire suppression work in a neat, well organized manner, with piping and similar services running parallel with primary lines of the building.
- C. Give right-of-way to piping which may slope for drainage.
- D. Locate operating and control equipment properly to provide easy access, and arrange entire fire-suppression work with adequate access for operation and maintenance.
- E. Advise other trades of openings required in their work for the subsequent move-in of large units of fire-suppression work (equipment).

3.3 INTERRUPTION OF UTILITIES

- A. This project includes elements of work that will require disconnection and modification of existing systems, with resultant outages. These episodes must be strictly limited and controlled. No

outage affecting any portion of the existing facilities will be allowed without specific written authorization by the Owner.

- B. The Contractor shall schedule and coordinate all interruptions of utilities with the applicable utility provider and the Owner within 20 working days after award of contract. At least 3 working days prior to the interruption, the Contractor shall submit to the Owner a schedule request indicating the proposed date, time and duration of interruption, the work to be accomplished, the area(s) that will be affected and a proposed contingency plan to be followed in the event that normal services or facilities cannot be restored on schedule. Do not commence with the work until the Owner has approved the time, date and contingency in writing.
- C. Provide all labor, materials, equipment and personnel necessary to restore services on a contingency basis should normal service of facilities not be restored on schedule.

3.4 DAMAGE BY LEAKAGE

- A. The Contractor shall be responsible for damage to the grounds, walks, roads, buildings (including walls, floors and ceilings), piping systems, mechanical and electrical systems (and their related equipment and contents) caused by leakage in the piping systems being installed or having been installed herein. The Contractor shall repair all damage caused at no additional cost to the Owner. All repair work shall be performed as directed by the Owner.

3.5 EMERGENCY REPAIRS

- A. The Owner reserves the right to make emergency repairs as may be required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities.

3.6 PHASING

- A. General: Where the scope of work dictates that the project shall be constructed in phases, all costs shall be included for any temporary work required so that previous phases can be operational while construction is being done to adjacent spaces.

3.7 SUPERVISION AND WORKMANSHIP

- A. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent to do all the work required.
- B. Furnish the services of an experienced superintendent to be in constant charge of the work at all times.
- C. Quality Assurances: If requested, provide documentation that confirms the ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of inability to perform.
- D. A minimum of three (3) years of experience in the installation of fire-suppression systems similar to the systems specified is required.

- E. Core Drilling: Use core drills rather than percussion type equipment for making holes in concrete. All percussion type drilling including hammer drills must be scheduled through owner's representative.
- F. Inspection: Provisions shall be made for owner's representative to make rough-in and open ceiling inspections prior to covering up work.

3.8 LOCATIONS AND INSPECTION OF SITE

- A. The Contractor shall fully familiarize himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under this Contract. Coordinate with all other trades in advance of the work, requirements for openings, recesses and chases in the walls, partitions, equipment housekeeping pads, framing or openings, requirements for servicing equipment and routing of piping relative to each trade to alleviate conflicts. Should furnishing this information be neglected, delayed or incorrect and additional cutting is required, the cost of it shall be borne by the Contractor. Nothing in this paragraph shall be construed to relieve the Contractor of the responsibility for providing and paying for the required core drillings and openings in existing work.
- B. Diagrammatic indications on the Drawings are:
 - 1. Approximate only.
 - 2. Shown distorted at various locations.
 - 3. Possibly moved for visual clarity.
- C. Exact locations shall:
 - 1. Be required for proper installation in available space.
 - 2. Be as required to preserve the required space for the servicing of equipment and components.
 - 3. Avoid interference with Architectural and Structural features and the work of all other trades.
 - 4. Be coordinated with the work of all other trades toward the general purpose of having the work progress rapidly and smoothly with a minimum interference between one trade and another.
 - 5. Preserve headroom and keep openings and passageways clear.
 - 6. Conceal all piping above ceilings, in walls, pipe shafts, pipe spaces and furring whenever possible.
- D. Include a neat, orderly arrangement of piping symmetrical to building lines, light and tile patterns and other building elements. Any deviations not shown on the Drawings shall be requested in writing prior to implementation.

3.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Protect products against dirt, water, chemical and mechanical damage. Do not install damaged products.
- B. Deliver products to site in factory fabricated containers, with the manufacturer's label clearly visible. Handle carefully to avoid damage to components, enclosure and finish, and in strict accordance with manufacturer's instructions.
- C. Store products in clean dry place in original containers, protected from weather and construction traffic.

3.10 SUBSTITUTIONS

- A. A substitution is the use of any product other than that identified as the “Basis of Design,” the “Standard of Quality,” or an “Additional Approved Product.”
- B. Substitutions require pre-bid approval. Only substitutions authorized via addendum shall be considered.
- C. Substitutions are considered on a product-by-product and model specific basis.
- D. Substitution Submittal Requirements:
 - 1. Substitution requests must be received by the Designer sufficiently in advance of the scheduled bid date to allow time for review and issuance of an Addendum. If the timing of the request does not permit an Addendum, substitution shall not be considered or acceptable.
 - 2. Substitution requests shall consist of the following for each proposed substitution:
 - a. Substitution Request Letter:
 - 1) On company letterhead, for each specific product substitution request. The letter shall include the following:
 - a) The specification section and paragraph number and drawing number where the product requirement is identified.
 - b) The specific system in which the product is to be used.
 - c) The reason the Contractor is requesting the substitution.
 - d) Statement of impact on the system(s) in which the product is used.
 - e) An enumeration declaring each difference between the Basis of Design product and the proposed substitute, including performance differences, technical specifications difference, feature differences, method of operation differences, warranty differences, dimensional differences, method and means of control differences, compliance differences. Failure to disclose 100-percent of the differences in this manner may be grounds for a post-bid and/or post–installation rejection of Contractor proposed substitute product.
 - 2) A separate letter shall be furnished for each product substitution request.
 - b. Product Datasheets/Brochures:
 - 1) Complete system brochure(s) and/or individual product data sheet(s), as applicable and appropriate for the Basis of Design product(s) the requested substitute is intended to replace.
 - 2) Complete system brochure(s) and/or individual product data sheet(s), as applicable, for the proposed substitute product(s).
 - 3. Failure to furnish the required information is sufficient grounds for rejection of the request for substitution.
 - 4. A demonstration of the proposed substitute equipment and/or system(s) may be required by the Designer prior to consideration of substitute products or system(s). Costs associated with these demonstrations are the responsibility of the entity submitting the request.
 - 5. Substitution Pre-Bid Submittal Exceptions:
 - a. Additional Approved Manufacturer(s):
 - 1) These specifications may use phrases such as “or equal by,” or “Additional Approved Manufacture(s)” for products. When a product category uses these designations, it is an indication that a product model from one of the listed manufacturer(s) may be provided without the requirement to obtain pre-bid approval for the model selected, provided that the Contractor has adequately researched and has become familiar with the Basis of Design product and intends to supply a model that is equal to or superior than the Basis of Design product.

- 2) Since it is impractical to enumerate every characteristic of modern electronic products, it is incumbent upon the Contractor to research manufacturer's publications to obtain the fullest possible understanding of Basis of Design / Standard of Quality products the Contractor proposes to substitute with a product from any Additional Approved Manufacturer considered.
 - 3) Although not mandatory, for the Contractor's own protection, model specific pre-bid approval is strongly encouraged.
 - 4) The decision as to whether a Contractor selected model from a list of Approved Additional Manufacturer(s) is acceptable remains solely with the Designer, and the Designer's decision is final.
- E. Costs that result from the use of substitute products and/or Additional Approved Manufacturer(s), including costs for additional equipment, coordination, accessories, modules, interface products, cables, software, and programming, as well as costs for any additional labor, materials, and products incurred by other trades or members of the project Design Team or Owner, are the sole responsibility of the Contractor making the substitution. This includes costs that may not be incurred or known until after Contract award or Work execution. Such costs shall be deducted from final sum payable to the Contractor.
- F. Post Contract award substitutions may be considered, but only if the proposed substitution includes substantial additional benefit to the Owner. Post award substitutions are considered solely at the discretion and convenience of the Designer. For a post Contract award substitution to be considered, one or more of the following shall apply:
1. The Designer initiates the request for substitution.
 2. A basis of design product has become discontinued and is no longer available, and as a result, the use of a substitute product has become a necessity to meet the Owner's objectives for the Project. See "Discontinued Products."
 3. The request for substitution is accompanied by a proposal that identifies the benefits to the Owner, including a fair-market Contract price reduction.

3.11 EXPLANATION AND PRECEDENCE OF DRAWINGS AND SPECIFICATIONS

- A. Prior to submitting his bid, the Contractor shall review all Drawings and Specifications to determine any conflict with all applicable local codes, rules or regulations. The Contractor shall obtain clarification of such during bidding.
- B. When the work as indicated on the Drawings and/or Specifications exceeds the minimum required by any code, standard, rule or regulation, the Drawings and/or Specifications shall govern the design and installation of the work.
- C. For purposes of clarity and legibility, the Drawings are essentially diagrammatic although size and location of equipment are drawn to scale wherever possible. The Contractor shall make use of and verify all information on the Drawings and Specifications.
- D. The Contractor shall fully inform himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnish and installed under this Contract. He shall exercise due and particular caution to determine that all parts of his work are made readily accessible.
- E. The Drawings indicate required sizes and points of termination of piping and suggests proper routes to conform to structure, avoid obstructions and preserve clearances. However, it is not intended that the Drawings indicate all necessary offsets, and it shall be the work of the Contractor to make the installation in such a manner as to conform to the structure, avoid obstruc-

tions, preserve headroom, keep openings and passageways clear and maintain required service clearances without additional cost to the Owner.

- F. Significant changes by the Contractor in design, sizing and/or location of system piping, fixtures and/or equipment as shown on the Drawings are prohibited without prior written approval by the Owner. Should the Contractor fail to obtain the Owner's written approval and proceed to make these unauthorized changes, he does so at the risk of accepting total responsibility and related costs therein for the design elements he may alter.
- G. It is intended that all fire protection devices, piping, etc. be located symmetrically with all Architectural elements. Refer to the Drawings and Specifications of all disciplines in completing the required coordination.
- H. Where the Drawings and/or Specifications are in conflict, obtain clarification of such during bidding. Official clarification will only be given in written form. Any clarification issued by other than written form will not be considered official and shall be non-binding for work under this Contract. Where clarification cannot be delivered in a timely manner, the Contractor shall base his bid on the greater quantities, higher standards or more restrictive requirements. In the event of discrepancies in the Drawings and/or Specifications after the bid period, the Contractor shall advise the Architect and Engineer of such prior to proceeding with the work in question in order that correct progress of the work may be insured.
- I. Prior to submitting his bid, the Contractor shall review all Drawings and Specifications to determine any conflict with all applicable local codes, rules or regulations. The Contractor shall obtain clarification of such during bidding as outlined above.
- J. The submittal of his bid shall indicate the Contractor has examined the site; all applicable local codes, rules and regulations; the Drawings and Specifications and has included all required allowances in his bid. No allowance shall be made for any error or omission resulting from the Contractor's failure to visit the job site and/or review the Drawings and Specifications. The Contractor's bid shall include costs for all required drawings and changes as outlined above at no additional cost to the Owner.

3.12 CUTTING, PATCHING, AND DEMOLITION

- A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Contractor shall include all necessary cutting and patching required to perform their work. For interior work, cut and patch all walls, ceilings, and floors as applicable. For exterior work, provide saw-cutting, replacement of concrete, paving, re-seeding/straw for grassy areas, and replacement of landscaping areas where applicable.
- C. All cutting of concrete work by the Contractor shall be by core drilling or concrete saws with dust collection systems. No cutting or coring of structural members shall be done without first obtaining the permission of the Owner. All cuts by the Contractor shall be plumb, square and true.
- D. Core Drilling: Use core drills rather than percussion type equipment for making holes in concrete. All percussion type drilling including hammer drills must be scheduled through the Owner.
- E. All patching of existing, adjacent surfaces shall match existing material and finish in a manner satisfactory to the Architect.

- F. Disconnect, demolish, and remove fire protection systems, equipment, and components indicated to be removed and as necessary to perform the described scope of work.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- G. 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.

- H. No means of demolition shall be used that would result in damage to structures, materials, equipment or components indicated to remain or endanger the health, safety and welfare of the general public. The use of explosives is strictly prohibited. Where piping, insulation, fixtures, equipment or components to remain are damaged or disturbed, remove damaged portions and install new products of equal capacity and quality, subject to the approval of and at no additional cost to the Owner.

- I. Demolition Scope of Work:
 - 1. Before beginning demolition, make all arrangements required to turn off and disconnect utilities and other such facilities involved.
 - 2. The Owner has the right of first refusal of all removed materials as indicated on the Drawings. All items designated to remain as the Owner's property shall be removed, cleaned and presented to him as he may direct.
 - 3. All items to be removed and relocated shall be removed and responsibly stored, cleaned, repaired (as required and to satisfactory working order), reinstalled (complete with new fittings, trim, etc), reconnected and made operational by the Contractor.
 - 4. All other demolished items shall become property of the Contractor and shall be responsibly disposed of in accordance with applicable codes and regulations or salvaged. All costs associated with disposal or salvaging are the Contractor's responsibility.

3.13 SYSTEM TESTS

- A. Perform all system tests in the presence of an authorized representative of the Owner and local authority having jurisdiction as applicable. Notify the Owner of all system's tests at least 48 hours in advance.

3.14 CLEANING PREMISES

- A. During the progress of the work, clean up and leave the premises and all portions of the building in which work was performed in a clean and safe condition. Refer to Division 1.

3.15 MAINTENANCE, OPERATION INSTRUCTIONS, ETC.

- A. General: Before final acceptance of the project by the Owner, the Contractor shall schedule with the Owner's maintenance personnel, at a time mutually convenient, a training session. At

this time, he will thoroughly familiarize the Owner's maintenance personnel with all operating and service procedures (routine and emergency) associated with the building systems and equipment. Provide the Owner with a list of all equipment including the following information:

1. Manufacturer's name.
2. Equipment model number
3. Equipment serial number.
4. Local sales representative (including postal & email addresses and telephone & fax numbers).
5. Parts list, complete with source(s) of supply.
6. Complete internal wiring diagrams.
7. Warranties.

- B. All directions for operation furnished by the manufacturer shall be carefully saved and turned over to the Owner, together with written sequence of operation, operating and maintenance schedules & instructions (routine and emergency) for each system and its equipment. All verbiage and units of measure shall be in English.

3.16 PROJECT SITE SAFETY

- A. The Engineer claims no expertise in and assumes no responsibility for any and all safety procedures and protocols associated with the Contractor's work. The Contractor shall exercise due diligence and comply with all established safety standards and regulations as listed by OSHA and any equipment manufacturers' requirements as they may relate to personal safety. The Contractor shall insure that all of his subcontractor(s) and/or tradesmen are apprised of all safety-related standards and procedures as they may relate to their work and immediately correct any violation of OSHA standards and regulations or equipment manufacturers' safety recommendations.

3.17 WORK IN EXISTING SPACES

- A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.
- B. Existing Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications are the responsibility of others, remove and replace existing ceilings where work is being performed. In those instances, costs for all repair and installation of new grid, ceiling panels, etc shall be included. Match existing finishes.
- C. New Ceilings: Where existing sprinklers are to remain, and the architectural drawings indicate replacement of the ceilings, temporarily remove and reinstall sprinkler escutcheons, etc. as required to accommodate the ceiling removal.
- D. Walls & Floors: Patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.

3.18 FIRE ALARM RELATED WORK FOR FIRE-SUPPRESSION SYSTEMS

- A. The following applies whether or not shown on drawings. Prior to submitting a bid, review documents of all other disciplines which may have an impact on such work.

- B. If a sprinkler system exists in the building, furnish and install all required flow and tamper switches. Wiring and installation of the fire alarm devices shall not be included.

3.19 ARCHITECTURAL COORDINATION ITEMS

- A. Cut and drill all openings in walls and floors required for the installation. Secure approval of Engineer before cutting and drilling. Neatly patch all openings cut.
- B. Cutting and patching to be held to a minimum. Coordinate locations of sleeves and openings before construction is started.
- C. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.
- D. Caulk or fire safe between sleeves and pipes, see Division 7 for caulking and fire-safing requirements and the floor plan and partition schedule for partition ratings.
- E. Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, controls, and sprinkler devices required by NFPA. Provide frame as required for finish. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks. Refer to Division 9 for access panel manufacturers and material requirements. Provide phenolic plate with ID of item behind access panel on the face of the door.
- F. Install steel pipe sleeves two sizes larger than pipes passing through floors, walls or masonry construction.
- G. Sleeves through walls to be cut flush with both faces.
- H. Sleeves through floor to extend one inch above floor top elevation.
- I. Caulk or fire safe between sleeves and pipes, see Division 7 for caulking and fire-safing requirements and the floor plan partition schedule for partition ratings.
- J. Install manufactured chromium plated escutcheon plates wherever uninsulated exposed pipes pass through walls, floors, or ceilings. Escutcheon inside diameter to closely fit around pipe and outside diameter to completely cover opening.
- K. Furnish and set all forms required in masonry walls or foundation to accommodate pipes.
- L. Provide flexible connectors where all pipes cross building expansion joints. Coordinate exact quantity & location with Architectural plans prior to installation of piping.

END OF SECTION 21 05 00.00

SECTION 21 05 03.00 – SUBMITTALS FOR FIRE-SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 21 General Requirements Section apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.
- B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

- A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:
 1. Supply of one or more products.
 2. Installation of one or more products.
 3. Integration of one or more products.
 4. Creation of one or more deliverable products.
 5. Labeling of one or more products.
 6. Contractor-based design or engineering of one or more products or systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Submittals shall be routed through established Project channels as identified by the Owner's representative.
- B. Coordinate, assemble, title, transmit and track Project submittals.

- C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall feature the same appearance and organization as those of other Sections.
- D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents.
- E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.
- F. Designer reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis. Additional submittals shall be provided at the Contractor's expense.
- G. The cost for preparation and transportation of submittals is Work of the Contract.
- H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.
- I. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.
- J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.
- K. Organize submittals as identified in the Contract Documents.
- L. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. This allows for tracking and processing efficiency, so that:
 - 1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
 - 2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
 - 3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.
- M. Use of Electronic Drawings from the Owner's Design Team:
 - 1. Plan drawings for the Project were created with Revit.
 - 2.
 - 1. Revit files are not available. If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of published two-dimensional plan drawings may be made available for the creation of shop and as-built drawings for a fee of \$100 per division group for projects that were designed in Revit and must be converted to an AutoCAD or Navisworks format. Divisions 21 and 22 are one group, Division 23 is a second group, and Divisions 26, 27 and 28 are a third group.
 - 2. Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Designer.

3.2 SUBMITTAL TYPES

- A. The following are the common submittal types referenced in this Section:
 - 1. Quality Assurance (QA).
 - 2. Quality Control (QC).
 - 3. Product Data (PD).
 - 4. Shop Drawing (SD).
 - 5. Training (TG).
 - 6. Field Observation Response (FO).
 - 7. Closeout Submittal (CO).

3.3 SUBMITTAL SEQUENCE

- A. Quality Assurance Submittal:
 - 1. When not expressly requested to be supplied with bid, the Quality Assurance submittal(s) shall be supplied upon request. When requested the submittal shall be delivered to the Designer within 16 business hours.
- B. Product Data Submittal:
 - 1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.
- C. Shop Drawing Submittal:
 - 1. Submit for review prior to commencement of fabrication and installation.
 - 2. Submit concurrently with Section-specific Product Data submittals.
- D. Samples Submittal:
 - 1. Submit concurrent with, or soon after, product data and shop drawings and prior to installation of Work.
- E. Training Submittal:
 - 1. Submit thirty (30) days prior to the first training session.
- F. Field Observation Report Submittal:
 - 1. Submit five (5) business days prior to punch list walkthrough.
- G. Closeout Submittal:
 - 1. Submit following completion of onsite work but not more than ten (10) business days following successful Acceptance Testing.

3.4 SUBMITTAL IDENTIFICATION

- A. Identify each submittal uniquely.
- B. Identify each submittal by specification Section number, submittal type, and submittal iteration.
- C. The format for labeling the submittals shall be as follows:
 - 1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
 - 2. Examples:
 - a. First Product Data Submittal for section 211313: “211313-PD-00.”
 - b. Revised Product Data Submittal for section 211313: “211313-PD-01.”
 - c. Second Revised Product Data Submittal for 211313: “211313-PD-02.”

3.5 SUBMITTAL CONTENTS

- A. All Submittals:
1. Transmittal:
 - a. Supply a dedicated transmittal for submittals for each individual Section.
 - b. Itemize the specific submittals included by Section, submittal type, and iteration.
 2. Title Sheet:
 - a. Include a separate title sheet with each submittal, of each type.
 - b. Title sheets for each Section, for each submittal type, shall have the same appearance.
 - c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.
 - d. Title sheets for drawings shall be the same size as the associated drawings.
 - e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.
 3. Index:
 - a. Include an index outlining and identifying the contents of the submittal.
 - b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.
 4. Checklists:
 - a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and may also be found within individual Sections.
 5. Title Blocks:
 - a. Drawing submittals shall be created on the Contractor's, manufacturer's, or vendor's own title block. The title blocks of the Owner, Architect, Engineer, Designer or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.
 6. Legend:
 - a. Drawing submittals shall include a legend of symbology.
 7. Resubmittals:
 - a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.
- B. Quality Assurance Submittals:
1. List of Subcontractors to be used on the Project along with a description of the role each will play on the Project.
 2. The last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value. References shall include:
 - a. Owner's name and current contact information.
 - b. Project address.
 - c. Description of the system(s) and scope of actual work performed.
 - d. Monetary contract value of the Work performed.
 3. Financial Disclosure of the Contractor: Prior to contract award, upon request.
- C. Product Data Submittals:
1. Bill of Materials (BOM):
 - a. Separate list for each system:
 - 1) When a Section covers products for use in multiple systems, supply separate BOM for each unique system covered by the Section. Label each with the system name, space/room name, and room number.
 - b. Include the following:
 - 1) Make, model, and description of each product.
 - 2) Quantity estimates for each product.
 - 3) Section paragraph number from which the product requirement is derived. Use drawing and detail references when the requirement is derived from the Drawings.

- c. Organize the BOM to follow the order in which products appear within the Section. Products shown on the Drawings but not enumerated within the Specifications shall be placed at the end of the list and include a reference to the Drawing from which the product requirement was derived.
 - 2. Product Datasheets Submittals:
 - a. Separate manufacturer datasheets for each product.
 - b. Datasheets shall be manufacturer originals or first generation printed versions (i.e., from PDF) of the manufacturer's official electronic datasheet:
 - 1) Distributor modified, distributor branded, and/or html based "web" datasheets are not acceptable.
 - 2) Datasheets shall include size and technical support data.
 - c. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or with bold visible arrows the model(s), version(s) and option(s) being supplied. Exact catalog number(s) shall be indicated.
 - d. Each datasheet shall be labeled with the Section paragraph reference number. Datasheets shall include the Drawing reference when no specific paragraph reference exists within the Section.
- D. Shop Drawing Submittals:
 - 1. General:
 - a. Drawing descriptions identify the required contents of common drawings required under the Contract.
 - b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Designer, are required.
 - c. Drawing Scales:
 - 1) Floor plans shall be drawn to scale.
 - 2) Section drawings shall be drawn to scale.
 - 3) Elevation drawings shall be drawn to scale.
 - 4) Details of physical items shall be drawn to scale.
 - d. Sizes:
 - 1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Designer.
 - 2. Floor Plans:
 - a. Fire-suppression components per NFPA guidelines.
 - b. Location of sprinklers, piping, valves, devices, and equipment.
- E. Training Submittals:
 - 1. Proposed schedule.
 - 2. Training agendas for each session.
 - 3. Identification of personnel that will conduct training.
 - 4. Handouts proposed for distribution during training.
- F. Field Observation Report Submittals:
 - 1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:
 - a. The response shall include a copy of the original Field Observation Report.
 - b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.
- G. Closeout Submittals:
 - 1. As-Built Drawings:
 - a. General:
 - 1) Requirements for Shop Drawings apply to "As-Built" drawings.

- b. Required Drawings:
 - 1) Title Sheet.
 - 2) Floor Plans.
 - 3) As-built version of each Project shop drawing.
 - c. Drawing Formats:
 - 1) Electronic Editable: Editable version using the native application used to create the file (e.g., Revit, AutoCAD).
 - 2) Non-Editable: PDF file format.
 - 3) Printed Hardcopy.
 - 4) Sheets shall be the same size and feature consistent title block information in the lower-right corner.
 - d. Drawing Organization:
 - 1) Hardcopy drawings shall be bound together into logical sets, bound along the left edge of the sheets.
 - 2) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.
2. Operation and Maintenance Manuals:
- a. Manual Format:
 - 1) Hard-cover 3-ring type binder.
 - 2) Front clear plastic cover pocket complete with Project and system Information insert.
 - 3) Clear plastic spine pocket with Project and system Information insert.
 - 4) Binder sized to suit the contents only, neither oversized nor undersized.
 - 5) Maximum binder thickness: 3 inches.
 - b. Manual Contents and Organization:
 - 1) General:
 - a) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
 - b) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).
 - c) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
 - d) Insert labeled tabs within binder to identify separate contents of the manual.
 - e) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.
 - 2) Project Information Cover:
 - a) Title of Project.
 - b) Name and address of Owner, Designer, Architect, Contractor of Record and Subcontractor.
 - c) System name and specification references.
 - 3) Index:
 - a) Contents of the manual.
 - 4) Warranty Statement:
 - a) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
 - b) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 2 year parts and labor).
 - c) A separate warranty statement shall be supplied for each system.
 - d) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if

- one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
- e) Supply standard out-of-warranty service rates and service contact information.
- 5) Bill of Materials:
 - a) List of products supplied.
 - b) Serial numbers of each product.
 - 6) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):
 - a) Manufacturer datasheets for each product supplied.
 - 7) Manufacturer Owner / User Manuals:
 - a) Manufacturer's Owner's or User's manual for each product.
 - b) Manufacturer's Installation instructions and other documentation supplied with the product.
 - 8) Test Reports and Checklists:
 - a) Test reports, checklists, and other forms generated and completed during the course of the Project.
 - 9) Training Information:
 - a) Photocopy of training outlines / agendas.
 - b) Photocopy of training session handouts.
 - c) Photocopy of training sign-in sheets.
 - d) Photocopy of signed delivery receipt for each training session recording (applicable to those Sections/systems requiring recording).
 - 10) As-Built Drawings:
 - a) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.
 - b) The electronic manual shall contain electronic PDF version of the as-built drawings.

3.6 SUBMITTAL QUANTITY

A. General:

- 1. The quantity of submittals required shall be the greater of the following:
 - a. Quantity identified within Division 01.
 - b. Quantity identified within the individual Section.
 - c. Quantity identified herein.
- 2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
- 3. The Designer shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

B. Product Data Submittals:

- 1. Two (2) Hardcopies.
- 2. One (1) Electronic.

C. Shop Drawings Submittals:

- 1. Two (2) Hardcopies.
- 2. One (1) Electronic.

D. Training Submittals:

- 1. Two (2) Hardcopies.
- 2. One (1) Electronic.

E. Field Observation Report Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

F. Samples Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

G. Closeout Submittals:

1. Two (2) Hardcopies.
2. One (2) Electronic.

3.7 SUBMITTAL REJECTION

A. The following items are representative reasons that submittals may need to be revised and resubmitted:

1. Binding submittals for multiple Sections together.
2. Failing to supply separate transmittal for submittals for each Section.
3. Failing to include a submittal title sheet.
4. Failing to use and accurately complete the published title sheet.
5. Failing to supply and accurately complete the submittal checklists.
6. Failing to supply product data and shop drawings at the same time.
7. Failing to include a detailed BOM with the product data.
8. Failing to supply product data sheets.
9. Failing to supply product data sheets with the correct product and required accessories enumerated.
10. Failing to supply shop drawings.
11. Failing to supply shop drawings with required information.
12. Failing to supply accurate information.
13. Failing to supply relevant information required by the Specifications.
14. Failing to supply products that are in compliance with the Specifications.
15. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

A. Revise and Resubmit:

1. When a submittal is rejected and flagged as "Revise and Resubmit," the entire submittal shall be reviewed, revised and resubmitted in totality.
2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.

B. Exceptions Noted:

1. When a submittal is flagged as "Exceptions Noted," the specific actions identified shall be taken.
2. If the reviewer's comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.

C. Resubmittals shall:

1. Include a copy of the reviewer's previous comments.
2. Include a written description of the action(s) taken.
3. Be labeled chronologically.
4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

- A. Electronic submittals shall only be permissible where electronic submittals are expressly required and where express approval for such has been granted.
- B. Electronic submittal files shall be compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard, version 1.5.
- C. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.
- D. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.
- E. Single File Submission:
 - 1. Option 1 – Single File, PDF Format:
 - a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
 - b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, BOM, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
 - c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.
 - d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model. Entries shall be organized in a sorted manner, first by make, then by model.
 - e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
 - f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., 211313-PD-01.pdf).
 - 1) Where the Designer directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:
 - a) 211313-PD-01 (1 of 3).pdf
 - b) 211313-PD-01 (2 of 3).pdf
 - c) 211313-PD-01 (3 of 3).pdf
 - 2. Option 2 – Single File, Zip Format:
 - a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible “.zip” file.
 - b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 02-BOM, 03-Datasheets, 04-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.

- c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing, separate file for each BOM).
- d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
- e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial.
- f. Consult the Designer for supplement instructions should the WinZip file exceed 50 Megabytes in size.
- g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., 211313-PD-01.zip).
 - 1) Where the Designer directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:
 - a) 211313-PD-01 (1 of 3).zip
 - b) 211313-PD-01 (2 of 3).zip
 - c) 211313-PD-01 (3 of 3).zip

END OF SECTION 21 05 03.00

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
211313-PD-00

SECTION TITLE:
Wet-Pipe Sprinkler Systems

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: <u>xxxxxxxxxxx@xxxx.xx</u>
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PRODUCT DATA SUBMITTAL
CHECKLIST
(Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet		
Project Name		
Specification Section number		
Submittal iteration number (0 for first iteration, 1 + for each subsequent iteration (e.g., 211313-0, 211313-1))		
Contractor of Record identified		
Sub-contractor / vendor / supplier name identified		
Title Sheet appearance consistent with sample title sheet		
Bill of Materials		
Section paragraph and/or Drawing reference identified		
Make		
Model		
Product Description		
Separate lists included for each system		
Checklists included		
This checklist		
Checklists from Section being submitted (where applicable)		
Previous submittal review, with contractor actions and comments		
Product Datasheets included		
Datasheets are manufacturer originals		
Datasheets for each product included		
Section paragraph and/or Drawing reference on each datasheet		
Product accessories and options identified		
Products organized by paragraph (or alphabetically by brand)		
No photocopies, faxes and other illegible datasheets included		
Shop Drawings included		
Shop drawings accompany this product data submittal.		
This submittal contains product data for one Section only.		

This checklist serves as a simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to Section 210503 "Submittals for Fire-Suppression" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and provided along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 21 05 17.00 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Mechanical Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.

1.3 SUBMITTALS

- A. General:
 - 1. Comply with Section 21 05 03.00 "Submittals for Fire-Suppression."
- B. Product Data (PD):
 - 1. Product Datasheets for Sleeve Seals.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-steel Sheet: 0.0239 inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Install steel pipe sleeves two sizes larger than pipes passing through floors, walls or masonry construction.

2.2 STACK-SLEEVE FITTINGS

- A. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 MECHANICAL SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Advance Products & Systems, Inc.
 2. CALPICO, Inc.
 3. Metraflex Company (The).
 4. Pipeline Seal and Insulator, Inc.
 5. Proco Products, Inc.
 6. Link-Seal Modular Seals
- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Presealed Systems.
 2. Advance Products & Systems, Inc.
 3. CALPICO, Inc.
 4. Metraflex Company (The).
 5. Pipeline Seal and Insulator, Inc.
 6. Proco Products, Inc.
 7. Link-Seal Modular Seals
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, nonshrink, and recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- B. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- C. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."
- D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
- B. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
- C. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
- D. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
- E. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
- F. Using grout, seal the space around outside of stack-sleeve fittings.
- G. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a water-tight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above Grade:
 - a. Galvanized steel pipe sleeves ASTM A53 Type E Grade B Sch. 40
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve seal system
 - 2. Exterior Concrete Walls below Grade:
 - a. Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Stack-sleeve fittings
 - b. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
 - 5. Interior Partitions:
 - a. Steel Pipe: ASTM A 795, Schedule 40, plain ends.
 - 1) Select sleeve size to allow for sealing of annular spaces.

END OF SECTION 21 05 17.00

SECTION 21 05 18.00 - ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall Escutcheons.
 - 2. Floor plates.

1.3 SUBMITTALS

- A. General:
 - 1. Comply with Section 21 05 03.00 "Submittals for Fire-Suppression."

PART 2 - PRODUCTS

2.1 WALL ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

2.2 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.

- b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with rough-brass finish.
 - f. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.
2. Escutcheons for Existing Piping:
- a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
 - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
 - d. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
 - e. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
- 1. New Piping: One-piece, floor-plate type.
 - 2. Existing Piping: Split-casting, floor-plate type.
- 3.2 FIELD QUALITY CONTROL
- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 21 05 18.00

SECTION 21 13 13.00 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Piping materials.
 - 2. Steel pipe and fittings.
 - 3. Pipe joining materials.
 - 4. Trim and drain valves.
 - 5. Sprinkler specialty pipe fittings.
 - 6. Sprinklers.
 - 7. Additional sprinklers.
 - 8. Alarm devices.
 - 9. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
 - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - 2. Sprinkler Occupancy Hazard Classifications:
 - a. Office and Public Areas: Light Hazard.
 - b. Libraries except Stack Areas: Light Hazard.
 - c. Clubs: Light Hazard.
 - d. Educational: Light Hazard.
 - e. Museums: Light Hazard.
 - f. Office Buildings: Light Hazard.
 - g. Theaters and Auditoriums, excluding Stages and Prosceniums: Light Hazard
 - h. Restaurant Seating Areas: Light Hazard.

- i. Restaurant Service Areas: Ordinary Hazard, Group 1.
- j. Building Service Areas: Ordinary Hazard, Group
- k. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
- l. General Storage Areas: Ordinary Hazard, Group 1.
- m. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
- n. Mercantile: Ordinary Hazard, Group 2.
- o. Library Stack Areas: Ordinary Hazard, Group 2.
- p. Exterior Loading Docks: Ordinary Hazard, Group 2.
- q. Post Offices: Ordinary Hazard, Group 2.
- r. Printing and Publishing: Ordinary Hazard, Group 2.
3. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
 - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
 - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
 - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
 - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
4. Maximum Protection Area per Sprinkler: Per UL listing.
5. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft.
 - b. Storage Areas: 130 sq. ft.
 - c. Mechanical Equipment Rooms: 130 sq. ft.
 - d. Electrical Equipment Rooms: 130 sq. ft.
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
 - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
 - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
 - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.

1.6 SUBMITTALS

- A. General:
 1. Comply with Section 21 05 03.00 "Submittals for Fire-Suppression."
- B. Product Data (PD):
 1. Provide product datasheets for all fire-suppression materials, components, valves, devices, and equipment. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories
- C. Shop Drawings (SD), Delegated-Design Submittal: For fire-suppression systems in compliance with performance requirements and design criteria, all applicable codes, the authority having jurisdiction, and NFPA guidelines. Shop Drawings and associated hydraulic calculations shall be signed and sealed by the qualified professional engineer responsible for their preparation. or the Level III NICET certified designer responsible for their preparation.
 1. Include plans, elevations, sections, and hangers, and items listed in NFPA-13
 2. Include water flow test data and calculations on the drawings.
 3. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - a. Items penetrating finished ceiling include the following:
 - 1) Lighting fixtures.
 - 2) Air outlets and inlets.
 - 3) Fire Alarm Devices

b. Coordinate with all equipment, piping, conduit, ductwork, from other contractors.

D. Closeout Submittals (CO):

1. Provide operation and maintenance manuals for all fire-suppression components, valves, devices, and equipment.
2. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA. Include "Contractor's Material and Test Certificate for Aboveground Piping."
3. 'As-Built' Plans, electronic format and one printed copy.
4. Reduced building plans showing locations of all zones, control valves, system drains, test locations and valve tag numbers.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 13R, "Installation of Sprinkler Systems in Residential Occupancies up to and Including Four Stories in Height."
3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Architect's and Owner's written permission.

1.9 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.10 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of spare sprinklers and sprinkler wrench(s) for each style used per NFPA-13.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Piping 2" and smaller shall be Schedule 40, Black-Steel Pipe: ASTM A 135 or A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Piping 2-1/2" and larger shall be Schedule 10, Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 6 and smaller; and NFPA 13-specified wall thickness in NPS 8 and larger, plain end.
- C. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- D. Steel Couplings: ASTM A 865, threaded.
- E. Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.
- F. Malleable- or Ductile-Iron Unions: UL 860.
- G. Cast-Iron Flanges: ASME 16.1, Class 125.
- H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- I. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.
- J. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil Star, Inc.
 - b. Corcoran Piping System Co
 - c. Bull Moose Tube Co.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - f. State Pipe Co.
 - 2. Pressure Rating: 175 psig minimum.
 - 3. Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections,

EPDM-rubber gasket, and bolts and nuts. Fittings in paragraph below are available in NPS 3/4 to NPS 2 (DN 20 to DN 50).

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
 - 1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
 - 2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- E. Plastic, Pipe-Flange Gasket, and Bolts and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 SPRINKLER SPECIALTY PIPE FITTINGS

- A. Branch Outlet Fittings:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International, Inc.
 - b. National Fittings, Inc.
 - c. Shurjoint Piping Products.
 - d. Tyco Fire & Building Products LP.
 - e. Victaulic Company.
 - 2. Standard: UL 213.
 - 3. Pressure Rating: 175 psig minimum.
 - 4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
 - 5. Type: Mechanical-T and -cross fittings.
 - 6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
 - 7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
 - 8. Branch Outlets: Grooved, or threaded.
- B. Flow Detection and Test Assemblies:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Reliable Automatic Sprinkler Co., Inc.
 - c. Tyco Fire & Building Products LP.
 - d. Victaulic Company.
 - 2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. AGF Manufacturing Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Flexible, Sprinkler Hose Fittings:

1. Flexible, stainless steel sprinkler fittings equal to Victaulic Vic-Flex Sprinkler Fittings shall be approved. Where used, the flexible extensions shall be a minimum of three feet in length and installed in a manner that will allow the sprinkler to be adjusted to any location within the ceiling tile that it is installed in. The intent is to allow for some flexibility in the event that future renovations require the ceiling and/or sprinkler location to be adjusted without modification of the rigid piping serving the sprinkler.
2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. FlexHead Industries, Inc.
 - b. Victaulic Company.
 - c. Aquaflex
 - d. Viking
3. Standard: UL 1474.
4. Type: Multiple-use flexible drop with hose for connection to sprinkler, and with AB1 open-gate bracket for connection to ceiling grid.
 - a. The bracket shall allow installation before the ceiling tile is in place.
5. Pressure Rating: 175 psig minimum.
6. The drop shall include a UL approved braided hose with a bend radius to 2" to allow for proper installation in confined spaces.
7. Union joints shall be provided for ease of installation.
8. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

- B. General Requirements:
 - 1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
 - 2. Pressure Rating for Residential Sprinklers: 175 psig maximum.
 - 3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.
 - 4. Pressure Rating for High-Pressure Automatic Sprinklers: 300 psig.

- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. Residential Applications: UL 1626.
 - 4. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

- D. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
 - 1. Ceiling Mounting: Chrome-plated steel, one piece, flat, with 1-inch vertical adjustment.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

- E. Sprinkler Guards:
 - 1. Provide sprinkler guards to protect exposed sprinklers in mechanical rooms, in gymnasiums, and all other locations subject to damage.
 - 2. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Reliable Automatic Sprinkler Co., Inc.
 - b. Tyco Fire & Building Products LP.
 - c. Victaulic Company.
 - d. Viking Corporation.
 - 3. Standard: UL 199.
 - 4. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 ADDITIONAL SPRINKLERS

- A. For each type of sprinkler being used, provide and maintain spare sprinklers on the premises during construction so that any sprinklers that have operated or been damaged in any way can be promptly replaced.

- B. For each type of sprinkler being used, provide the owner with additional sprinklers per NFPA-13 requirements in a wall mounted storage cabinet(s). Coordinate location of storage cabinet with owner.

- C. Where dry sprinklers of different lengths are installed, spare dry sprinklers shall not be required, provided that a means of returning the system to service is furnished.

- D. Furnish and install a sprinkler head storage cabinet(s) large enough to house all of the spare sprinklers and tools. Install the cabinet where the temperature to which they are subject will at no time exceed 100 F.

- E. A special sprinkler wrench shall be provided and kept in the cabinet to be used in the removal and installation of sprinklers. One sprinkler wrench shall be provided for each type of sprinkler installed.

2.7 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections and fire alarm electrical requirements.
- B. Electrically Operated Alarm Bell:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Notifier; a Honeywell company.
 - c. Potter Electric Signal Company.
 2. Standard: UL 464.
 3. Type: Vibrating, metal alarm bell.
 4. Size: 6-inch minimum-diameter.
 5. Finish: Red-enamel factory finish, suitable for outdoor use.
- C. Water-Flow Indicators:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ADT Security Services, Inc.
 - b. McDonnell & Miller; ITT Industries.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 - e. Viking Corporation.
 2. Standard: UL 346.
 3. Water-Flow Detector: Electrically supervised.
 4. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
 5. Type: Paddle operated.
 6. Pressure Rating: 250 psig.
 7. Design Installation: Horizontal or vertical.
- D. Valve Supervisory Switches:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire-Lite Alarms, Inc.; a Honeywell company.
 - b. Kennedy Valve; a division of McWane, Inc.
 - c. Potter Electric Signal Company.
 - d. System Sensor; a Honeywell company.
 2. Standard: UL 346.
 3. Type: Electrically supervised.
 4. Components: Single-pole, double-throw switch with normally closed contacts.
 5. Design: Signals that controlled valve is in other than fully open position.

2.8 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. AMETEK; U.S. Gauge Division.

2. Ashcroft, Inc.
 3. Brecco Corporation.
 4. WIKA Instrument Corporation.
- B. Standard: UL 393.
- C. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- D. Pressure Gage Range: 0 to 300 psig.
- E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.
- F. Air System Piping Gage: Include retard feature and "AIR" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 WATER-SUPPLY CONNECTIONS

- A. Connect sprinkler piping to building's interior water-distribution piping.

3.3 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.

- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.4 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for above-ground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
 2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.
 3. Dry Valves: Include all required trim for fully functional system

3.6 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings within 1 inch in both directions, in the center of a 2x2 ceiling tile or in the center of a 2x2 end-section of a 2x4 ceiling tile.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or side-wall, wet-type sprinklers in areas subject to freezing.

3.7 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
 - 4. Energize circuits to electrical equipment and devices.
 - 5. Coordinate with fire-alarm tests. Operate as required.
 - 6. Coordinate with fire-pump tests. Operate as required.
 - 7. Verify that equipment hose threads are same as local fire-department equipment.
- C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

3.9 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Remove grease, excess pipe dope, prep surfaces for painting.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.11 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers with factory brass finish.
 - 2. Finished Rooms with Ceilings:
 - a. Ceilings: Fully concealed pendent sprinklers with rough bronze finish on sprinkler and factory-painted adjustable cover confirm finish with architect.
 - b. Walls: Concealed horizontal sidewall sprinklers with factory-painted white cover.
 - 3. Spaces Subject to Freezing: Dry pendent sprinklers or dry sidewall sprinklers.
 - a. Ceiling areas: Fully exposed chrome sprinkler with 2 piece chrome escutcheon
 - b. Walls: Fully exposed brass sprinkler with brass 2 piece escutcheons.
 - 4. Spaces subject to corrosive atmospheres

- a. Exposed, Ceilings and Walls: Provide coating similar to nickel Teflon or similar coating for use in the specific application area.
5. Special Condition Areas: Refer to drawings for areas requiring special use and special style sprinklers. Architect may require sample cover plates for selection.

END OF SECTION 21 13 13.00

SECTION 230170.00 - OPERATION AND MAINTENANCE OF HVAC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
 - 1. Operation and Maintenance Manuals.
 - 2. Instructions for Owner's Personnel.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Detail fabrication and assembly.
 - 4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Drawings drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.
- B. Qualification Data: For manufacturer.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For equipment and systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components that fail(s) in materials or workmanship within specified warranty period.
 - 1. Warranty Period: one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPERATING AND MAINTENANCE MANUALS

- A. The contents of operating and maintenance manuals shall include the following:
 - 1. Description of mechanical equipment and systems.
 - 2. Operating instructions.
 - 3. Routine maintenance schedules and procedures.
- B. Organization - A manual of such purpose shall be arranged in two parts, with Part I dealing with information pertaining to systems and Part II covering information pertaining to equipment. These may be bound in as many volumes as may be required for convenience of use and reference.
 - 1. Part 1 - Systems:
 - a. The systems volumes shall be organized into Divisions wherein each Division represents a generic function. Systems shall be classified under appropriate Divisions. An example of such an arrangement is as follows:

b.	Division Title	Division No.
	1) Cooling	1.0
	a) Air Conditioning	
 - b. Division Title
 - c. The material for each system shall be organized in sections descriptive of the following basic areas of information:
 - 1) Descriptive Information.
 - 2) Operating Instructions.
 - 3) Inspection and Maintenance Instructions.
 - d. Sections could be organized to include the following categories of information:
 - 1) Descriptive Information
 - 2) Function of service.
 - 3) Classification.
 - 4) Design capability.
 - 5) Performance characteristics.
 - 6) Principal components.
 - 7) Distribution arrangement.
 - 8) Schematic diagram.
 - 9) Control diagram.
 - 10) Equipment Data.
 - 11) Inventory designation.
 - 12) Manufacturer and model.
 - 13) Size and rating.
 - 14) Pressure, speed and temperature limitations.

- 15) Operating Instructions.
 - 16) Starting and stopping procedures.
 - 17) Adjustment and regulation.
 - 18) Seasonal start-up.
 - 19) Seasonal shut-down.
 - 20) Logs and records.
 - 21) Inspection and Maintenance.
 - 22) Inspection schedule and checklist.
 - 23) Schedules and procedures for lubrication, replacements, adjustment, cleaning, painting, protection and testing.
 - 24) Inspection and maintenance records.
 - e. Reference Documents:
 - 1) Construction drawing list.
 - 2) Construction specifications.
 - 3) Record drawings.
 - 4) Test and balance records.
2. Part 2 - Equipment:
- a. This part of the manual shall be composed of manufacturers and fabricators data on equipment and materials organized into divisions wherein each division represents a generic classification of equipment such as:
 - b. Division Title
 - 1) Air Conditioning and Ventilating
 - 2) Controls
 - 3) Instrument and Accessories
 - c. Each division shall be organized in sections wherein each section would represent a specific type of equipment in Division 1, the sections shall include the following:
 - 1) Air Conditioning and Ventilating
 - d. Each section shall include the following manufacturer information:
 - 1) Descriptive Literature
 - a) Catalog cuts, brochures or shop drawings
 - b) Dimensional drawings
 - c) Materials of construction
 - d) Parts designations
 - 2) Operating Characteristics
 - a) Performance tables and charts
 - b) Performance curves
 - c) Pressure, temperature and speed limitations
 - d) Safety devices
 - 3) Operating Instructions
 - a) Pre-start check list
 - b) Start-up procedures
 - c) Inspection during operation
 - d) Adjustment and regulation
 - e) Testing
 - f) Detection of malfunction
 - g) Precautions
 - 4) Inspection Instruments and Procedures
 - a) Normal and abnormal operating temperature, pressure and speed limits
 - b) Schedule and manner of operation
 - c) Detection signals
 - 5) Maintenance Instructions and Procedures
 - a) Schedule of routing maintenance
 - b) Procedures
 - c) Troubleshooting chart

- 6) Parts List
 - a) Spare Parts
 - b) Essential inventory
 - c) Distributor directory
- 7) Service and Dealer Directory
- 8) Service Contracts

PART 3 - EXECUTION

3.1 INSTRUCTIONS FOR THE OWNER'S PERSONNEL

- A. Arrange for suppliers and/or installers to meet with the Owner's operating and maintenance personnel to provide instruction in the proper operation and maintenance of equipment that requires routine servicing. Include the following:
 - 1. Review of operation and maintenance manuals.
 - 2. Required tools.
 - 3. Lubricants.
 - 4. Spare parts.
 - 5. Cleaning.
 - 6. Hazards.
 - 7. Warranties and maintenance agreements.
- B. Demonstrate equipment and systems operation including the following:
 - 1. Start-up.
 - 2. Shut-down.
 - 3. Emergency conditions.
 - 4. Safety procedures.
 - 5. Setpoint and schedule adjustments.
 - 6. Economy and efficiency adjustments.

End of Section 230170.00

SECTION 23 05 01.00 – COMMON REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Scope:
 - 1. The base bid shall include furnishing all materials, labor, tools, equipment and installation of all work required to install complete mechanical systems as outlined in the contract documents.
 - 2. Submittal of a bid indicates that the contractor has examined the drawings, specifications, and visited the site and has included all required allowances for a complete bid.
 - 3. Contractor shall be designated as the sub-contractor for that section of work unless specifically stated otherwise.
- B. Permits, Fees, Inspection, Laws and Regulations
 - 1. Permits and fees of every nature required in connection with this work shall be obtained and paid for by this contractor who shall also pay for all the installation fees and similar charges.
 - 2. Laws and regulations which bear upon or affect the various branches of this work shall be complied with by this contractor, and are hereby made a part of this contract.
 - 3. All work which laws require to be inspected shall be submitted to the proper public officials for inspections and certificates of final approval must be furnished to the Owner before final acceptance will be given by the Engineer.

1.3 ELECTRONIC FILES

- A. Drawings for this project were prepared using AutoCAD and Revit software. Electronic files are available upon request for use by the successful contractor(s) for planning, coordination and installation.
- B. There will be no charge for drawing files that were prepared using AutoCAD. These files will be available in the version in which they were created.
- C. There will be a charge of \$100 per division group for projects prepared using Revit that must be converted to AutoCAD or Navisworks format. Divisions 21 and 22 are one group, Division 23 is a second group and Divisions 26, 27, and 28 are a third group. Revit model files will not be available.
- D. The Request Drawings Form can be accessed, filled out and submitted at the following internet address at the bottom of the page: <http://www.klhengrs.com>.

1.4 DEFINITIONS AND DESCRIPTIONS

- A. Acceptance Testing Authorities (ATA) - The individuals and/or business entities that participate in Acceptance Testing and report to the Owner when work appears to be complete. These parties represent the interest of the Owner.
- B. As shown – As shown, indicated or described on the contract documents.
- C. Authority Having Jurisdiction (AHJ) - The governmental agency or sub-agency having authority over the construction process and having the ultimate authority to enforce, uphold and rule on codes and safety compliance at the project site.
- D. Commissioning Authority - An agent of the Owner, often independent of the design team, responsible for ensuring compliance with the Owner's project intent. The commissioning authority represents the interest of the Owner.
- E. Contract Documents – Drawings, specification sections, contracts and submittals.
- F. Contractor - The entity(s) contractually responsible for performing work of this Division.
- G. Contractor of Record - A business entity entering into a contract for any element of work defined in the Project Documents directly with the Owner, directly with the Construction Manager or directly with a General Contractor.
- H. Coordinate – To locate and avoid both new and existing equipment, services and obstructions.
- I. Furnish - To supply product or labor (context dependent) including associated shipping, storage, travel, lodging, miscellaneous and warranty expenses.
- J. Install - To supply labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust a product in order to fulfill the requirements of the Project.
- K. Provide - To furnish and install, inclusive of accessories, modules, and ancillary items necessary to render the respective product and system fully operational and usable to the Owner for the intended purpose.
- L. Reinstall – To remove existing, install existing in the same location and make operational.
- M. RFI – Acronym for "Request for Information". This is written request from the Contractor to the Architect, through the Construction Manager, to only seek an interpretation of the contract documents and/or design intent so that the average, reasonable prudent builder will be in a position to provide the subject building system. All RFI's received will be responded in a prompt and professional manner. Any RFI's pertaining to means and methods, substitution requests, information already contained in the Contract Documents, or anything other than an interpretation or design intent will be labeled as "Unjustified".
- N. Relocate – To remove existing, install existing in a different location and make operational.
- O. Remove – To disconnect, dismantle or disconnect and dismantle as necessary. All removals not designated for reuse nor designated to be salvaged for the Owner is the property of the contractor unless stated otherwise.
- P. Replace – To remove existing and provide new as indicated in the same location.
- Q. Reroute – To remove part of system and provide extension to system to circumvent obstruction.

- R. Substantial Completion (Division 23 only)
 - 1. The point in the Project where work of this Division that occurs at the project site has been completed. For work to be substantially complete, the following must be valid:
 - a. Products have been delivered and installed at the project site, and;
 - b. Systems have been installed, tested, adjusted and are operational for their intended purpose, and;
 - c. Products have been labeled in accordance with the Contract Documents, and;
 - d. Systems are performing in accordance with the design intent, and;
 - e. Systems have been demonstrated to the Owner as complete and working.
- S. Work – All labor, materials and equipment described by the contract documents.
- T. Work of Other Trades – Work included in this contract that is normally described in other Sections of the Specifications under the Construction Specification Institute’s 23 Division format.
- U. Wherever the words “Site,” “Project Site,” or “Premises” appear in these specifications or related drawings, it shall be interpreted to mean real estate, buildings and structures where work shall be performed and where products shall be installed and reside.

1.5 QUALITY ASSURANCE

- A. General Standards
 - 1. The installation of all work shall conform to the applicable State and Local codes and statutes. The applicable provisions of the following standards shall govern:
 - a. State Building Code and applicable local amendments.
 - b. Local Building Code (if applicable)
 - c. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - d. American Society of Test Materials (ASTM)
 - e. National Fire Protection Association (NFPA)
 - f. Underwriters Laboratories (UL)
 - g. National Sanitation Foundation (NSF)
 - h. Sheet Metal & Air Conditioning Contractors National Association (SMACNA)
 - i. American National Standards Institute (ANSI)
 - j. Building Code Seismic Relative Displacement Requirements
- B. Qualifications
 - 1. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- C. Supervision and Workmanship
 - 1. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent and qualified to do all the work required.
 - 2. Contractor shall furnish the services of an experienced superintendent to be in constant charge of the work at all times.
 - 3. Quality Assurances: Contractor if requested shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor’s inability to perform.
 - 4. Contractor shall have a minimum five (5) years experience in the installation of HVAC systems similar to the systems specified.
 - 5. Core Drilling: Contractors shall use core drills rather than percussion type equipment for making holes in concrete. All percussion type drilling including hammer drills must be

scheduled through owner's representative. Openings shall be no larger than required to install services.

6. Inspection: Provisions shall be made for owner's representative to make rough-in and open ceiling inspections prior to covering up work.

D. Materials

1. All materials installed shall be new, full weight and of the best quality. All similar materials shall be of the same type and manufacturer.
2. Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner. Materials shall be stored to prevent damage, freezing or weathering prior to installation.
3. When several materials, products or items of equipment are specified by name for one use, the contractor may select any one of those specified and shall include with his bid and Equipment List listing the equipment selected.
4. Any manufacturer(s) other than scheduled shall have unit dimensions, weights and clearances equal to or less than any specified base-bid equipment, unless reviewed by the Engineer.
5. The responsibility for costs incurred from deviation from the base scheduled and specified equipment shall be this contractor. Use of any equipment will be considered as a statement that capacities, requirements, clearances and arrangements have been checked, verified and found satisfactory and meet the intent of the scheduled and specified equipment. Such additional costs shall not be approved for these modifications.
6. Should electrical characteristics for submitted HVAC equipment differ from the scheduled basis of design equipment electrical characteristics, any costs associated with the different electrical characteristics shall be borne by this Division's contractor without additional compensation.
7. All manufacturer or Mechanical Contractor provided electrical disconnect switches shall comply with current National Electric Code requirements and rated to meet or exceed the overcurrent device serving the equipment.

E. Specifications

1. Specifications shall be interpreted in connection with the drawings hereinbefore described, and if anything is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both.
2. Furthermore, all materials or labor previously required to fully complete the work shall be included in the contractor's work even though each item necessarily involved be not specifically mentioned or shown. Such work and/or materials shall be of the same grade or quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

F. Plans

1. Plans are diagrammatic indicating required size, points of termination of ducts and suggested routes. However, it is not intended that drawings indicate all necessary offsets. It shall be the work of the contractor to install ductwork in such manner as to conform to the structure, avoid obstructions, provide required service clearances and preserve headroom. Take field measurements to make these determinations. Do not rely on measurements taken or provided by others or scaled from drawings.
2. Coordination Drawings: The contractor shall provide a 1/4" scale double line set of coordination drawings to the Engineer prior to installation of the systems. This contractor shall provide all necessary coordination drawings required to make sure all disciplines are coordinated and fit into specified mechanical spaces (i.e. ceilings, chases, and all others). The top elevation of all disciplines shall be clearly marked throughout the drawings so that no interferences occur. Drawings shall depict actual clearances of installed equipment, penetration locations and service clearances. Indicate scheduling, sequencing, movement and positioning of large equipment during construction. Indicate

where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work. Conflicts in equipment and materials shall be corrected prior to installation. Contractor shall provide drawings showing all disciplines for coordination.

3. Exact location of electric outlets, heating equipment, lighting fixtures, ducts, etc., shall be coordinated so there will be no interferences at installation between the various trades. It is the work of the contractor to prepare complete coordination drawings indicating exact location of all items. The engineer shall have the option to move any piece of mechanical equipment up to fifteen feet from location shown on contract documents without any additional cost.
4. All ducts shall be run as straight as possible and symmetrical with architectural items.
5. Ductwork fabricated before coordination with the other trades will be done at the contractor's risk.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment and materials according to factory shipping requirements. Pack components in factory-fabricated protective containers. Units shall be delivered in sections of such size as will pass through available openings.
- B. Store equipment and materials in clean dry place and protect from weather and construction traffic. When stored inside, do not exceed structural capacity of the floor.
- C. Handling and rigging of equipment and products shall be as recommended by the manufacturer. Components and equipment damaged during shipment or handling shall not be installed. Replace and return damaged components to the manufacturer.
- D. All equipment and materials shall have the ability to be returned to the manufacturer after purchase and charged a reasonable restocking fee by the manufacturer equal to a small portion of the cost.

1.7 WARRANTY

- A. The contractor shall provide a guarantee in written form stating that all work under this section shall be free of defective work, materials, or parts for a period of one year from the date of substantial completion owner's final acceptance and shall repair, revise or replace at no cost to the owner any such defects occurring within the guarantee period. Contractor shall also state in written form that any items or occurrences arising during the guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

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

- B. Examine products or materials before installation. Reject products or materials that are wet, moisture damaged, or mold damaged.
- C. Examine walls, floors, roofs, etc. for suitable conditions where product or system will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY SERVICE

- A. Refer to Division 01
- B. Temporary Heating or Cooling: Provide, maintain and pay for all charges for temporary heating or cooling and adequate ventilation in all construction areas of the project, as may be deemed necessary to protect the building and work installed therein from damage due to cold, dampness, or humidity and shall maintain heating or cooling during finishing operations and until date of final completion. Use of permanent and existing building heating/cooling systems will not be permitted without prior written permission from the owner, architect, and engineer.

3.3 FIRE ALARM RELATED WORK FOR MECHANICAL SYSTEMS

- A. The following applies whether or not shown on drawings. Prior to submitting a bid, each contractor shall review documents of all other branches which may have an impact on such work.
- B. It shall be the responsibility of the contractor who installs the alarm panel and/or wiring to provide all necessary working drawings and submittals (wiring diagrams, zone schedule, plan view layouts, routing, wiring, device & panel submittals, etc.). These submittals shall be reviewed by the State Fire Marshall's office (or a similar agency as locally required) prior to submittal to engineer. All components shall be UL listed and NFPA approved for their specific application. Where control panels are required, provide remote annunciator (at location as directed in field) and provide full battery back-up as required by NFPA.
- C. All smoke detectors shall be specifically UL listed for use with the existing or new building fire alarm panel(s) and shall be provided with all required power supply/alarm wiring, sampling tubes, test station, auxiliary contacts, etc.
- D. All work shall be in strict compliance with all applicable sections of the latest edition of NFPA. Each air handling unit, sprinkler flow switch and/or sprinkler tamper switch shall be separately zoned. All fire alarm system wiring shall be supervised and installed in conduit (3/4" minimum).
- E. Unless local prevailing codes require otherwise, fire alarm related work for mechanical systems shall be as follows:
 - 1. If a sprinkler system exists in the building, the sprinkler contractor shall furnish and install all required flow and tamper switches. The Electrical Contractor shall furnish, install and wire all required fire alarm system wiring as well as all required additional components within the fire alarm system control and annunciator panels to allow for the additional zoning.
 - 2. Electrical contractor shall coordinate with mechanical contractors and shall install the detectors in easily accessible locations. Electrical Contractor shall provide all necessary fire alarm system wiring (in conduit) and supplementary work, components, equipment,

etc. as required to interface the sprinkler and/or smoke detector work with the building fire alarm system(s).

3. HVAC Contractor shall make wiring connection from the auxiliary contacts of the relay module or detectors into fan control circuits to shutdown equipment, in a controlled and safe manner, in the presence of smoke. If alarm status for the smoke detector is indicated in specification section 23 09 93.00, then the HVAC/ Temperature Controls Contractor is responsible for providing a control relay and all wiring from the smoke detector to allow notification at the BAS. If a supply & return/exhaust fan arrangement is installed, the HVAC/ Temperature Controls Contractor shall provide a 3-Pole Double Throw relay to shut down both the supply and return/exhaust fans in event of presence of smoke.

3.4 ARCHITECTURAL COORDINATION ITEMS

A. Cutting and Patching:

1. Cut and drill all openings in walls and floors required for the installation. Secure approval of Engineer before cutting and drilling. Neatly patch all openings cut.
2. Cutting and patching to be held to a minimum by arranging with other contractors for all sleeves and openings before construction is started.

B. Fire Caulking:

1. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.
2. Provide products equivalent to the following:
 - a. For Floor Openings: Instant Firestop; 305-SL
 - b. For Wall Openings: Instant Firestop; 344-GG
 - c. Mineral Felt: Instant Firestop; Type MW
 - d. For Insulated Pipes: Instant Firestop; Type PI
 - e. For Fill Areas: Instant Firestop; C-1000
3. For larger openings where pipes penetrate fire rated enclosures that cannot be sealed with products described above, utilize approved UL products equal to 3M FireDam Spray 200. Install per manufacturer's instructions.

C. Access Panels and Pathways:

1. Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, vents, controls, cleanout doors, and sprinkler devices required by NFPA. Provide access panels for all fire and/or fire & smoke dampers. Provide frame as required for finish. Furnish panels to General Contractor. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks.
2. For equipment above gypsum board or "hard ceilings", provide equipment access panels sized to permit complete holistic removal of the unit in its entirety. Access panel shall also be sized to accommodate removal of the largest piece of equipment in the case where such access panel is used as a removal pathway for multiple pieces of equipment.
3. Provide and maintain a minimum 34" wide by 80" high pathway for removal of equipment. Pathway shall be continuous from location of installed to building exterior. Ductwork and conduit shall not be installed within this pathway.

3.5 ROOFING, FINISHED FLOORS AND SLABS

- A. Protect roofs and flooring by using plywood planking to cover walkways and work areas on roofs, slabs and floors.

- B. Make roof penetrations and install insulated roof curbs and flashing in accordance with roofing manufacturer's recommendations. Obtain written certification from roofing manufacturer that work has been performed properly and that roof warranty has not been voided.

3.6 INSTALLATION

- A. Equipment shall be installed in accordance with manufactures installation recommendations.
- B. Provide and maintain service, maintenance and operating clearances as required by the manufacturer.
- C. Provide all cabling, raceways and devices required to connect the BAS server to the owner's Ethernet. HVAC contractor may elect to coordinate this with the electrical contractor or communications contractor. Owner shall provide IP address for BAS. In all cases, this contractor shall be responsible for providing and testing internet connections required for the BAS.

3.7 CHANGE ORDERS

- A. In the absence of direction elsewhere in the contract documents and event of revised scope or work formally issued through Change of Work Orders, contractor shall provide pricing prior to commencing work. Labor hours shall be estimated based on current version of RS Means.

3.8 CLEANING EQUIPMENT AND PREMISES

- A. Clean all parts of the apparatus and equipment. Exposed parts which are to be painted shall be cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all corners and cracks scraped out.
- B. Exposed metal work shall be brushed down with steel brushes to remove rust and other spots and left smooth and clean. Remove trapped elements during cleaning and flushing period, after which they shall be replaced and adjusted.
- C. During the progress of the work, the contractor shall clean up after his men and leave the premises and all portions of the building in which he is working in a clean and safe condition.

3.9 FIELD QUALITY CONTROL

- A. Prepare test and inspection reports.
- B. Prepare and provide Utility Verification reports.

3.10 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 1. Complete installation and startup checks according to manufacturer's written instructions.
 2. Unit may be started up and utilized only after the floor has been prepared and after drywall sanding has occurred 100%. Coordinate with all trades prior to startup.

3.11 ADJUSTING

- A. Adjust hardware and moving parts to function smoothly, and lubricate as recommended by manufacturer.

3.12 PROTECTION

- A. Protect installed equipment, ductwork, piping, devices and accessories during construction. Items damaged during construction will not be accepted and shall be replaced by this contractor with new at this contractor's expense.
- B. Remove and replace products or materials that are wet, moisture damaged, or mold damaged.

3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION 23 05 01.00

SECTION 23 05 03.00 – SUBMITTALS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 23 General Requirements Section apply to this Section.

1.2 SUMMARY

- A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.
- B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

- A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:
 1. Supply of one or more products.
 2. Installation of one or more products.
 3. Integration of one or more products.
 4. Programming of one or more products.
 5. Creation of one or more deliverable products.
 6. Labeling of one or more products.
 7. Contractor-based design or engineering of one or more products or systems.

1.5 REFERENCES

- A. Definitions:
 1. Component Identifier / Component ID: See Device ID.
 2. Device.ID: The unique identifier given to a specific instance of a product, module and assembly. Identifiers are unique within the context of the system and product in which it is used.
 3. Product Identifier / Product ID: See Device ID.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Submittals shall be routed through established Project channels as identified by the Owner's representative.
- B. Coordinate, assemble, title, transmit and track Project submittals.
- C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall have the same appearance and organization as those of other Sections.
- D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents.
- E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.
- F. Engineer reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis.
- G. The cost for preparation and transportation of submittals is Work of the Contract.
- H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.
- I. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.
- J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.
- K. Organize submittals as identified in the Contract Documents.
- L. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. This allows for tracking and processing efficiency, so that:
 - 1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
 - 2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
 - 3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.
- M. Use of Electronic Drawings from the Owner's Design Team:
 - 1. Plan drawings for the Project were created with Revit.
 - 1. Revit files are not available. If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of published two-dimensional plan drawings may be made available for the creation of shop and as-built drawings for a fee of \$100 per division group for projects that were designed in Revit and must be converted to an AutoCAD or Navisworks format. Divisions 21 and 22 are one group, Division 23 is a second group, and Divisions 26, 27 and 28 are a third group.

2. Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Designer.

3.2 SUBMITTAL TYPES

- A. The following are the common submittal types referenced in this Section:
 1. Quality Assurance (QA).
 2. Quality Control (QC).
 3. Product Data (PD).
 4. Shop Drawing (SD).
 5. Samples (SS).
 6. Training (TG).
 7. Field Observation Response (FO).
 8. Pre-Acceptances (PA).
 9. Closeout Submittal (CO).

3.3 SEQUENCE

- A. Quality Assurance Submittal:
 1. When not expressly requested to be supplied with bid, the Quality Assurance submittal(s) shall be supplied upon request. When requested the submittal shall be delivered to the Designer within 16 business hours.
- B. Product Data Submittal:
 1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.
- C. Shop Drawing Submittal:
 1. Submit for review prior to commencement of fabrication and installation.
 2. Submit concurrently with Section-specific Product Data submittals.
- D. Training Submittal:
 1. Submit thirty (30) days prior to the first training session.

3.4 IDENTIFICATION

- A. Identify each submittal uniquely.
- B. Identify each submittal by specification Section number, submittal type, and submittal iteration.
- C. The format for labeling the submittals shall be as follows:
 1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
 2. Examples:
 - a. First Product Data Submittal for section 23 31 13.00: “233113-PD-00.”
 - b. Revised Product Data Submittal for section 23 31 13: “233113-PD-01.”
 - c. Second Revised Product Data Submittal for 23 31 13: “233113-PD-02.”

3.5 CONTENTS

- A. General:
1. Transmittal:
 - a. Supply a dedicated transmittal for submittals for each individual Section.
 - b. Itemize the specific submittals included by Section, submittal type, and iteration.
 2. Title Sheet:
 - a. Include a separate title sheet with each submittal, of each type.
 - b. Title sheets for each Section, for each submittal type, shall have the same appearance.
 - c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.
 - d. Title sheets for drawings shall be the same size as the associated drawings.
 - e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.
 3. Index:
 - a. Include an index outlining and identifying the contents of the submittal.
 - b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.
 4. Checklists:
 - a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and within individual Sections.
 5. Title Blocks:
 - a. Drawing submittals shall be created on the Contractor's, manufacturers, or vendor's own title block. The title blocks of the Owner, Architect, Engineer, Designer or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.
 6. Legend:
 - a. Drawing submittals shall include a legend of symbology.
 7. Resubmittals:
 - a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.
- B. Quality Assurance:
1. List of Subcontractors to be used on the Project along with a description of the role each shall play on the Project.
 2. Proof of Quality Assurance compliance, as identified within each Division 23 Section "Quality Assurance" and in each individual Section.
 3. The last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value. References shall include:
 - a. Owner's name and current contact information.
 - b. Project address.
 - c. Description of the system(s) and scope of actual work performed.
 - d. Monetary contract value of the Work performed.
 4. Financial Disclosure of the Contractor: Prior to contract award, upon request.
- C. Product Data Submittals:
1. Product Datasheets:
 - a. Separate manufacturer datasheets for each product.
 - b. Datasheets shall be manufacturer originals or first generation printed versions (i.e., from PDF) of the manufacturer's official electronic datasheet:
 - 1) Distributor modified, distributor branded, and/or html based "web" datasheets are not acceptable.
 - 2) Datasheets shall include size and technical support data.
 - c. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or with bold visible arrows the model(s),

version(s) and option(s) being supplied. Exact catalog number(s) shall be indicated.

- d. Each datasheet shall be labeled with the Section paragraph reference number. Datasheets shall include the Drawing reference when no specific paragraph reference exists within the Section.

D. Shop Drawings Submittals:

1. General:
 - a. Drawing descriptions identify the required contents of common drawings required under the Contract.
 - b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Designer, are required.
 - c. Drawing Scales:
 - 1) Floor plans shall be drawn to scale.
 - 2) Section drawings shall be drawn to scale.
 - 3) Elevation drawings shall be drawn to scale.
 - 4) Details of physical items shall be drawn to scale.
 - 5) System drawings and schematic drawings shall be drawn 1:1 (no scale).
 - d. Sizes:
 - 1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Designer.
2. Floor Plans:
 - a. Location of major system components.
 - b. Location of equipment that is Work of another Section to which Work interconnects.
3. Reflected Ceiling Plans:
 - a. Location of ceiling devices, coordinated with devices that are Work of others, and existing devices (where applicable).
4. System Diagrams:
 - a. Hybrid schematic / block wiring diagram.
 - b. System products depicted.
 - c. Product inputs, outputs and other ports depicted.
 - d. Product brand, model, description, options, and accessories declared.
 - e. Equipment ID assignment for each product.
 - f. Interconnections depicted between system products.
 - g. Interconnections depicted between system products and related system products.
5. Custom Assemblies and Products:
 - a. Manufacturer.
 - b. Materials.
 - c. Finish and color(s).
 - d. Parts list.
 - e. Nomenclature sizes, colors.
 - f. Dimensions.
 - g. Schematic diagram(s), where applicable.
6. Mounting Details:
 - a. Depicting the materials and means of securing installed products.
 - b. Finishes and colors of exposed parts.

E. Training Submittals:

1. Proposed schedule.
2. Training agendas for each session.
3. Identification of personnel that will conduct training.
4. Handouts proposed for distribution during training.

- F. Field Observation Reports Submittals:
1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:
 - a. The response shall include a copy of the original Field Observation Report.
 - b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.
- G. Closeout Submittals:
1. As-Built Drawings:
 - a. General:
 - 1) Requirements for Shop Drawings apply to "As-Built" drawings.
 - b. Required Drawings:
 - 1) Title Sheet.
 - 2) Floor Plans.
 - 3) System Diagrams.
 - 4) Mounting Details.
 - 5) Labeling Schema.
 - 6) As-built version of each Project shop drawing.
 - c. Drawing Formats:
 - 1) Electronic Editable: Editable version using the native application used to create the file (e.g., Revit, AutoCAD, Star-Draw, Visio, VidCAD).
 - 2) Non-Editable: PDF file format.
 - 3) Printed Hardcopy.
 - 4) Sheets shall be the same size and feature consistent title block information in the lower-right corner.
 - d. Drawing Organization:
 - 1) Hardcopy drawings shall be bound together into logical sets, bound along the left edge of the sheets.
 - 2) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.
 2. Operation and Maintenance Manuals:
 - a. Manual Format:
 - 1) Hard-cover 3-ring type binder.
 - 2) Front clear plastic cover pocket complete with Project and system Information insert.
 - 3) Clear plastic spine pocket with Project and system Information insert.
 - 4) Binder sized to suit the contents only, neither oversized nor undersized.
 - 5) Maximum binder thickness: 3 inches.
 - b. Manual Contents and Organization:
 - 1) General:
 - a) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
 - b) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).
 - c) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
 - d) Insert labeled tabs within binder to identify separate contents of the manual.
 - e) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.
 - 2) Project Information Cover:
 - a) Title of Project.
 - b) Name and address of Owner, Designer, Architect, Contractor of Record and Subcontractor.
 - c) System name and specification references.

- 3) Index:
 - a) Contents of the manual.
- 4) Warranty Statement:
 - a) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
 - b) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 2 year parts and labor).
 - c) A separate warranty statement shall be supplied for each system.
 - d) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
 - e) Supply standard out-of-warranty service rates and service contact information.
- 5) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):
 - a) Manufacturer datasheets for each product supplied.
- 6) Manufacturer Owner / User Manuals:
 - a) Manufacturer's Owner's or User's manual for each product.
 - b) Manufacturer's Installation instructions and other documentation supplied with the product.
- 7) Test Reports and Checklists:
 - a) Test reports, checklists, and other forms generated and completed during the course of the Project.
- 8) Training Information:
 - a) Photocopy of training outlines / agendas.
 - b) Photocopy of training session handouts.
 - c) Photocopy of training sign-in sheets.
 - d) Photocopy of signed delivery receipt for each training session recording (applicable to those Sections/systems requiring recording).
- 9) As-Built Drawings:
 - a) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.
 - b) The electronic manual shall contain electronic PDF version of the as-built drawings.
- 10) Software (electronic manual only):
 - a) Editable configuration files for system equipment.
 - b) Software source code use in supplied products.
 - c) Compiled versions of configuration files and source code.
 - d) Software required for reviewing and editing supplied files.

3.6 QUANTITY

A. General:

1. The quantity of submittals required shall be the greater of the following:
 - a. Quantity identified within Division 01.
 - b. Quantity identified within the individual Section.
 - c. Quantity identified herein.

2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
3. The Designer shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

B. Product Data Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

C. Shop Drawings Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

D. Training Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

E. Field Observation Reports Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

F. Pre-Acceptance Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

G. Closeout Submittals:

1. Two (2) Hardcopies.
2. One (2) Electronic.

3.7 REJECTION

A. The following items are representative reasons that submittals may need to be revised and resubmitted:

1. Binding submittals for multiple Sections together.
2. Failing to supply separate transmittal for submittals for each Section.
3. Failing to include a submittal title sheet.
4. Failing to use and accurately complete the published title sheet.
5. Failing to supply and accurately complete the submittal checklists.
6. Failing to supply product data and shop drawings at the same time.
7. Failing to supply product data sheets.
8. Failing to supply product data sheets with the correct product and required accessories enumerated.
9. Failing to supply shop drawings.
10. Failing to supply shop drawings with required information.
11. Failing to supply accurate information.
12. Failing to supply relevant information required by the Specifications.
13. Failing to supply products that are in compliance with the Specifications.
14. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

A. Revise and Resubmit:

1. When a submittal is rejected and flagged as "Revise and Resubmit," the entire submittal shall be reviewed, revised and resubmitted in totality.
 2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.
- B. Exceptions Noted:
1. When a submittal is flagged as "Exceptions Noted," the specific actions identified shall be taken.
 2. If the reviewer's comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.
- C. Resubmittals shall:
1. Include a copy of the reviewer's previous comments.
 2. Include a written description of the action(s) taken.
 3. Be labeled chronologically.
 4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

- A. Electronic submittals shall only be permissible where electronic submittals are expressly required and where express approval for such has been granted.
- B. Electronic submittal files shall be compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard, version 1.5.
- C. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.
- D. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.
- E. Single File Submission:
1. Option 1 – Single File, PDF Format:
 - a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
 - b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
 - c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.
 - d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model (e.g., Carrier – 48TJ008 – Gas-Fired Rooftop Unit). Entries shall be organized in a sorted manner, first by make, then by model.

- e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
 - f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., 233113-PD-01.pdf).
 - 1) Where the Designer directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:
 - a) 233113-PD-01 (1 of 3).pdf
 - b) 233113-PD-01 (2 of 3).pdf
 - c) 233113-PD-01 (3 of 3).pdf
2. Option 2 – Single File, Zip Format:
- a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible “.zip” file.
 - b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 02-Datasheets, 03-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.
 - c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing, separate file for each shop drawing).
 - d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
 - e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial (e.g., Carrier – 48TJ008 – Gas-Fired Rooftop Unit).
 - f. Consult the Designer for supplement instructions should the WinZip file exceed 50 Megabytes in size.
 - g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., 233113-PD-01.zip).
 - 1) Where the Designer directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:
 - a) 233113-PD-01 (1 of 3).zip
 - b) 233113-PD-01 (2 of 3).zip
 - c) 233113-PD-01 (3 of 3).zip

END OF SECTION 23 05 03.00

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
233113-PD-00

SECTION TITLE:
Metal Ducts

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: <u>xxxxxxxxxx@xxxx.xx</u>
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PRODUCT DATA SUBMITTAL

CHECKLIST
(Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet.		
Project Name.		
Spec Section number.		
Submittal iteration number. (0 for first iteration, 1 + for each subsequent iteration (e.g. 231513-0,231513-1))		
Contractor of Record identified.		
Sub-contractor / vendor / supplier name identified.		
Title Sheet appearance consistent with sample title sheet.		
Checklists included.		
This checklist.		
Checklists from Section being.		
Previous submittal review, with contractor actions and comments.		
Product Datasheets included.		
Datasheets are manufacturer originals.		
Datasheets for each product included.		
Section paragraph and/or drawing reference on each datasheet.		
Product accessories and options identified.		
Products organized by paragraph (or alphabetically by brand).		
No photocopies, faxes and other illegible datasheets included.		
Shop Drawings included.		
Shop drawings accompany this product data submittal.		
This submittal contains product data for one section only.		

This checklist serves as simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to the 23 05 03.00 "Submittals for HVAC" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and supplied along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 23 05 05.00 – EXISTING CONDITIONS AND DEMOLITION

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 DESCRIPTION OF WORK

- A. Prior to submitting a bid, the Mechanical Contractor shall perform a detailed walk-through field inspection, to review the existing structures and premises, to determine all existing conditions, equipment/ductwork/piping locations, etc. and shall make all necessary allowances for all required mechanically related demolition and relocation work. This pre-bid inspection by the Mechanical Contractor shall include inspection of all applicable accessible ceiling cavity, areas, etc.
- B. Should the Mechanical Contractor take any exceptions to providing any related demolition or relocation work, such exceptions shall be stated in detail within the Prime Contractor's bid. No subsequent allowance to the contract cost shall be made for any insufficient allowances made by the Mechanical Contractor during bidding which may result from the Mechanical Contractor's failure to visit job site and review drawings.
- C. The Mechanical Contractor shall confirm the working operation and condition of existing systems to remain. The Mechanical Contractor shall note any malfunctioning systems, system deficiencies or any other noteworthy system items prior to commencement of work. The Mechanical Contractor shall provide a written systems condition assessment report to the owner prior to commencement of work. The owner shall sign the assessment report acknowledging the condition of the existing systems. The Mechanical Contractor shall protect these existing systems and shall be responsible for these systems during demolition and construction. The Mechanical Contractor shall be responsible for turning these existing systems back over to the owner in the same operating condition as the contractor received it. The mechanical contractor shall be responsible for repairing or replacing any malfunctioning systems, components or deficient systems to the satisfaction of the owner that have not been noted on the written systems condition assessment report. The mechanical contractor shall be responsible for all existing system components and operation in the absence of an owner-signed systems condition assessment report.
- D. Demolition related work may not be specifically indicated on drawings, but shall be included under base bid. All mechanically related demolition, relocation, etc. work, including work described herein, shall be under base bid.
- E. It is not the intent of these contract documents that existing conditions be accurately shown. Existing mechanical work is shown to a limited extent on drawings and is shown for general planning reference only. Such locations, etc. have been located from portions of contract documents which were prepared for previously installed work (not from "as-builts"). These locations are not guaranteed. The successful Mechanical Contractor shall have access to all available existing building/system plans and specifications.

- F. The existing ductwork systems may be utilized only to the extent indicated herein or on drawings and/or as directed by Owner's representative in field.
- G. Routing of all new ductwork in existing buildings shall be approved by Owner's representative prior to installation.
- H. Provide new volume dampers in all existing branch ductwork.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EFFECT ON ADJACENT OCCUPIED AREAS

- A. Locate, identify, and protect existing mechanical services passing through demolition areas and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services (including proper filtration) for affected areas.
- B. It is recognized that there may be some ductwork and/or piping systems rendered inactive by demolition, causing disconnection of "downstream" terminals, equipment, etc. which serve occupied areas. It shall be the responsibility of the Mechanical Contractor to investigate these types of conditions (for all systems) prior to demolition. Provide all necessary corrective mechanical work prior to demolition to ensure that such "downstream" work remain permanently active throughout demolition, new construction and after project completion.
- C. All work and system shutdowns shall be carefully coordinated in advance with owner's representative and all affected trades so that normal building activities and other construction trades are minimally affected. All required mechanical related demolition and/or new construction work, which will affect any and all occupied areas (including those which are located outside the immediate area of project work) shall be performed at special times if/as directed by Owner's representative in field.
- D. All existing systems and components shall remain fully operational in all occupied spaces during all occupied periods.
- E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and/or other system components. During cutting and patching operations, protect adjacent installations. Remove protection and barriers after demolition operations are complete.

3.2 WORK IN EXISTING SPACES

- A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.
- B. Existing Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications by the General Contractor, it shall be the

responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor. Match existing finishes.

- C. New Ceilings: Where existing air outlets are to remain, and the architectural drawings indicate replacement of the ceilings, this contractor shall temporarily remove air outlets, clean and store temporarily. This contractor shall support existing run outs to structure to facilitate replacement of ceiling. This contractor shall re-install existing air outlets at previous locations and extend run outs to air outlets after new ceiling is installed. Refer to architectural drawings for all required ceiling replacements. Coordinate with all trades prior to re-installation.
- D. Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.
- E. HVAC Units: Replace all air filters in all HVAC equipment serving renovated space prior to turning space over to owner.
- F. If asbestos, PCB's, or other hazardous materials are encountered in the course of the work, stop work in the vicinity of such materials and report their presence to the Owner. Owner will arrange for proper removal and disposal of hazardous materials.

3.3 GENERAL DEMOLITION

- A. Provide complete mechanical demolition as required for all systems throughout all project areas not indicated to be salvaged or saved. Unless specifically noted otherwise on plans or determined otherwise during this contractor's pre-demolition survey, all abandoned existing mechanical work in the project areas shall be disconnected and removed in its entirety by the Mechanical Contractor. All related work shall comply with the notes specified herein.
- B. Provide demolition work as required to clear and remove all existing mechanical work to be abandoned and as required to accommodate all new work of all trades. In general, remove existing related ductwork, piping, control media, etc. back to nearest concealed accessible terminal or take-off "upstream". Extend ductwork, piping, etc. as required to accommodate new or relocated mechanical work.
- C. Remove abandoned, inactive and obsolete equipment, ductwork, piping, etc. Abandoned work embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove all abandoned materials above accessible ceilings.
- D. Perform cutting and patching required for demolition in accordance with the contract documents.
- E. All abandoned ductwork shall be removed and capped back to respective sources, even if sources are outside of the confines of the project area. Coordinate all work carefully with Owner prior to beginning any mechanical demolition work.
- F. All ductwork, piping, etc. conflicting with construction related work of any and all trades shall be removed and/or relocated by the Mechanical Contractor as necessary and/or as directed by Owner's representative in the field. Mechanical disconnections (and/or reconnections) for equipment to be removed (and/or relocated) shall be by the Mechanical Contractor. This shall apply to all existing mechanical work whether shown on drawings or not.
- G. All refrigerant evacuations and reclaim shall be required for demolished or relocated equipment.

- H. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- I. Provide new work as required to accommodate relocations, etc. Routing of all new ductwork in existing buildings shall be held tight to structure above wherever possible and shall be approved by owner's representative prior to installation.

3.4 DISPOSITION OF REMOVED EQUIPMENT & MATERIALS

- A. Except where specifically noted otherwise herein or on drawings, all mechanical work shown on new work plans shall be new.
- B. If required to accommodate construction related activities, remove and reinstall any conflicting fixtures, devices or equipment that are to remain.
- C. All abandoned materials removed during demolition and thereafter shall be referred to the Owner's representative for disposal instructions. All materials which the Owner elects to retain shall be neatly stored at the site by the Mechanical Contractor as designated by the Owner's representative. All materials which the Owner elects not to retain shall be disposed of by the Mechanical Contractor in a lawful manner.
- D. All fixtures, devices or equipment designated for salvage (removal and reuse, or for turning over to Owner) shall be disconnected and removed undamaged. Disconnect all pigtails, etc. from equipment terminal points and carefully transport and neatly store same to a protected on-site storage location as directed in field.
- E. Components to be reused shall be cleaned (inside and out) and reinstalled where indicated on drawings. Modify and/or extend related existing ductwork and/or piping as required.
- F. Components turned over to Owner shall be neatly stored as groups by system type.

3.5 PRE-EXISTING CODE VIOLATIONS

- A. All existing work which is accessed and/or used under this project shall be inspected and brought into compliance with current codes and standards by the Mechanical Contractor. This shall apply only to the extent that such work is uncovered in the immediate project areas affected by demolition and/or new construction and only to the limited extent that it applies to pre-existing general installation methods (i.e. a missing hanger/support, a missing seal and other minor incidental work).
- B. If more extensive code or safety violations are discovered by the Mechanical Contractor, they shall be immediately brought to the attention (detailed in writing) of the Owner's representative along with the contractors proposed cost for corrections.

3.6 INTERIM LIFE SAFETY WORK

- A. Provide interim fire protection (sprinkler) work in all demolition and construction areas for full code coverage. Further definition will be provided in field if required.

3.7 INTERIM INDOOR AIR QUALITY (IAQ) WORK

- A. All requirements of this IAQ subsection shall be implemented prior to commencement of any demolition/construction activities.
- B. No airborne dust or particulate matter shall be permitted to enter any occupied spaces or any air intakes to existing systems.
- C. Become familiar with all affected HVAC systems to ensure that positive pressure can be maintained, relative to construction areas, in all areas adjacent to construction areas. This shall include all possible operational sequences of all systems such, including operation of smoke control, fire dampers, etc.
- D. All return air and exhaust air terminals within all demolition/construction spaces shall be covered and properly sealed until construction is complete.
- E. All air filters shall be checked at the beginning and end of each work shift and shall be changed in-kind as required to permit free airflow at all times.
- F. Provide temporary exhaust throughout all demolition/construction spaces to ensure proper negative pressure is maintained relative to adjacent areas, including allowances for normal construction traffic through all access doors. Ensure that no windows or doors are left open which could upset the desired negative pressure.
- G. Designate a dedicated qualified person to be on site to monitor all IAQ requirements, including checking filters three to four times per shift, checking for any breeches (by any contractor) such as drilled/cut openings in walls/floors, open windows, etc. Ensure that openings through walls and floors (by any contractor) are made immediately prior to installation of work and properly/permanently sealed immediately thereafter.

END OF SECTION 23 05 05.00

SECTION 23 05 29.00 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fastener systems
 - 2. Equipment supports
- B. Related Sections:
 - 1. Section 055000.00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 230503.00 "Submittals for HVAC".
 - 3. Section 233113.00 "Metal Ducts"

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified structural professional engineer, using performance requirements and design criteria indicated.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
 - 1. Powder-actuated fastener systems.

PART 2 - PRODUCTS

2.1 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc.
 - b. ITW Ramset/Red Head
 - c. MKT Fastening, LLC
 - d. Powers Fasteners.

- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hilti, Inc
 - b. ITW Ramset/Red Head
 - c. MKT Fastening, LLC
 - d. Powers Fasteners

2.2 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. General: Install hangers, supports, clamps and attachments to support ductwork properly from building structure.
- B. Do not suspend hangers from roof decks. Suspend from roof trusses, joists and joist girders only at panel points and at top chords unless otherwise indicated.
- C. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Clamps:
 - a. C-Clamps (MSS Type 23): For structural shapes.
 - b. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
- D. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, expansion joints, strainers and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports. Install and align fabricated anchors in indicated locations.

3.4 ADJUSTING

- A. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29.00

SECTION 23 05 53.00 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Warning signs and labels.
 - 2. Equipment labels.
 - 3. Duct labels.
- B. Related Sections:
 - 1. Section 23 05 03.00 "Submittals for HVAC".

1.3 QUALITY ASSURANCE

- A. Comply with ASTM E84

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. General: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
 - 1. Brady (W.H.) Co., Signmark Div.
 - 2. Brimar
 - 3. Seton Name Plate Corp.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: Approximately 4 by 7 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.
- C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless-steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets or self-tapping screws.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

3.3 EQUIPMENT LABEL INSTALLATION

- A. The contractor shall provide labeling for each piece of equipment above the ceiling. Labeling shall be on ceiling grid (not ceiling tile) below the equipment. The label shall match the equipment identification shown on the drawings sheet.
- B. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device.
- C. Install or permanently fasten labels on each major item of mechanical equipment.
- D. Locate equipment labels where accessible and visible.

3.4 DUCT LABEL INSTALLATION

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with tags and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).
- B. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Red: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- C. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs. Identification shall be applied only to new work.

END OF SECTION 23 05 53.00

SECTION 23 05 93.00 – TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.
- B. Test, adjust, and balance the following mechanical systems:
 - 1. Supply, return, and outside air systems for all pressure classes.
 - 2. Additional Tests
- C. Related Sections:
 - 1. Section 23 05 03 "Submittals for HVAC".

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council
- B. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- F. NC: Noise criteria.
- G. NEBB: National Environmental Balancing Bureau
- H. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- I. RC: Room criteria.

- J. Report Forms: Test data sheets for recording test data in logical order.
- K. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- L. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- M. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- N. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- O. TAB: Testing, adjusting, and balancing.
- P. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- Q. Test: A procedure to determine quantitative performance of systems or equipment.
- R. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 ACTION SUBMITTALS

- A. Agency Data
 - 1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.
- B. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1.
- C. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:
 - 1. Final Report: Upon verification and approval prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
 - 2. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:
 - a. General Information and Summary
 - b. Air Systems

- D. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- E. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.
- F. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- G. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- H. Sample Report Forms: Submit two sets of sample TAB report forms.

1.5 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. AABC: "National Standards for Total System Balance".
 - 2. ASHRAE: ASHRAE Handbook, Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.
- B. Agency Qualifications
 - 1. The HVAC Contractor shall procure the services of an independent Balance and Testing Agency, approved by the Engineer, and a member of Associated Air Balance Council (AABC) or NEBB, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems, to balance, adjust and test all air and water systems and equipment as herein specified.
 - 2. All work by this agency shall be done under direct supervision of a qualified heating and ventilating Engineer employed by this agency.
 - 3. All instruments used by this agency shall be accurately calibrated and maintained in good working order.
- C. The Balance and Testing Agency must provide the technicians with the following instruments for field use:
 - 1. One set of pressure gages and fittings.
 - 2. Dry bulb thermometer.
 - 3. Wet bulb thermometer.
 - 4. Thermocouple unit and thermocouples.
 - 5. Set of balancing cock adjustment wrenches.
 - 6. Portable field flowmeter.
- D. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.
- E. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.

- d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
2. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
- a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- F. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing." TAB firm's forms approved by Architect.
- G. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems NEBB's " Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, " Section II, " Required Instrumentation for NEBB Certification."
- H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
- 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- 1.6 SEQUENCING AND SCHEDULING
- A. Systems shall be fully operational prior to beginning procedures.
 - B. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg F wet bulb temperature of maximum summer design condition, and within 10 deg F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.
- 1.7 PROJECT CONDITIONS
- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- 1.8 COORDINATION
- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
 - B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
 - C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

1.9 GUARANTEE

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.
- B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - 2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper testing and balancing of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.
- C. Examine the reviewed submittals for HVAC systems and equipment.
- D. Examine system and equipment installations and verify that field quality control testing, cleaning and adjusting specified in individual system and equipment Sections.
- E. Examine HVAC equipment and verify that bearings are greased and equipment with functioning controls are ready for operation.
- F. Examine terminal units, such as variable air volume boxes, and verify that they are accessible and their controls are connected and functioning.
- G. Examine operating safety interlocks and controls on HVAC equipment.
- H. Report deficiencies discovered before and during performance of the testing and balancing procedures. Observe and record system reactions to changes in conditions. Record default setpoints if different from indicated values.

3.2 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

- A. Examine ceiling plenums and underfloor air plenums used for supply, return or relief air to verify that they are properly separated from adjacent areas and are sealed air tight. Verify that all penetrations in plenum walls are sealed and fire-stopped as required.

- B. Examine equipment performance data including fan curves.
- C. Check filters for cleanliness.
- D. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
- E. Place outlet dampers in the full open position.
- F. Lubricate all motors and bearings
- G. Check fan rotation
- H. Air balance and testing shall not begin until the system has been completed and is in full working order. The Contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day of testing and balancing. The contractor shall submit within 30 days after receipt of contract, 8 copies of submittal data for the testing and balancing of the air conditioning, heating, and ventilating systems. The Air Balance and Testing Agency shall provide proof of having successfully completed at least five projects of similar size and scope.

3.3 PREPARATION

- A. Prepare a testing and balancing plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Prepare system-readiness checklists, as described in the "AABC National Standards for Total System Balance," for use by systems installers in verifying system readiness for T&B. These shall include, at a minimum, the following:
 - 1. Airside:
 - a. Ductwork is complete with terminals installed.
 - b. Volume, smoke and fire dampers are open and functional.
 - c. Clean filters are installed.
 - d. Fans are operating, free of vibration, and rotating in correct direction.
 - e. Variable-frequency controllers' start-up is complete and safeties are verified.
 - f. Automatic temperature-control systems are operational.
 - g. Ceilings are installed.
 - h. Windows and doors are installed.
 - i. Suitable access to balancing devices and equipment is provided.

3.4 MEASUREMENTS

- A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

3.5 PERFORMING TESTING, ADJUSTING, AND BALANCING

- A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.
- B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
 - 1. Patch insulation, ductwork, and housings, using materials identical to those removed.
 - 2. Seal ducts after testing. Then test for leaks and repair if found.
 - 3. Seal insulation to re-establish integrity of the vapor barrier.
- C. Mark equipment settings, including damper control positions, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.
- D. Retest, adjust, and balance systems subsequent to significant system modifications, and re-submit test results.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain approved submittals and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare single-line schematic diagram of systems for the purpose of identifying HVAC components.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check condensate drains for proper connections and functioning.
- H. Check for proper sealing of air-handling-unit components.

3.7 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Adjust the variable-air-volume systems as follows:
 - 1. Verify that the system static pressure sensor is located 2/3 of the distance down the duct from the fan discharge and in other locations as specified.
 - 2. Verify that the system is under static pressure control.
 - 3. Select the terminal unit that is most critical to the supply-fan airflow. Measure inlet static pressure, and adjust system static pressure control setpoint so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 4. Calibrate and balance each terminal unit for maximum and minimum design airflow as follows

- a. Adjust controls so that terminal is calling for maximum airflow (note some controllers require starting with minimum airflow. Verify calibration procedure for specific project).
 - b. Measure airflow and adjust calibration factor as required for design maximum airflow. Record calibration factor.
 - c. When maximum airflow is correct, balance the air outlets downstream from terminal units.
 - d. Adjust controls so that terminal is calling for minimum airflow.
 - e. Measure airflow and adjust calibration factor as required for design minimum airflow. Record calibration factor. If no minimum calibration is available, note any deviation from design airflow.
 - f. When in full cooling or full heating, ensure that there is no mixing of hot deck and cold deck airstreams unless so designed.
 - g. On constant volume terminals, in critical areas where room pressure is to be maintained, verify that the airflow remains constant over the full range of full cooling to full heating. Note any deviation from design airflow or room pressure.
5. After all terminals have been calibrated and balanced, test and adjust system for total airflow. Adjust fans to deliver total design airflows within the maximum allowable fan speed listed by fan manufacturer.
- a. Set outside air, return air and relief air dampers for proper position that simulates minimum outdoor air conditions.
 - b. Set terminals for maximum airflow. If system design includes diversity, adjust terminals for maximum and minimum airflow so that connected total matches fan selection and simulates actual load in the building.
 - c. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.
 - d. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.
 - e. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.
6. Measure fan static pressures as follows:
- a. Measure static pressure directly at the fan outlet or through the flexible connection.
 - b. Measure static pressure directly at the fan inlet or through the flexible connection.
 - c. Measure static pressure across each component that makes up the air-handling system.
 - d. Report any artificial loading of filters at the time static pressures are measured.
7. Set final return and outside airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- a. Balance the return-air ducts and inlets the same as described for constant-volume air systems.
 - b. Verify all terminal units are meeting design airflow under system maximum flow.
8. Re-measure the inlet static pressure at the most critical terminal unit and adjust the system static pressure setpoint to the most energy-efficient setpoint to maintain the optimum system static pressure. Record setpoint and give to controls contractor.
9. Verify final system conditions as follows:
- a. Re-measure and confirm minimum outdoor air, return and relief airflows are within design. Readjust to design if necessary.

- b. Re-measure and confirm total airflow is within design.
- c. Re-measure all final fan operating data, rpms, volts, amps, static profile.
- d. Mark all final settings.
- e. Test system in economizer mode. Verify proper operation and adjust, if necessary. Measure and record all operating data.

3.8 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record the operating speed, airflow, and static pressure of each fan.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check the condition of coils.
 5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
 1. New filters are installed.
 2. Coils are clean and fins combed.
 3. Drain pans are clean.
 4. Fans are clean.
 5. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed.
 2. Verify that the indicated airflows of the renovated work result in fan speeds that are within the acceptable limits defined by equipment manufacturer.
 3. Adjust fan speeds within the limits of the installed drives to achieve design airflow.
 4. Balance system to design airflows indicated.
- D. Renovations – Air Side:
 1. In areas where existing air handling equipment or exhaust fans are being utilized, balancing contractor shall include the cost to pre-check each fan airflow (supply, return, exhaust) and any branch ductwork serving existing areas, prior to demolition and provide a report outlining existing air flows prior to any work. Any discrepancies of required air flows compared to design air flows shall be brought to the attention of the engineer prior to any work.
 2. At the completion of construction, balancing contractor shall re-check and adjust each air handler or exhaust fan air flows. (supply, return, exhaust) to meet the required air flows. Change out sheaves, increase static pressure set-points, change motors and ramp up fans as required to obtain design air flows. Clean existing coils, change filters as required to obtain design air flows.
 3. Adjust existing ductwork dampers serving existing spaces and balance to pre-checked air flows. Air flows serving existing spaces shall be similar after project is complete.

3.9 FINAL TEST AND BALANCE REPORT

- A. The report shall be a complete record of the HVAC system performance, including conditions of operation, items outstanding, and any deviations found during the T&B process. The final report also provides a reference of actual operating conditions for the owner and/or operations personnel. All measurements and test results that appear in the reports must be made on site and dated by the AABC technicians or test and balance engineers.
- B. The report must be organized by systems and shall include the following information as a minimum:
 - 1. Title Page:
 - a. AABC certified company name
 - b. Company address
 - c. Company telephone number
 - d. Project identification number
 - e. Location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Project number
 - j. Date of report
 - k. AABC Certification Statement
 - l. Name, signature, and certification number of AABC TBE
 - 2. Table of Contents.
 - 3. AABC National Performance Guaranty.
 - 4. Report Summary:
 - a. The summary shall include a list of items that do not meet design tolerances, with information that may be considered in resolving deficiencies.
 - 5. Instrument List:
 - a. Type.
 - b. Manufacturer.
 - c. Model.
 - d. Serial Number.
 - e. Calibration Date.
 - 6. T&B Data:
 - a. Provide test data for specific systems and equipment as required by the most recent edition of the "AABC National Standards."
- C. One copy of the final test and balance report shall be sent to the engineer of record. Provide five additional copies to the contractor.

3.10 VERIFICATION OF T&B REPORT

- A. Final Verification:

1. After testing and balancing is complete and accurately documented in the final report, request that a final verification be made by the engineer of record
2. The engineer of record shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
3. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
4. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final verification, the testing and balancing shall be considered incomplete.

3.11 REVERIFICATION

- A. T&B Agency shall recheck all measurements and make adjustments as required to complete the balancing. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second verification.
- B. If the second verification also fails, the engineer of record may contact AABC Headquarters regarding the AABC National Performance Guaranty.

3.12 ADDITIONAL TESTS

- A. Seasonal Periods: If initial T&B procedures were not performed during near-peak conditions, the engineer of record may request a temperature recheck to further verify performance at near-peak conditions.
- B. Sound Testing
 1. After the systems are balanced and the spaces are architecturally complete, read and record sound levels at 10 locations as designated by the engineer of record.
 2. Instrumentation:
 - a. The sound-testing meter shall be a portable, general-purpose testing meter consisting of a microphone, processing unit, and readout.
 - b. The sound-testing meter shall be capable of showing fluctuations at minimum and maximum levels, and measuring the equivalent continuous sound pressure level (LEQ).
 - c. The sound-testing meter must be capable of using 1/3 octave band filters to measure mid-frequencies from 31.5 HZ to 8000 HZ.
 - d. The accuracy of the sound-testing meter shall be ± 1 decibel.
 3. Test Procedures
 - a. Perform test at the quietest background noise period. Note any cause of unpreventable sound that may affect the test outcome.
 - b. Equipment should be operating at design values.
 - c. Calibrate the sound-testing meter prior to taking measurements.
 - d. Use a microphone suitable for the type of noise levels measured that is compatible with the meter. Provide a windshield for outside or in-duct measurements.

- e. Record a set of background measurements in dB(A), and sound pressure levels in the eight un-weighted octave bands 63 HZ to 8000 HZ (NC) with the equipment off.
 - f. Take sound readings in dB(A), and sound pressure levels in the eight un-weighted octave bands 63 HZ to 8000 HZ (NC) with the equipment on.
 - g. Take readings no closer than 3' from a wall or from the operating equipment, and approximately 5' from the floor, with the meter held or mounted on a tripod.
 - h. For outdoor measurements, move the sound-testing meter slowly and scan the area that has the greatest exposure to the noise source being tested. (This type of reading is generally performed using the A-Weighted scale).
4. Reporting
- a. The report must record: the location, the system tested, the dB(A) reading, and the sound pressure level in each octave band with equipment on and off.
 - b. Plot all the sound pressure levels on the NC work sheet, with the equipment on and off.
- C. Duct Leakage Testing:
1. Witness the duct pressure testing performed by the mechanical/installing contractor.
 2. Verify that proper test methods are used and that leakage rates are within specified tolerances.
 3. Report any deficiencies observed.
- D. Controls Verification
1. In conjunction with system balancing perform the following:
 - a. Work with the temperature control contractor to ensure the system is operating within the design limitations, and gain a mutual understanding of intended control performance.
 - b. Confirm that the sequences of operation are in compliance with the approved drawings.
 - c. Verify that controllers are calibrated and function as intended.
 - d. Verify that controller setpoints are as specified.
 - e. Verify the operation of lockout or interlock systems.
 - f. Verify the operation of all valve and damper actuators.
 - g. Verify that all controlled devices are properly installed and connected to the correct controller.
 - h. Verify that all controlled devices travel freely and are in the position indicated by the controller: open, closed, or modulating.
 - i. Verify the location and installation of all sensors to ensure they will sense only the intended temperatures, humidities, or pressures.
 2. Reporting
 - a. The report shall include a summary of verifications performed, remaining deficiencies, and any variations from specified conditions.

END OF SECTION 23 05 93.00

SECTION 23 07 13.00 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes insulating the following duct services:
 1. HVAC Ductwork.
 2. Section 23 05 03 "Submittals for HVAC".
 3. Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment".
 4. Section 23 31 13 "Metal Ducts".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).
- B. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, and accessories.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
 2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 3. Detail application at linkages of control devices.
- D. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, installed R-values and accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ANSI/ASTM E 84 and NFPA 255, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
 - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- C. Installed R-Values for insulation on ducts shall comply with local mechanical and energy code as required for indoor applications.
- D. Insulation tape shall comply with UL 181.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

- A. Schedule insulation application after pressure testing duct systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION MATERIALS

- A. Manufacturers
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CertainTeed Corp.; SoftTouch Duct Wrap.
 - b. Johns Manville; Microlite.
 - c. Knauf Insulation; Friendly Feel Duct Wrap.
 - d. Owens Corning; SOFTR All-Service Duct Wrap.
 - e. ThermaDuct, LLC

- B. Interior (indoor) ductwork insulation shall have a minimum installed thermal resistance value of R6 or code minimum, whichever higher.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, without facing and with vapor barrier Type II with factory-applied kraft paper, reinforcing scrim, aluminum foil and vinyl jackets.
- E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. For duct and plenum applications, provide insulation without facing and with vapor barrier with factory-applied kraft paper, reinforcing scrim, aluminum foil and vinyl jacket.
- F. Vapor Barrier Material for Ductwork: Paper-backed aluminum-foil, except as otherwise indicated; strength and permeability rating equivalent to factory-applied vapor barriers on adjoining ductwork insulation, where available; with following additional construction characteristics:
 - 1. High Puncture Resistance: Low vapor transmission (for ducts in exposed, high traffic areas susceptible to damage: Mech. Rooms, etc.)
 - 2. Moderate Puncture Resistance: Medium vapor transmission (for ducts in concealed areas).
- G. Ductwork Insulation Accessories: Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- H. Ductwork Insulation Compounds: Cements, mastics, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 - 1. Verify that systems to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

- B. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- C. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- D. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated
- E. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces.
- F. Provide insulation on collar and backside of supply diffusers in all ceiling spaces. Provide insulation on plenum box of all supply grilles and registers in all ceiling spaces.
- G. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.
- H. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- I. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- J. Install multiple layers of insulation with longitudinal and end seams staggered.
- K. Keep insulation materials dry during application and finishing.
- L. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- M. Install insulation with least number of joints practical.
- N. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
- O. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- P. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- Q. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- R. Do not overly compress insulation which will result in decreased thermal resistance properties. Install insulation as recommended by the insulation manufacturer.

- S. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 DUCT INSULATION SCHEDULE, GENERAL

- A. All ductwork shall be insulated except:
 - 1. Factory-insulated flexible ducts.
 - 2. Flexible connectors.
 - 3. Factory-insulated access panels and doors.
 - 4. Supply ductwork exposed in conditioned spaces excluding mechanical rooms, server rooms and electric equipment rooms.
- B. Grilles, Registers, and Diffusers:
 - 1. Provide insulation on collar and backside of supply diffusers in all ceiling spaces. Provide insulation on plenum box of all supply grilles & registers in all ceiling spaces.

3.5 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
- B. All insulation applications will be considered defective Work if sample inspection reveals non-compliance with requirements.

3.7 PROTECTION AND REPLACEMENT

- A. Repair damaged vapor barrier using vapor barrier tape to fully cover torn area.
- B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- C. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 23 07 13.00

SECTION 23 09 00.00 – BUILDING AUTOMATION SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes
 - 1. WEB Based Open Protocol Building Automation System (BAS)
- B. Related Requirements:
 - 1. Section 23 05 03 “Submittals for HVAC”.
 - 2. Section 23 09 93 – Sequence of Operations for HVAC Controls
- C. General Provisions
 - 1. The general provisions of the Contract, including the General Conditions and supplemental General Conditions, apply to the work specified in this section.
 - 2. This Contract is for all labor, materials and equipment required for the complete construction and installation of an Open Interoperable Web Based Building Automation System
 - 3. General Provisions and mechanical systems are specified in other Sections of Division 23.
 - 4. The systems shall be complete in all respects, tested and ready for operation.
 - 5. Temperature Controls Contractor (TCC), Building Automation System Contractor (BAS Contractor) or Facility Management System Contractor (FMS Contractor) shall be defined as the same. Additionally, BAS and FMS shall also be defined equally and used interchangeably.
- D. General Instructions
 - 1. The BAS, as specified herein, shall be provided in their entirety by the BAS Contractor. The BAS Contractor shall base his Bid on the systems as specified.
 - 2. The BAS Contractor shall submit a (Base) Bid which will include all central processing hardware and software, electronic and control equipment, sensors, valves, dampers and thermostats, as shown on plans and specified.
 - 3. In general, the proposal shall be based on a complete Building Automation and Control system, including controllers, valves damper actuators, relays, wiring and tubing and a full DDC system. The control contractor shall provide full commissioning of his equipment.
 - 4. The BAS Contractor shall be prepared to make a personal presentation of his systems to the Owner or his designated representatives prior to award of Contract should the Owner request it.
- E. Scope
 - 1. The Open Interoperable Web Based BAS shall be supplied and installed completely under the BAS Contract. Components shall be mounted and wired by the BAS Sub-Contractor.
 - 2. The BAS shall graphically display real time control points.

3. The engineering, installation, calibration, software programming, and checkout necessary for complete and fully operational BAS, as specified hereafter, shall be provided by the BAS Contractor.
4. BAS Sub-Contractor shall provide power wiring as required for wiring each individual control panel. Power wiring shall be located within the same room as the BAS equipment or within 20 feet of the connection. BAS sub-contractor shall install wiring according to Division 26.

F. System Description

1. Ethernet (IEEE 802.3), Peer-To-Peer CSMA/CD
2. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available on at least 24 client computers, simultaneous access from at least 4 computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein. The Local Area Network (LAN) shall be either a 10 or 100 Mbps Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNC's), user workstations and a local host computer system. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
3. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI/ASHRAE™ Standard 135-1995, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol are required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guidelines for such encapsulation and shall be based on industry standard protocols. The products used in constructing the BAS shall be LonMark™ compliant. In those instances in which LonMark™ devices are not available, the BAS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions. The software tools required to network manage both the LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995 BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP for BACnet and FTT-10A for LonTalk.
4. Temperature control system to be completely DDC with electronic sensors and electronic actuation of valves and dampers. The Open Interoperable Web Based BAS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable. A hierarchical

topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.

5. The systems shall include the Tridium/Niagara /Jace based products for access and communication with the remote Central Operator Work Station (COWS) via computer LAN, WAN or Internet.

G. Work by Others

1. The HVAC Sub-Contractor shall:
 - a. Furnish and install all necessary piping connections, taps and wells required for flow, pressure or temperature devices.
 - b. Provide dampers, if so indicated, under Equipment Specifications.
 - c. Assemble multiple section dampers with required interconnecting linkages, shafts and brackets and extend the required number of shafts through the ducts for externally-mounted damper motors. Jack shafts will be assembled with sealed roller or ball bearings of stainless steel construction.
 - d. Provide all cabling, raceways and devices required to connect the BAS server to the owner's Ethernet. HVAC contractor may elect to coordinate this with the electrical contractor or communications contractor. Owner shall provide IP address for BAS. In all cases, this contractor shall be responsible for providing and testing internet connections required for the BAS.
2. The Electrical Sub-Contractor shall install conduit and connect power wiring. Power wiring and conduit shall be defined as follows:
 - a. Wiring of power feeds through all disconnect starters and variable speed controllers to electric motors.
 - b. Wiring of 120 VAC emergency power feeds to junction boxes in locations of temperature control panels.
 - c. Power wiring to 120 Volt, single-phase motors shown on Electrical Plans and specified in the Electrical Sections.
 - d. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the BAS Contractor.
 - e. Conduit for routing temperature control wiring where shown on electrical plans.
 - f. Raceways where shown on electrical plans which shall be utilized for temperature control wiring.

H. Related Work

1. BAS contractor shall coordinate and remain on site with the balancing contractor to operate the facility management system during balancing. The BAS contractor shall manipulate the system as instructed by the balancing contractor. This shall include but not limited to changing damper positions, valve positions, fan speeds, pump speeds and set points as required to complete the balancing procedures.
2. The installation of motor starters that are not factory installed, thermal overload switches, and power wiring to motors, starters, thermal overload switches, contactors, and electric heating coils is specified in another Division. This Section includes installation of controls plus wiring for automatic controls, electric damper and valve operators, terminal control units, interlocks, starting circuits, and wiring to power consuming control devices.
3. Area smoke detectors are provided, installed and wired under another Division. Duct smoke detectors shall be installed under this Division, but furnished and wired into the fire alarm system under another Division. This Section includes wiring alarm signal relays, provided and installed under another Division, to the BAS.
4. BAS contractor shall utilize equipment manufacturer devices such as sensors for hardware inputs. It is unacceptable to provide additional sensors when the control and monitoring points available from equipment manufacturers can be utilized. BAS Contractor shall provide additional sensors and wiring as required that are not provided by the equipment manufacturer to control and monitor specified points.

1.3 SYSTEM LAYOUT AND PERFORMANCE

- A. The DDC system shall be engineered and equipment selected by the manufacturer as required to meet the performance specified herein.
- B. The location and quantity of DDC panels shall be as determined by the DDC system manufacturer except that in no circumstance shall more than 25% of the total number of sensor and control points be connected through a signal panel.
- C. Each DDC system component, including the central computer, data transmission system, and each panel shall provide for the future addition of at least 20% of the number of sensor and control points connected to that component.
- D. An alarm condition shall be reported to the appropriate operator device no more 10 seconds following the occurrence of that condition.
- E. Sensor and control values displayed to the operator in graphics displays shall be dynamically updated within 5 to 15 seconds of significant change of value. Values shall be prioritized.

1.4 SUBMITTALS

- A. All submittals for this section, including product samples, shall be reviewed and approved by owner.
- B. Specification Compliance Review (Submit with Submittals)
 - 1. Each BAS Contractor shall supply, at the time of submittals, a paragraph by paragraph specification compliance report to the Owner. The report shall indicate for each paragraph, how the Contractor meets the criteria of the paragraph.
 - 2. The following format must be utilized in completing the compliance report:
 - a. Comply - without exception.
 - b. Qualify - Meet the functional intent. For each paragraph, the Contractor shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.
- C. Diagrams:
 - 1. Provide separate diagrams for each system, including piping, motor starting and interlock wiring, push buttons, control wiring, interior electrical circuits of control instruments with terminal designations, control motors, colors of wires, locations of instruments and remote elements, and normal position of valves, dampers, relays, control and monitoring points list and sample graphics screen shots.
 - 2. A detailed description of the operation of the control system including device designations shall accompany the drawings. Schedule of dampers including size, leakage, and flow characteristics and a schedule of valves including close-off and flow characteristics shall also be furnished for the entire project.
- D. DDC system data:
 - 1. Provide manufacturer's data sheets on the DDC panels, sensors, control interface devices, terminal control units, protection devices, and software.
 - 2. Provide the actual physical proposed room thermostat/temperature sensor and guards, at the time of submittal review, to both the Engineer and Owner for approval.
 - 3. Complete field wiring diagram with terminals labeled as they will be marked on the equipment, including sensors, control and power wiring for each sensor, control and DDC panel.

4. Programmer's manual, flow charts of DDC control programs provided to perform control sequences specified herein.
5. Floor plans locating DDC panels and terminal control units coordinated with work of other trades. The BAS contractor shall provide the actual physical proposed room thermostat and guards, at the time of submittal review, to both the Engineer and Owner for approval.
6. Provide External Interface Files:
 - a. XIF files or object diagrams for each DDC system component (Building Controller, Custom Application Controller, and Application Specific Controller) proposed.
7. Provide ANSI/ASHRAE™ Standard 135-1995, BACnet PIC Statement. Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.

E. DDC central station data:

1. Manufacturer's data sheets on DDC central station equipment including computers, CRT's, printers, disk systems, protection and communications equipment, and software.
2. Complete field wiring diagrams for data communications with DDC panels and interconnection of central station equipment; proposed graphics displays if specified herein, and floor plans showing layout of central station equipment.

- F. All submittal information (drawings and cut sheets) shall be furnished in both paper and electronic format.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For building automation system to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Protocol to comply with ASHRAE 135.
- B. Refer to Section 23 09 93 and the drawings for all work to be included in the controls work.
- C. Bids by wholesalers and non-franchised contractors shall not be acceptable.
- D. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.
- E. All materials, equipment and apparatus shall be new and of first-class quality.
- F. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the Facility Management System manufacturer's field office. The local installing office shall have a minimum of ten years of installation experience with the manufacturer and shall provide documentation prior to the bid and with the submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the factory authorized field office.
- G. The Facility Management System Contractor shall have a full service facility within 50 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonWorks instructions and routine emergency

maintenance service on all system components. The service facility shall stock spare parts inventory and all necessary test and diagnostic equipment.

- H. The contractor must be able to respond to any warranty or service call within 8 hours.
- I. Electrical Components, Devices, and Accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- J. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."
- K. Comply with National Electric Code, UL-916 Energy Management Systems, LonMark™, ULC, and FCC Part 15, subpart J, Class B Computing Devices.
- L. Comply with EIA Standard 709.1 LonTalk™ protocol for DDC system control components.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to manufacturer of that equipment.

1.8 COORDINATION

- A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.
- B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.
- C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.
- D. Coordinate with Owner's IT department for IP addresses and access to Owner's existing high speed Intranet.

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

- A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.
- B. All project developed software and documentation shall become the property of the Owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

1.10 INSTRUCTION OF OPERATING PERSONNEL

- A. General:
 - 1. Conduct formal instruction sessions for operating personnel.

2. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading.
3. Obtain direction from the Owner on which operating personnel shall be instructed in each system.

1.11 SEASONAL ADJUSTMENTS

- A. Visit each Building during the first heating or cooling season approximately 6 months after the date of substantial completion to make repairs and adjustments to provide uniform conditions throughout. Each visit shall consist of a minimum of one (1) day. Schedule the visit for the heating cycle during the months of October through November, and for the cooling cycle during May through June.
- B. During each visit:
 1. Check and calibrate temperature control devices and thermostats.
 2. Test and verify control sequences for proper operation for the season.
 3. Modify the system based on the owner's direction.
 4. Assist the owner in understanding and clearing any alarms.
- C. Prepare and submit a report for each visit documenting conditions found and corrective action taken.
- D. Have the Owner sign the report acknowledging the visit.

1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of building automation system that fail(s) in materials or workmanship within specified warranty period.
 1. Warranty Period: one year(s) from date of Substantial Completion.
- B. When warranty begins this contractor shall send a letter to the Owner and copy the architect and engineer stating that the work is complete per the drawings and specifications and the warranty is to start at one date and end at another.
- C. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the owner.
- D. The contractor must respond to any warranty or service call within 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide an system manufactured and installed by one of the following:
 1. Siemens (BACnet)

2.2 GENERAL

- A. Provide a complete system of direct digital controls (DDC) and monitoring points as specified herein. The DDC system shall interface with the electric and electronic systems to provide control outputs and monitoring inputs to the DDC systems as specified in other Division 23 sections, and as listed in the I/O summaries.
- B. The Building Automation System shall improve HVAC reliability and enhance building efficiency while providing an easy to use interface for monitoring and managing the building. The Building Automation System shall provide the necessary Hardware, Software, and Network Communication abilities to provide Scheduling, Monitoring, Trending, Historical Storage, and alarm functions for the HVAC equipment and systems as describe in this specification. Control capabilities shall include but are not limited to: Time of Day scheduling, Direct Digital Control, Custom Control, Boolean Logic, Optimum Start/Stop, Duty Cycling, Electrical Demand Control, Temperature Control, After Hours Override, Reports and Logs, Trend Prints, Remote Communications, Alarm Logging, Run Time and Maintenance, and Expanded Informational Messages.
- C. The Building Automation System shall allow full user operation with a minimum of training. It shall have an English language display, with both user prompts and "help" user tutorial. It shall contain management reports for the monitoring of both current and historical energy usage, heating and cooling degree day, building status and after hours occupancy information.
- D. All applications programs shall be pre-engineered and pre-tested.

2.3 GRAPHICAL PROGRAMMER (GP)

- A. The Graphical Programmer's utility tool is existing on the central server computer.
- B. The GP is a graphical object-oriented Visio-based drawing tool that provides an intuitive interface for network design integrating capabilities into Windows NT based applications. The functions shall include Network Management services such as device installation, device configuration, diagnostics, maintenance, and defining network data connections between system controllers, known as "binding".

2.4 OPERATOR INTERFACE (GUI SERVER APPLICATION SOFTWARE)

- A. Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.
- B. Operating System: The GUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4, Windows 2000, or later.
- C. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

- D. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:
1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
 2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
 3. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
 4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
 - a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
 - b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
 5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
 6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and entering the desired value.
- E. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:
1. Create, delete or modify control strategies.
 2. Add/delete objects to the system.
 3. Tune control loops through the adjustment of control loop parameters.
 4. Enable or disable control strategies.
 5. Generate hard copy records or control strategies on a printer.
 6. Select points to be alarmable and define the alarm state.
 7. Select points to be trended over a period of time and initiate the recording of values automatically.
- F. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.
- G. Security.
1. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator.
 2. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.
 3. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password.
 4. All system security data shall be stored in an encrypted format.
 5. User access shall be secured using individual security passwords for a minimum of fifty users. It will be partitioned into multiple levels of user access (minimum of seven levels) with data entry restrictions being assignable by password. User log on/log off attempts will be recorded.

- H. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

2.5 ALARM CONSOLE

- A. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.
- B. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.6 GUI SYSTEM SECURITY

- A. System Security shall be on an application by application basis. System Administrator shall setup and define access privileges per user, per application and per setpoint levels.
- B. The Users shall be assigned discrete password names and codes, both of which must be entered in order to have access to any particular application or function within the system.
- C. Access privileges shall also be assignable for entry into the standard MS Windows NT or array of applications such as File Manager, Task Manager or others.
- D. A minimum of 10,000 levels of assignable access must be provided. Systems not supporting this level of customization and flexibility for system security must define delivered capabilities, and may not be accessible.

2.7 GUI DISPLAY FRAMES

- A. The Dynamic Graphic portion of this GUI shall allow the operator to access any system information via a "system penetration" method. "System penetration" shall allow the operator to penetrate into the facility until the detailed color graphic display of a specific area of the facility is represented. All system travel shall be 100% accessible via the mouse, no keyboard commands shall be necessary to edit dynamic data.
- B. The ability to import background images for the display frames shall include as a minimum, photos, digital images, bitmaps and standard image formats. Systems that utilize a proprietary background image format are not acceptable.
- C. As a minimum, graphic displays shall be provided for overall site, for each subsystem within the site and for all individual locations associated with each subsystem. All graphics shall be logically linked to allow the operator to traverse through the overall system and at any time return immediately to the associated subsystem, or overall site plan, via a graphic element.
- D. The system must be set up to have at least 3 access levels: guest, user and administrator. Guest privileges shall be limited to view only. Users shall be able to make setpoint and

schedule changes. Administrators shall have all privileges as users in addition to being able to assign passwords.

- E. The graphic displays shall have an HTML tree on the left side of the screen and the currently viewed graphic on the right side. Tree views shall be different based on access level and the tree must only show screens that are available based on access privileges.
- F. At a minim, each unit shall have a graphic screens available from the tree view. One screen shall display the airflow pattern with all dampers, coils and fans shown in their correct schematic location and dynamic data for all input values shown. This main graphic screen shall show the control devices in mechanical flow diagram format with directional arrows to indicate normal flow arrangement. These screens shall be available to anyone with access to the system, and therefore shall be view only. Systems that won't permit creating these customized screens as described herein will not be acceptable. Systems that use controllers that won't permit overrides of inputs and outputs and adjusting loop tuning parameters for all control loops from a browser based graphic screen will not be acceptable.
- G. All shapes shall be 3-D with a common perspective. All dampers shall have a minimum of 4 animation levels to show partially open, half open, mostly open, fully open, and closed position of dampers. All analog inputs shall show the actual value and engineering units on the graphic screen. Binary inputs shall be linked to flashing animated displays. Safety alarms will flash when in alarm. Filter status shall be indicated when value indicates that they are dirty. To prevent clutter on the graphic displays, symbols will only be shown for equipment that is controlled or monitored by the DDC system. Also, normal status for safeties will not be indicated, and normal status for filters will be indicated by an image of a clean filter. Fans shall rotate when flow is proven by a monitoring device.
- H. Graphics shall use common color schemes to make the overall system easy to understand. All overall backgrounds shall be white. All text shall be black. Any value that is in alarm shall have a red background. Any value that is overridden shall have a blue background. All like sensors shall be the same color. For example, all temperature devices shall be yellow, all pressure devices shall be purple, all humidity devices shall be teal, all fire alarm devices shall be red and all CO2 devices shall be green.
- I. Current setpoints and occupancy status shall be shown at the bottom of each graphic screen.
- J. Floor plan drawings shall be provided, and permit access to each zone's individual floor plan sections. On the individual floor plan sections, room numbers and room temperatures shall be displayed. Values that are out of the acceptable range shall appear in a different background color and / or flash. Each VAV shall have its own graphic that contains the points from within its controller including the box flow setpoint, room temperature setpoint, maximum cooling flow setpoint, minimum cooling flow setpoint, and minimum heating flow setpoint, plus the discharge air temperature from the AHU supplying the unit. The VAV text screen shall have the same information as the graphic screen plus high and low flow calibration values, damper rotation adjustment (CW or CCW), and air balance set-up features. GUI shall permit operator the ability to enable, set or disable high and low occupied and unoccupied limits for each room temperature reading.
- K. Text Screens shall be available for all levels of access. Setpoint and output values are changeable from the text screen for users with appropriate access privileges and administrators, but not guests. When a value can be overridden or edited, a red box shall appear around it when the cursor is position on it. A single click of the mouse shall bring up pop up menu that provide options to make a permanent override, change setpoint, or release a previous override of an output point. Analog inputs shall have pop up menus that allow setting high and low alarm limits and the ability to enable and disable alarm limits as appropriate for the

sensing device. Pop up menus must be customized to include a description of the point that is being modified. Generic override menus are not permitted because they would not describe to an operator what is about to be modified. The BAS Contractor shall set up all initial alarms as indicated in the point matrix.

- L. Text screens shall include schedule information including current state and date and time of next scheduled event. Positioning the mouse over the current state shall permit single click access to the schedule. The schedule screen shall allow the operator to edit a yearly, weekly, daily, holiday or special event schedule for the system being viewed. Temperature values and setpoints shall be displayed below the schedule information, and shall have a minimum of 1 decimal place. Heating, cooling and damper outputs shall be displayed next. Air flow readings shall be shown with setpoint and actual readings. Fan information shall be shown next, followed by static pressure readings and setpoints, which shall have a minimum of 2 decimal places. Miscellaneous setpoints including night setback cooling and heating, average zone temperature, return air warm-up and cool-down, dehumidification, and unoccupied mixed air temperature setpoints shall all be shown and adjustable. All safeties shall be shown, followed by coil pump control information.
- M. Each system shall have its own specific alarm screen available to all operators but only editable by operators with user and administration access privileges. From the alarm screen, users and administrators shall be able to enable and disable alarms. Points that are in alarm shall have an alarm symbol highlighted in red. Points that are not in alarm shall be shown in gray. Alarms that are disabled shall have a way to indicate this on the alarm screen graphic.
- N. Loop tuning screens shall be available through the web browser interface to save the owner the cost and time associated with using vendor specific software for tuning loops. Access to these screens shall not be provided to guests. Loop tuning screen for discharge air temperature shall include the discharge air temperature, discharge air temperature setpoint, cooling loop throttling range, I-gain and ramp time, heating loop throttling range, I-gain and ramp time, economizer loop throttling range, I-gain and ramp time, unoccupied heating loop throttling range, I-gain and ramp time, cooling valve output, heating valve output, and damper control output. Screens shall also have graphs that show 5 minutes of live data for the discharge air temperature, setpoint, cooling valve, heating valve and mixed air dampers. Each loop tuning screen shall include the appropriate throttling range, I-gain and ramp time.
- O. Each non-unitary controller shall have an override screen. These screens shall be available on-site for use during point-to-point check-out and commissioning. The override screen shall show the inputs and outputs for each controller with the points in their wired location. Unused points shall be shown as spares. Points that are in alarm shall have a red background, and points that are overridden shall have a blue background just as on other screens. These screens shall show the actual values that come back from the controller, not the values that may have been typed in for override at the GUI if the controller software is not accepting the override value. The override screen shall also permit timed overrides.
- P. Although only one outside air temperature sensor is needed per building, the GUI shall use independent outside air temperature points, so that during check-out and commissioning, the outside air temperature for a system can be changed without changing the outside air temperature for the whole building. The GUI shall also have a global outside air temperature point that can be overridden from the screen for the controller where the point is physically connected. Overriding this outside air temperature value will change it for all systems, except when outside air temperature has been overridden for an individual system.
- Q. The system shall allow for the easy development and editing of dynamic graphics. Wizards shall be utilized to assist the operator with their manipulation of the graphic system. The operator shall be able to, through a single mouse function, select between the dynamic display

mode and the graphic edit mode for the currently viewed graphic frame, assuming appropriate access level is provided to the operator. Systems requiring multiple mouse or operator keyboard commands to enter the graphic edit mode are not desirable and require thorough definition of steps involved to accomplish function.

- R. Animation of system data shall be provided via graphic elements on the display frames. Standard graphic element library shall be provided to assist the operator with their implementation. The ability to define and add new animated graphic elements shall be provided. As a minimum, the ability to move, size, draw, arrange, align, layer, space, rotate, invert, duplicate, cut, copy, paste, erase any animated element shall be provided. System parameters and setpoints shall be assignable and modifiable by the animated graphic elements, relieving the need for keyboard commands for system manipulation.
- S. The ability to simultaneously display a dynamic X/Y chart of selected points, shall be provided. The chart shall be an element of the graphic display and shall automatically update with the display data. The chart shall allow for dynamic manipulation to modify the range, rate, and timeframe of view, in both a real-time as well as historical configuration. A minimum of 4 values shall be included on any chart display element. There shall not be a limit to the quantity of chart elements displayed on a graphic frame. Trace colors and X values shall be User configurable. Systems not providing this capability are required to provide an equivalent charting package with the GUI offering.
- T. Full on-line system documentation shall be provided. It shall not be necessary to maintain printed copies of user or programming manuals. Context sensitive help files shall be provided for all applications within the FMCS area of the GUI. The ability to update on-line documentation must be provided via electronic updates, definition of update procedure shall be provided.
 - 1. Electronic O&M manual information shall be installed in the web server(s), so that information can be retrieved by logging on to the building's BAS from any web browser. PDF files of control drawings, sequences of operations, and product cut sheets shall be loaded on the web server(s), so they can also be remotely accessed.
- U. By pointing and clicking on any individual graphic element, the following shall be available for display or modification, but not be limited to the current value or state may be edited. A self-prompting pop-up window shall be displayed providing the ability to modify the selected point value. Instructions assisting the operator in their use of the pop-up window shall be provided.
- V. The ability to provide graphically displayed global scheduling and editing functions shall be provided. The ability to link these functions to the associated equipment or zone frames shall be a standard feature. A calendar shall be provided for display and modification of the SDC time clock functions. The User shall be able to view a daily, weekly, monthly, annual, special or holiday schedule from a defined display frame. A list of served areas shall be displayed on the same screen, this list shall be displayed at all times, pull down menus or other means of accessing these areas shall not be acceptable. The system shall have a master override screen that will allow an operator to change the schedule for every piece of equipment in every building by changing the master schedule. This is often referred to as a "Snow Day" command and does not require the operator to log onto each building's UNC.
- W. All analog values shall be trended every 15 minutes. The trend samples shall be saved in the UNC for at least 36 hours. Access to trended data shall be available by the single click of a mouse on the analog value. Systems that open other windows and require a selection of the desired data are not acceptable.

2.8 GUI ALARMING

- A. The GUI shall provide, as standard, alarm annunciation of system data. On every display frame, the ability to view, acknowledge, delete and manipulate real-time and historical alarms shall be provided. The ability to provide a unique and custom alarm display for every display frame shall be provided. The ability to continuously or upon request, view the alarm display, shall be provided.
- B. Alarm conditions shall be capable of invoking, as a minimum; a display frame, an email message, a text message sent to a pager or cellular phone.
- C. Alarm logging shall be provided in a user definable configuration. All alarms shall be displayed and/or routed as follows, as a minimum; GUI display frame, local printer, server printer, client printer, logged to file, and archived in standard format for information management. Alarm groupings shall be hierarchical in nature allowing up to 8 alarm groups and 16 sub-groups. The GUI shall not possess any limits on the quantity of alarms that can be logged, including historical data archiving. Systems possessing limits must define the restrictions and may not be acceptable.
- D. Alarm provide shall provide up to 999 alarm priorities with up to 5 alarm color changes, per priority, according to alarm status.

2.9 GUI TRENDING

- A. The GUI shall automatically perform time based, user defined, periodic collection of real time point data. The data shall be presented as an X/Y chart in the display frame. The data shall be stored and archived in a file format that allows for the manipulation and utilization of the data by third party applications.
- B. A dynamic trend shall be defined as a group of at least 4 data points, with a circular buffer of 2000 data points. A historical trend shall be defined as a group of at least 8 data points, with the sampled points limited only by archival disk space. Sampling rates shall be user selectable from instantaneous (one per second) to once a week. Collection of data shall be user selectable to start and stop on a specific time and date. There shall be no limit to the number of X/Y charts within a display frame.
- C. X/Y charting and column and row reporting shall be an integral part of the HMI. All points shall be chartable or reportable. Analytical data shall be displayed for any of the selected points in a clearly displayed X/Y chart. This analytical data shall consist of at least the following: Average Mean, Standard Deviation, Simple Average, Current Value, Cycle Length, Cycle High and Cycle Low.
- D. X/Y charting shall provide for the following chart manipulation: display, zoom, scroll, centering, pen legend and export to Excel, Text via Dynamic Data Exchange.

2.10 CONTROL UNITS GENERAL

- A. Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate LonMark™/LonWorks™ or BacNet controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. If multiple controllers are furnished, the contractor must make sure that corresponding outputs and inputs are on the same controller. Extra controllers will be required to ensure that all control outputs are controlled by a controller that has the control inputs directly

connected to it. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. When multiple controllers are used for controlling one system, the controllers shall be identical. To minimize the number of spare parts that the owner will need to stock in the future, the same part number controller shall be used for all major system applications (i.e. AHUs, heating water system, chilled water system, pump systems, etc.). All analog outputs shall be true AO (0-20mA or 0-10Vdc). Floating, pulse-width or phase-cut modulating outputs will not be acceptable for this project. Each of the following panel types shall meet the following requirements.

- B. Controllers shall be suitable for the anticipated ambient conditions.
 - 1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non condensing.
 - 2. Controllers used in conditioned ambient space shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non-condensing.
- C. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
- D. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.
- E. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.
- F. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.
- G. Automatic staggered restart of field equipment after restoration of power and short cycle protection is required.

2.11 UNIVERSAL NETWORK CONTROLLERS (UNC)

- A. The Universal Network Controllers (UNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the UNC. It shall be capable of executing application control programs to provide:
 - 1. Calendar functions
 - 2. Scheduling
 - 3. Trending
 - 4. Alarm monitoring and routing
 - 5. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization
 - 6. Integration of LonWorks™ controller data and BACnet controller data
 - 7. Network Management functions for all LonWorks™ based devices
- B. The Universal Network Controllers must provide the following hardware features as a minimum:
 - 1. One Ethernet Port – 10/100 Mbps
 - 2. One RS-232 port

3. One LonWorks™ Interface Port – 78KB FTT-10A
 4. Battery Backup
 5. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
 6. The UNC must be capable of operation over a temperature range of 0 to 55°C
 7. The UNC must be capable of withstanding storage temperatures of between 0 and 70°C
 8. The UNC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing
- C. The UNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the UNC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.
- D. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.
- E. Event Alarm Notification and actions
1. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
 2. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
 3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:
 - a. To alarm
 - b. Return to normal
 - c. To fault
 4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
 5. Provide timed (schedule) routing of alarms by class, object, group, or node.
 6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
 7. Control equipment and network failures shall be treated as alarms and annunciated.
 8. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text
 - b. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
 - 1) -Day of week
 - 2) -Time of day
 - 3) -Recipient
 - c. Pagers via paging services that initiate a page on receipt of email message
 - d. Graphic with flashing alarm object(s)
 - e. Printed message, routed directly to a dedicated alarm printer
 9. The following shall be recorded by the UNC for each alarm (at a minimum):
 - a. Time and date
 - b. Location (building, floor, zone, office number, etc.)
 - c. Equipment (air handler #, accessway, etc.)
 - d. Acknowledge time, date, and user who issued acknowledgement.
 - e. Number of occurrences since last acknowledgement.
 10. Alarm actions may be initiated by user defined programmable objects created for that purpose.
 11. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.

12. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.
13. Provide a "query" feature to allow review of specific alarms by user defined parameters.
14. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
15. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

F. Data Collection and Storage

1. The UNC shall have the ability to collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:
 - a. Designating the log as interval or deviation.
 - b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
 - c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
 - d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
 - e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
3. All log data shall be stored in a relational database in the UNC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
5. All log data shall be available to the user in the following data formats:
 - a. HTML
 - b. XML
 - c. Plain Text
 - d. Comma or tab separated values
6. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Server®, Oracle 8i or Express®, Hyperion Solutions™ SQL Server.
7. The UNC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other UNC on the network. Provide the ability to configure the following archiving properties, at a minimum:
 - a. Archive on time of day
 - b. Archive on user-defined number of data stores in the log (buffer size)
 - c. Archive when log has reached it's user-defined capacity of data stores
 - d. Provide ability to clear logs once archived

G. Audit Log

1. Provide and maintain an Audit Log that tracks all activities performed on the UNC.
2. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size.
3. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:
 - a. Time and date
 - b. User ID
 - c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

H. Database Backup and Storage

1. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.12 CUSTOM APPLICATION CONTROL UNITS (CAC)

- A. Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications
- B. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.
- C. Stand-alone mode control functions operate regardless of network status.
- D. Functions include the following:
 1. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNVT types as documented by the LonMark™ Interoperability Association to assure present and future compatibility with third party LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
 2. Automatic communications loss detection to maintain normal control functionality regardless of available network communications.
 3. Discrete/digital, analog, and pulse input/outputs.
 4. Monitoring, controlling, or addressing data points.
 5. Local energy management control strategies
 6. Incorporate internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to CAC 's.
 7. Local operator interface port provides for download from and connection to portable workstation.
- E. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CAC's shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).

2.13 ALL APPLICATION SPECIFIC CONTROL UNITS (ASC)

- A. Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASC's shall be provided for

Unit Ventilators, Fan Coils, Heat Pumps, VAV Terminal Boxes, Rooftop Units and other applications as shown on the drawings or indicated in the sequences of operation. To assure complete interoperability, all ASC's firmware shall support all mandatory and all optional LonMark™ Standard Network Variables (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association. Bidder shall provide proof of ASC compliance for all the mandatory and all optional LonMark™ SNVTs. ASC's shall be based on the Echelon Neuron 3150 microprocessor working with the ASCs stand alone control program.

- B. Units monitor or control each input/output point; process information; and download from the operator station.
- C. Stand-alone mode control functions operate regardless of network status.
- D. Functions include the following:
 - 1. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
 - 2. Discrete/digital, analog, and pulse input/output.
 - 3. Monitoring, controlling, or addressing data points.
 - 4. Appropriate LonMark™ profiles for specific unitary applications.
 - 5. Support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association
 - 6. Internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to ASC's.
- E. Local operator interface port located on ASC and ASC sensor provides for download from or upload to portable workstation. All devices on the Lon bus shall be accessible from either port.
- F. Communication: ASC's shall communicate with the Building Controller and CAC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).
- G. ASC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.
- H. All ASC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.

2.14 ASC – VAV CONTROLLER FUNCTIONALITY

- A. The VAV ASC shall be a single integrated package consisting of a microprocessor, power supply, damper actuator, differential pressure transducer, field terminations, and application software. VAV actuator must be rated for a minimum of 53 in-lb torque. When actuator is remote from controller, it must be controlled by true analog output and provide feedback to the VAV controller as to its actual position. An alternate model shall be utilized that allows for direct connectivity to an external actuator for those applications that employ a non-butterfly style damper configuration or if the interval actuator is rated for less than 53 in-lb torque. All input/output signals shall be directly hardwired to the VAV ASC controller. The internal actuator shall employ a manual override that allows for powered or non-powered adjustment of the damper position. In all cases, the controller shall automatically resume proper operation

following the return of power to, or control by the ASC. Programming, configuring and/or troubleshooting of input/output signals shall be easily executed through the ASC sensor or GP tool connected at the wall sensor location.

- B. LonMark™ VAV profiles for including support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) as documented by the LonMark™ Interoperability Association
- C. The VAV ASC control algorithms shall be designed to limit the frequency of damper repositioning, to assure a minimum 10-year life from all components. The VAV ASC shall provide internal differential pressure transducer for pressure independent applications with an accuracy of $\pm 5\%$. Flow through transducers requiring filter maintenance are not acceptable. The VAV ASC shall provide zone control accuracy equal to or better than ± 1 degree Fahrenheit. Systems providing control accuracies greater than ± 1 degrees Fahrenheit are not acceptable. With the submittal package, contractor shall provide performance data that verifies control accuracy of the VAV ASC.
- D. All input/output signals shall be directly hardwired to the VAV ASC. A minimum of one input point of the VAV ASC shall employ a universal configuration that allows for flexibility in application ranging from dry contact, resistive, to voltage/current sourced inputs. If a universal point is not available, a minimum of one input point (each) of the dry contact, resistive and analog voltage/current types must be provided on every controller. The outputs of the ASC shall be of the relay and universal analog form. All digital outputs shall be relay type. ASC devices utilizing non-relay outputs shall provide an interface relay for all points. All analog outputs shall be programmable for their start points and span to accommodate the control devices. Both analog and digital outputs must be available from all controllers. Only one type of controller shall be furnished for all types of VAV boxes (i.e. fan powered with hot water reheat and hot water radiant heat or cooling only) to minimize spare parts for owner. Configuration of all I/O points shall be accomplished without physical hardware jumpers, switches or settings. Troubleshooting of input/output signals shall be easily executed with the Graphical Programming tool or a volt-ohm meter (VOM). All I/O points shall be utilized by the local ASC or shall be available as I/O points for other controllers throughout the network.
- E. The FMCS contractor shall provide VAV ASC to the VAV box manufacturer, for factory mounting. The VAV terminal unit supplier shall include in its price all costs for mounting of VAV ASC controller, connection of actuator to damper shaft, wiring of device power, wiring of VAV ASC to fan (fan powered terminal) and wiring to electric reheat coils or reheat valve actuator as specified on drawing. VAV supplier shall wire external damper actuator to controller.
- F. The VAV terminal manufacturer shall provide a multi-point, averaging, differential pressure sensor mounted on the inlet to each VAV box. For fan powered or electric heat models, the VAV terminal unit manufacturer shall supply a line to low voltage transformer, of sufficient capacity, to power the VAV ASC plus all reheat valves and/or contactors and fan circuits associated with the VAV terminal and actuator assemblies. The FMCS contractor shall provide all reheat control valves to the mechanical contractor for mounting and piping. The FMCS contractor shall provide and install all wiring between the valve and VAV ASC controller and between the room sensor and the VAV ASC controller. The FMCS contractor shall provide transformers and power wiring for all non-fan powered VAV terminal units unless shown otherwise on electrical drawings.

2.15 ASC VAV - AIR BALANCING

- A. Balancing Software:

1. Provide software for laptop that allows access to individual application specific controllers through a room temperature sensor.
 2. The tool shall also permit balancing to be performed for VAV terminals.
 3. Provide all necessary software and cables for laptop to run the balancing software.
 4. The Owner may permit the balancing contractor to use this laptop or they may request the balancer to furnish their own laptop. Either way, the balancer will be permitted use of the software and cables to balance this system only. The control contractor shall work with the balancer to ensure that the software is functioning and the balancer is using the software correctly.
- B. Through the portable Graphical Programming Tool, the VAV ASC shall support a fully prompted Air Balance sequence.
- C. The Graphical Programming Tool shall, when connected through the wall sensor, access the connected VAV ASC unit. The air balance sequence shall step the balancing contractor through the checkout and calibration of the VAV ASC.
- D. Upon completion of the balancing sequence, the flow values presented by the VAV ASC shall match those observed by the balancing contractor's measurement equipment.
- E. Additionally, upon completion of the air balance, the balance settings shall be archived for future use if the controller were to require replacement.
- F. Systems not able to provide a formatted air balance Graphical Programming Tool shall provide an individual full time during the Air-balancing process to assure full balance compliance.

2.16 LOCAL AREA NETWORKS (LAN)

- A. Capacity for a minimum of 64 client workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.
- B. Enterprise Network LAN
1. Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 Base-T, UTP-8 wire, category 5
- C. Primary Controller Network LAN
1. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K.
- D. Secondary Network LAN (If Required)
1. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K
- E. Remote Connection
1. ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner

2.17 SOFTWARE

- A. Controller and System HVAC Applications
1. Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:
 - a. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.

- b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy/economizer switchover.
 - c. Chiller Control Programs: Chilled water plant optimization with condenser water reset, chilled-water reset, chiller and pump equipment selection and sequencing.
 - d. Boiler Control Programs: Boiler plant optimization with hot water supply reset, boiler and pump equipment selection and sequencing.
2. Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.
- B. Controller and Network Setup Software
1. Network management tools for LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol shall be provided including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

2.18 INPUT / OUTPUT POINTS

- A. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices. Where specified or indicated on the point list outputs shall have three position manual override switch (On/Off/Auto), a status light, and shall be selectable for either normally open or closed operation.
- B. Analog Outputs shall provide a modulating signal for control of remote devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 milliamp output signal as required to provide proper control for the output device. Floating control is not acceptable for modulating devices when noted as an analog output (AO) in the points list or as proportional control in the sequence of operation. Floating control is acceptable only for VAV box actuator and reheat coil control valve control unless otherwise noted, but the graphics must display the valve and damper positions as a percentage.
- C. Binary Inputs shall allow the monitoring of on/off signals from remote devices. The Binary Inputs shall be compatible with commonly available signaling devices. All status points shown on points list or mentioned in unit sequence of operation shall be positive proof binary switches, sensing the medium being controlled.
- D. Analog Inputs shall allow the monitoring of variable, low voltage, current, or resistance signals and shall have a minimum of a 12-bit resolution. The analog Inputs shall be compatible with, and field configurable to, commonly available sensing devices.
- E. All DO's and AO's shall be capable of being overridden through the BAS, either locally or remotely, by a user with the appropriate password protected privileges.
- F. Refer to 23 09 93 Sequence of Operation for addition points of control and monitoring

2.19 CUSTOM GRAPHICS SCREENS

- A. Custom graphics shall be created specifically for this project. Custom graphics shall be created by the manufacturer's local application engineer who is familiar with the hardware and software for this project. The manufacturer's local application engineer shall be certified for creating graphics. The manufacturer's application engineer shall meet with the owner to review sample and proposed graphics. After the meeting, custom graphics shall be created and submitted for review and comments.

- B. Graphics shall include a floor plan of each floor listing every zone temperature setpoint and actual temperature reading in the building. Those zones out of temperature range shall be highlighted in a different color. The floor plan graphics shall be split into multiple zones for each floor as designated by the owner. Each floor may be broken down into multiple screens per wing to avoid overcrowding information on the screens.
- C. Graphics shall include one master schedule listing every zone temperature setpoint and actual temperature reading in the building. Those zones out of temperature range shall be highlighted in a different color.
- D. Graphics shall have a screen for each HVAC system including a graphic depicting the air handler with supply temperature and each VAV box with supply temperature served by that air handler. All shall be shown on one screen for troubleshooting.
- E. Graphics shall be supplied for the overall building, each wing of the building, and each mechanical room as a minimum.

2.20 MISCELLANEOUS

- A. Materials
 - 1. All materials and equipment used shall be standard components, of regular manufacture for this application.
 - 2. All systems and components shall have been thoroughly tested and proven in actual use.
- B. Control Valves
 - 1. General:
 - a. Control valves shall be two-way or three-way pattern as required by Sequence of Operation, refer to Specification Section 23 09 93, and shall be constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials.
 - b. Control Isolation Valves and Control Two Position Valves shall be line size full port valves.
 - c. Valves with size up to and including 3" shall be screwed connections with 150 psi ANSI pressure body rating. Valves 4" and larger shall be flanged configuration.
 - d. Two-way control valves shall exhibit equal percentage characteristics. Non-equal percentage valve characteristics shall not be acceptable. Two-position control valves shall be line size and shall be provided with a 150 psi static pressure body rating.
 - e. Proportional control valves shall be sized for a maximum pressure drop of 4.0 psig at rated flow (except as noted).
 - f. Control valves on heating coils for air handling units that introduce outside air shall be spring return type, normally open on power failures and freeze conditions.
 - g. Globe valves are required for HRU and AHU heating and / or cooling applications.
 - 2. Terminal Unit Control Valves:
 - a. Constructed of 360 psi forged yellow brass body, nickel plated brass ball, with optimizer insert for modulating applications, blow-out resistant stem, two- or three-port as indicated, and threaded ends for chilled or hot water, up to 50% glycol solutions.
 - b. Spring return is required for all Unit Ventilator heating valves and other terminal equipment that have an outside air source.
 - c. All non-spring return valves must have manual override ability built in to the actuator.
 - d. Rating: ANSI class IV, maximum static pressure of 360 psig, minimum fluid temperature of 20°F and maximum of 250°F operating conditions.

- e. Sizing: 4 psig maximum pressure drop at design flow rate, rated to close against pump shutoff head.
 - f. Flow Characteristics: Two-way and three-way valves shall have equal percentage characteristics.
 - 3. Actuators:
 - a. Actuators for AHU, VAV, HRU and FCU valves shall be the same as specified below for dampers and shall have the same warranty.
 - b. Hydraulic actuators are not acceptable for any application for this project.
 - 4. Manufacturer:
 - a. Control valves shall be Belimo, Delta or Invensys electronic ball valves and Belimo or Invensys Globe valves for modulating applications. Belimo or Invensys Butterfly valves are acceptable for large flow applications, (ie. cooling tower, chiller).
- C. Motorized Control Dampers
- 1. General:
 - a. Blades shall be 16 gauge minimum and 6 " wide maximum and frame shall be of welded channel iron. Dampers with both dimensions under 18" may have strap iron frames. Dampers over 48" wide shall be equipped with a jack shaft to provide sufficient force throughout the intended operating range.
 - b. Dampers shall be black enamel finish or galvanized, with nylon bearings.
 - c. Blade edge, tip and jamb seals shall be included for all dampers. Leakage through the damper shall not exceed 10 CFM per square foot at 4" w.g. (based on a 48" x 48" test sample).
 - d. Motorized dampers shall be parallel blade for two-position control and opposed blade for proportional control applications.
 - e. All motorized dampers throughout the project shall be wired by the Temperature Controls Contractor. Refer to the fan and mechanical schedules, drawings, and control specifications for quantity of motor operated dampers.
 - 2. Damper Actuators
 - a. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. All actuators operating in series or parallel to another actuator or in an open loop, such as minimum percentage outside air, shall be equipped with a positive positioning device. Provide spring return type actuators on outside air (close), return air (open), and relief air (close) dampers.
 - b. Actuators for all dampers and AHU and VAV valves shall be manufactured by Invensys (Duradrive), Siemens (OpenAir) or Belimo. The manufacturer must include a five year warranty from the manufactured date for the actuator. In addition to the 1 year material and labor warranty, the manufacturer shall include a \$50 satisfaction guarantee for each actuator to cover the labor cost for the replacement of an actuator if it fails or if the owner is not satisfied with the performance at any time during the 5 year warranty period.
 - 3. Manufacturer:
 - a. Dampers shall be manufactured by Ruskin, Greenheck or Tamco.
- D. Thermostats
- 1. The thermostat shall be located as shown on the drawings. Provide a thermostat with digital readout of temperature with integral room setpoint adjustment. The thermostat shall contain a push-button for override of unoccupied conditions, up and down arrows to scroll through attributes, and enter key to make changes and a plug-in communications jack for connection of the portable editing device to the Lon or BacNet bus.
 - 2. The thermostat display shall be capable of full programmability of the unit controller without the use of a portable editing device. The thermostat shall be capable of showing the unit controller time and day of week. The display shall be capable of displaying setpoints & temperatures in either 1-degree increments or 0.1-degree increments and

space temperature an accuracy of $\pm \frac{1}{2}$ degrees. The thermostat shall provide unoccupied override with cancel. The override time shall be user settable from 1 minute up to 7 days. For 1 minute to 16 hours the user shall be able to select any one minute interval.

3. The thermostat shall provide password protection with user access codes and automatic time-out. The access levels of the thermostat shall provide 3 levels of access within the system.
4. Thermostats shall be RTD or Thermistor type, providing a linear OHM per degree F characteristic change, and shall be housed as required for the application.
5. Temperature ranges shall be selected as required for the application and all sensors shall be ± 1 deg. F.

E. Sensor/Thermostat Guards

1. Thermostats and room temperature sensors shall have exposed setpoint adjustment ± 3 degrees on either side of setpoint established at the BAS. Guards are to be smoked-clear Lexan for all sensors/thermostats. Guards shall be equal to Uni-Gard Inc model UG-2SC or UG-3SC. Provide one guard for all wall mounted sensors in a room.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine products and material before installation. Reject products or materials that are wet, moisture damaged, or mold damaged.
- C. Examine walls, floors, roofs, equipment for suitable conditions where controls will be installed.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROL DEVICES AND WIRING

- A. Low Voltage Temperature Control Devices
 1. Low voltage thermostats shall be furnished, installed and wired by the HVAC contractor.
 2. The electrical contractor shall provide 4" square by 1-1/2" deep wall outlet boxes (with single-gang rings) for all thermostats/sensors. The electrical contractor shall provide one $\frac{3}{4}$ " empty conduit from each thermostat/sensor location, turned out above accessible ceilings (in joist space or against overhead slab/deck).
 3. The HVAC Contractor shall provide all other necessary conduit, raceway and wiring related work. Conduit shall be identified in ceiling cavity and shall be provided with sweep bends, bushings and drag line.
 4. The HVAC Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.
- B. 120VAC Temperature Control Circuits
 1. Electrical Contractor shall provide all 120 Volt power wiring as required for temperature control panels and transformers to low voltage. Electrical Contractor shall connect to

existing spare at electrical panel board and provide proper circuit breaker per NEC and label panel board accordingly.

2. All other required 120VAC raceway and wiring related work shall be provided by the Electrical Contractor.
3. The Electrical Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

C. General Control Wiring Requirements and Installation Methods

1. Except where specifically indicated otherwise herein or within Division 23 specifications, the HVAC/Temperature Control Contractor shall provide all electrical work as required for all temperature control related wiring (i.e. conduit, raceway, outlet boxes, junction boxes, wiring, etc.) in accordance with Division 26 requirements. All conduit shall be 3/4" minimum.
2. Coordinate all thermostat/sensor locations in field (case by case) with Architect, Owner and Electrical Contractor to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. All thermostat/sensor wall locations indicated on HVAC drawings are schematic only and must be verified case-by-case prior to rough-in.
3. All electrical work as described in this specification shall be per the latest edition of the National Electrical Code (NEC) and per applicable state and local codes. Refer to Division 26 specifications (including Sections 260519 and 260533) for required installation methods and follow Division 26 requirements as related to low voltage and communication technology system cables.
4. Where "free-air" installation methods (either exposed above the ceilings, in bridle rings or in cable trays) are permitted under Division 26 above ceilings, provide plenum-rated cables wherever plenum ceilings (if any) exist and install as defined under Division 26. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit regardless of what wiring methods are permitted under Division 26.
5. Where cable trays or bridle rings are provided by the electrical contractor for low voltage cables, these raceways may be utilized for control wiring by this contractor (provide special color coded jackets, label cable jackets per Division 26 and group control wiring cables together). Provide conduit drops from cable tray/bridle ring paths to wall outlet boxes and equipment unless directed otherwise under Division 26.
6. Regardless of permitted methods in Division 26, all cables/wiring installed concealed by gypsum board, masonry or other inaccessible materials in walls or above ceilings shall be installed in conduit, 3/4" minimum.
7. All conduit, bridle rings, raceway, outlet boxes, etc. necessary for complete operational installation of control wiring shall be provided (furnished and installed) by the temperature control contractor in strict compliance with Division 26 documents. Coordinate all work with all other applicable trades including the electrical contractor.
8. Provide all required conduit work to and between equipment in a manner compliant with that described above (i.e. between VAV boxes, to boilers, starters, condensing units, etc. as applicable).
9. Install control wiring without splices between terminal points, color-coded. Where a splice is required, install within junction box. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and per Division 26.
10. Install circuits over 25 volt with color-coded No. 12 wire in electrical metallic tubing, per Division 26. Install circuits under 25 volt with color-coded No. 18 wire with 0.031" high temperature (105 degrees F) plastic insulation on each conductor and plastic sheath over all. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
11. All control cabling shall be labeled at both ends with descriptive information of control device.

3.3 OPERATING AMBIENTS

- A. Electronic controls mounted in unconditioned space shall be rated for ambient operating conditions of -40 degree F to +140 degree F.
- B. Controls not meeting these limits shall be mounted in an accessible location within conditioned space.

3.4 COMMISSIONING

- A. Automatic Temperature Controls
 - 1. Wiring and tubing shall be identified with the same numbers and symbols as used on the corrected, approved record diagrams.
 - 2. Label control apparatus with nameplates or valve tags bearing the functional designations shown on approved control diagrams.
- B. Operation and Maintenance Manuals
 - 1. Submit 3 manuals each, in hardback 3-ring loose-leaf binder, covering details of operation and maintenance for the Facility Management and Fire Alarm System.
 - 2. Submit manuals 1 month before systems start-up and commissioning.
 - 3. General Contents
 - a. Title page with project name, contractor's and subcontractors' names, addresses and telephone numbers.
 - 4. Index Sheet
 - a. Manufacturers' operating and maintenance manuals, including parts lists for each piece of equipment and accessories requiring service or maintenance, the warranty period, and the name, address, and telephone number of the nearest sales and service organization for each item.
 - b. Complete description of functions and operation of each piece of equipment including descriptions of how equipment operates in conjunction with automatic control systems, and instruction for cleaning, lubrication, and maintenance.
 - c. Descriptive information:
 - 1) Function or service.
 - 2) Classification.
 - 3) Design capability.
 - 4) Performance characteristics.
 - 5) Principal components.
 - 6) Distribution arrangement.
 - 7) Schematic diagram.
 - 8) Control diagram.
 - d. Equipment data:
 - 1) Materials of construction.
 - 2) Parts designation.
 - 3) Manufacturer and model number.
 - 4) Size and rating.
 - 5) Pressure, speed, and temperature limitations.
 - e. Inspection and maintenance information:
 - 1) Inspection schedule and checklist.
 - 2) Schedules and procedures for lubrication, replacement, adjustment, cleaning, painting, protection and testing.
 - 3) Standard forms for compiling inspection and maintenance records.
 - 4) Inspection during operation.
 - 5) Adjustment and regulation.
 - 6) Operational test procedures.

- 7) Detection of malfunction.
- 8) Precautions.
- 9) Troubleshooting.
- f. Step-by-step procedure for starting, stopping, an operating each system:
 - 1) Starting and stopping procedures.
 - 2) Adjustment and regulation.
 - 3) Seasonal changeover.
 - 4) Seasonal shut down.
 - 5) Seasonal start-up.
 - 6) Logs and records.
- g. Copies of inspection certificates provided by the city, county, state and insurance companies.
- h. Approved start and completion dates of the guarantee period.
- i. Valve schedules and diagrams.
- j. Point to point diagram for al control and monitoring points.

C. HVAC

1. Building Automation System
 - a. Control diagrams including electric and interlock wiring.
 - b. Final installed control software listings and flow charts. Listings shall include English comment lines documenting purpose of each group of executable statements and relationship to control sequence for ease of future troubleshooting and modification.
 - c. Record data base information.
 - d. Point identification and sensor characteristics.
 - e. As-built wiring diagrams.
 - f. Central station operator's manuals and software documentation.
 - g. Contents shall be type written.

D. DIAGRAMS

1. Frame and mount the following information:
 - a. Automatic temperature control diagrams adjacent to each control sequences panel.
 - b. Appropriate control and interface drawings including a simplified guide to local programming of each Facility through the digital display unit, a directory of I/O points connected to that panel, and variables which may be displayed – posted on inside cover of management panel
2. Diagrams shall be typed written or computer generated.
3. Diagrams shall be as-built, and shall include interfaces and interlocks with other equipment.

E. DOCUMENTATION

1. Submit the following certificates, statements, receipts, and reports as specified herein:
2. Record drawings.
3. Submittals.
4. Operation and maintenance manuals.
5. Certification of BAS calibration and testing.
6. Screen shots including text screens and graphics for each piece of equipment and/or system.
7. Receipts for BAS training.
8. Receipt acknowledging no BAS failures during test period.

F. RECORD DRAWINGS

1. Record drawings shall include the manufacture and model number of equipment indicated in schedules on the Drawings.

2. Reproductions of design drawings shall not be used in the preparation of record drawings.
3. All record drawing information (drawings and cut sheets) shall be furnished in an electronic format.

3.5 MAINTENANCE

- A. Equipment operated prior to the date of substantial completion shall be maintained in accordance with manufacturer's recommendations.

3.6 EQUIPMENT START-UP AND CHECK-OUT

A. General

1. Verify readiness for start-up of each item of equipment on the basis of inspection.

B. Automatic Temperature Controls

1. The system manufacturer shall provide the services of control technicians at start-up to check-out the system, input data supplied by the Owner, and place the system in operation. Manufacturer shall verify proper operation of each item in the sequences of operation, including hardware and software.
2. Check-out each system for control function through the entire sequence. Check actuator travel on dampers and valves for action and extent. Check calibration of instruments.
3. Verify that control dampers open and close completely.
4. Calculate and verify instrument setpoints.

C. BAS Acceptance Conditions

1. Calibration and testing: Calibrate equipment and verify operation before the system is placed on-line. Check each control point, within the system by making a comparison between the control command at the operator console and field-controlled device. BAS control loops, interlocks, sequences, energy management programs, and alarms shall be tested and stable operation verified. Control loop parameters and tuning constants shall be adjusted to produce accurate, stable control system operation. Before obtaining permission to schedule the acceptance test, provide written certification that the installed complete system has been calibrated, tested and is ready to begin acceptance testing.
2. Acceptance test: Conduct final acceptance test, with the Owner on site, on the complete and total installed and operational automation system to demonstrate that it is functioning in accordance with requirements specified herein. Demonstrate the correct operation of monitored and controlled points as well as the operation and capabilities of sequences, reports, specialized control algorithms, diagnostics, and software.
3. Final system acceptance will be based on the following items:
 - a. Completion of the installation of hardware and software items. Demonstrate complete operation of the system, including hardware and software, with no failures during a 14 consecutive day period. Obtain receipt from the Owner acknowledging no failures within the test period. Submit a daily log documenting failures.
 - b. Satisfactory completion of the record drawings, and operating and maintenance manuals.
 - c. Satisfactory completion of training programs.

3.7 BACKUPS

- A. At project closeout, this contractor shall turn over to the owner 2 sets of computerized backups of the complete temperature control system.
- B. Additionally, this contractor shall store at its main office a backup of the system for a period of not less than 5 years.
- C. Within the first year, any changes or modifications which are made to the software shall be backed up and two copies are to be distributed to the owner after each change.

3.8 ACCEPTANCE PROCEDURE

- A. Upon completion of the calibration, contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation.
- B. Contractor shall be responsible for generating all software and entering all database necessary to perform the sequence of control and specified software routines.
- C. An acceptance test in the presence of the Owner's representative or engineer shall be performed.

END OF SECTION 23 09 00.00

SECTION 23 31 13.00 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round and flat-oval ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Sealants and gaskets.
 - 5. Hangers and supports.
- B. Related Sections:
 - 1. Section 23 05 03 "Submittals for HVAC".
 - 2. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
 - 1. Liners and adhesives.
 - 2. Sealants and gaskets.
- B. Shop Drawings:
 - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
 - 2. Factory- and shop-fabricated ducts and fittings.
 - 3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
 - 4. Elevation of top of ducts.
 - 5. Dimensions of main duct runs from building grid lines.
 - 6. Fittings.
 - 7. Reinforcement and spacing.
 - 8. Seam and joint construction.
 - 9. Penetrations through fire-rated and other partitions.
 - 10. Equipment installation based on equipment being used on Project.
 - 11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.

12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Ductwork Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.

B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing

requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Dixie Sheetmetal
 - b. Eastern Sheetmetal of Cincinnati
 - c. Linx Industries.
 - d. Semco Mfg., Inc.
 - e. Hranec
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.

- C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 - 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 - 2. Tape Width: 3 inches.
 - 3. Sealant: Modified styrene acrylic.
 - 4. Water resistant.
 - 5. Mold and mildew resistant.
 - 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 - 7. Service: Indoor and outdoor.
 - 8. Service Temperature: Minus 40 to plus 200 deg F.
 - 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
- C. Solvent-Based Joint and Seam Sealant:
 - 1. Application Method: Brush on.
 - 2. Base: Synthetic rubber resin.
 - 3. Solvent: Toluene and heptane.
 - 4. Solids Content: Minimum 60 percent.
 - 5. Shore A Hardness: Minimum 60.
 - 6. Water resistant.
 - 7. Mold and mildew resistant.
 - 8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
 - 9. Service: Indoor or outdoor.
 - 10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Flanged Joint Sealant: Comply with ASTM C 920.
 - 1. General: Single-component, acid-curing, silicone, elastomeric.
 - 2. Type: S.
 - 3. Grade: NS.
 - 4. Class: 25.
 - 5. Use: O.
 - 6. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- E. Round Duct Joint O-Ring Seals:
 - 1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.5 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 DUCT SEALING

- A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
 4. Unconditioned Space, Exhaust Ducts: Seal Class C.
 5. Unconditioned Space, Return-Air Ducts: Seal Class B.
 6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 8. Conditioned Space, Exhaust Ducts: Seal Class B.
 9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.3 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.4 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 DUCT CLEANING

- A. Clean new and existing duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components.
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
 - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
 - 6. Provide drainage and cleanup for wash-down procedures.
 - 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.7 START UP

- A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 23 31 13.00

SECTION 23 33 00.00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual volume dampers.
 - 2. Flange connectors.
 - 3. Duct-mounted access doors.
 - 4. Flexible connectors.
 - 5. Flexible ducts.
 - 6. Duct accessory hardware.
- B. Related Requirements:
 - 1. Section 23 05 03 "Submittals for HVAC".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Motor operated damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Duct security bars.
 - f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. Vent Products Company, Inc.
 - g. Greenheck Fan Corporation.
 - 2. Standard leakage rating.
 - 3. Suitable for horizontal or vertical applications.
 - 4. For units less than 36" wide or 12" high
 - a. Frame shall be 22 gage galvanized steel.
 - b. Blade shall be single skin, 22 gage galvanized steel with center "V" groove for reinforcement.
 - c. Bearings shall be corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
 - d. Axles shall be 3/8" square shaft positively locked into damper blade.
 - 5. For units over 36" wide and 12" high

- a. Frame shall be 18 gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.
- b. Blades shall be single skin 18 gage galvanized steel with three longitudinal grooves for reinforcement.
- c. Bearings shall be corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
- d. Axles shall be hexagonal positively locked into damper blade.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Eastern Sheetmetal.
3. Nexus PDQ; Division of Shilco Holdings Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.5 DUCT-MOUNTED ACCESS DOORS

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

1. Ductmate Industries, Inc.
2. Flexmaster U.S.A., Inc.
3. Greenheck Fan Corporation.
4. McGill AirFlow LLC.
5. Ruskin.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
 - a. Double wall, rectangular.

- b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Continuous hinge and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Continuous hinge and two compression latches with outside and inside handles.
 - C. Pressure Relief Access Door:
 1. Door and Frame Material: Galvanized sheet steel.
 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts. Factory set at 3.0- to 8.0-inch wg.
 3. Doors close when pressures are within set-point range.
 4. Hinge: Continuous piano.
 5. Latches: Cam.
 6. Seal: Neoprene or foam rubber.
 7. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.6 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. Ventfabrics, Inc.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 1. Minimum Weight: 26 oz./sq. yd..
 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

2.7 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flexmaster U.S.A., Inc.
 2. McGill AirFlow LLC.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 2. Maximum Air Velocity: 4000 fpm.
 3. Temperature Range: Minus 10 to plus 160 deg F.
 4. Insulation R-value: Comply with local ASHRAE/IESNA 90.1 requirements.
- C. Flexible Duct Connectors:
 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.8 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts..
- C. Install motor operated dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. These dampers, whether shown on the drawings or not, shall be installed at no additional cost to the Owner. Consult with Testing, Adjusting, and Balancing Agency prior to ductwork installation to establish damper locations
 1. Install steel dampers in steel ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire and smoke dampers according to UL listing.

- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. Downstream from manual volume dampers, motor operated dampers, backdraft dampers, and equipment.
 - 2. Control devices requiring inspection.
 - 3. Elsewhere as indicated.
- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors to connect ducts to equipment. The use of flexible connectors as a means of duct transitions is prohibited.
- M. Connect terminal units to supply ducts with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- N. Connect diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- O. Connect flexible ducts to metal ducts with draw bands.
- P. Maximum length of flexible branch duct shall not exceed five feet and only be used at air devices.
- Q. Do not install flexible duct in inaccessible ceilings.
- R. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.

END OF SECTION 23 33 00.00

SECTION 23 36 00.00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Single-duct air terminal units.
- B. Provide the following electrical work as work of this section, complying with requirements of Division 26 sections:
 - 1. Power all 120 volt power and low voltage wiring for all VAV boxes including wiring to controllers, actuators, valves, dampers, etc. from power source to power connections. Provide transformers and low voltage wiring to all devices.
 - 2. Provide new circuit breaker(s) in spare(s) at panel board with 120 volt wiring to all transformers. Include transformers, disconnects and required electrical devices.
 - 3. Provide all control wiring between field-installed controls and air terminals.
- C. Refer to Division 26 for the following work; not work of this section:
 - 1. Power supply wiring for electric heat and fans.
- D. Related Sections:
 - 1. Section 23 05 03 "Submittals for HVAC".

1.3 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports and/or seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible", ASCE/SEI 7, and SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems"
 - 1. Seismic Hazard Level A: Seismic force to weight ratio, 0.48.
 - 2. Seismic Hazard Level B: Seismic force to weight ratio, 0.30.
 - 3. Seismic Hazard Level C: Seismic force to weight ratio, 0.15.

1.4 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
 - 1. Air terminal units.
 - 2. Liners and adhesives.
 - 3. Sealants and gaskets.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 2. Wiring Diagrams: For power, signal, and control wiring.
 3. Hangers and supports, including methods for duct and building attachment, seismic restraints and vibration isolation.
 4. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
- C. Delegated-Design Submittal:
1. Materials, fabrication, assembly, and spacing of hangers and supports.
 2. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.
- D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
1. Ceiling suspension assembly members.
 2. Size and location of initial access modules for acoustic tile.
 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- E. Field quality-control reports.
- F. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:
1. Instructions for resetting minimum and maximum air volumes.
 2. Instructions for adjusting software set points.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- C. Comply with ARI 880 standard for terminal boxes
- D. Comply with ARI 410 standard for reheat coils.
- E. Identification: Provide label on each unit indicating Plant Number, CFM Range, CFM factory setting, and calibration curve (if required).
- 1.6 TEMPERATURE CONTROL INTEGRATION
- A. Refer to Section 23 09 93 "Sequence of Operation for HVAC Controls". The manufacturer of this equipment shall provide the sequence of operation and control and monitoring points as specified. The control and monitoring points shall be capable of communication to the temperature control contractor via open protocol. Coordinate with the temperature control contractor for communication requirements. Provide controllers and protocols as required by the temperature controls contractor for seamless integration.

PART 2 - PRODUCTS

2.1 SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Price Industries.
 2. Titus.
 3. Trane; a division of Ingersoll Rand.
 4. Carrier.
 5. Enviro-Tec.
 6. Krueger.
- B. Configuration: Diverting-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. Casing: Construct of 22 gauge galvanized sheet metal. Provide airtight gasket and quarter turn latches. Provide hanger brackets for attachment of supports.
1. Casing Lining: Complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
 - a. Cotton, Foil faced
 2. Air Inlet: Round stub connection for duct attachment.
 3. Air Outlet: S-slip and drive connections.
 4. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- D. Velocity Sensors: Multipoint array with velocity sensors in air inlet. The airflow sensors shall be of the cross configuration and shall have multiple pickup points, designed to average the flow across the inlet of the assembly.
- E. Sound Power Levels: Provide sound power levels not exceeding the following:
- | | Radiated: | Discharge Sound: |
|----------------|-----------|------------------|
| a. 2nd octave: | 65 | 68 |
| b. 3rd octave: | 60 | 68 |
| c. 4th octave: | 55 | 65 |
| d. 5th octave: | 49 | 60 |
| e. 6th octave: | 40 | 57 |
| f. 7th octave: | 34 | 57 |
| g. NC: | 30 | 28 |
- F. Controls General: each VAV air terminal shall be equipped with the following:
1. Control enclosure for controller mounting.
 2. Each terminal shall have both discharge air temperature and supply CFM sensors
 3. Temperature Control Contractor shall furnish and field install DDC Controls for boxes.
- G. Direct Digital Controls: Single-package unitary controller and actuator specified in Section 23 09 00 "Instrumentation and Control for HVAC."
- H. Control Sequence: Refer to Drawings
- I. Accessories: Provide the following access panel accessories:
1. Quarter turn screw latch

2.2 HANGERS AND SUPPORTS

- A. Comply with section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment".
- B. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- C. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
 - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install temperature control devices including but not limited to wall mounted sensors and/or thermostats.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 - 1. Where practical, install concrete inserts before placing concrete.
 - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than 4 inches thick.
 - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
 - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.

- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Connect ducts to air terminal units according to Section 23 31 13 "Metal Ducts."
- C. Make connections to air terminal units with flexible connectors complying with requirements in Section 23 33 00 "Air Duct Accessories."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 23 05 53 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections per manufacturer's instructions and recommendations.
- C. Tests and Inspections:
 - 1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
 - 2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Air terminal unit will be considered defective if it does not pass tests and inspections.
- E. Prepare written test and inspection reports. Identify any discrepancies in operation and/or performance. Provide recommendations.

3.6 STARTUP SERVICE

- A. Perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.
 - 2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
 - 3. Verify that controls and control enclosure are accessible.
 - 4. Verify that control connections are complete.
 - 5. Verify that nameplate and identification tag are visible.
 - 6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION 23 36 00.00

Submittal Form – 23 36 00.00 – Variable-Air-Volume Units

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

KLH Job# 17917 KLH Job Name: Gallagher Bookstore and Student Space Renovation

Submittal Number: _____ Submittal Date: _____

Mechanical Contractor: _____ Mechanical Supplier: _____

Mechanical Contractor Rep: _____ Mechanical Supplier Rep: _____

Mechanical Contractor Ph. Number: _____ Mechanical Supplier Ph. Number: _____

Mechanical Contractor Rep email: _____ Mechanical Supplier Rep email: _____

Provide completed table as shown below with each Variable-Air-Volume Unit listed.

Submitted Variable-Air-Volume Unit(s) Manufacturer: _____	Yes	No
Manufacturer listed as basis of design or listed equivalent manufacturer?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturer's qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturer's warranty meets or exceeds the warranty period specified within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted Variable-Air-Volume Unit(s) meet all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
120 volt power and low voltage wiring for all VAV boxes provided?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
120 volt wiring to all transformers provided?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Microswitches stop the drive motor at full open and full closed positions?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Hanger brackets for attachments of supports provided?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

Total leakage does not exceed 4% of specified air flow capacity?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Air dampers are constructed of non-corroding heavy gauge metal with peripheral gas-ket, do not require lubrication, and include velocity rings?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Label indicating Air Handler number, CFM range, CFM factory setting, and calibration curve on each unit provided?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Control-powered transformer for each box provided?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Unit location maintains sufficient clearance for normal service and maintenance?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

CATEGORY	DESIGN	SUBMITTED	INSTALLED
EQUIPMENT MARK			
MANUFACTURER			
MODEL NUMBER			
WEIGHT			
MAX. SUPPLY AIRFLOW (CFM)			
HEATING MIN. (CFM)			
MIN. AIRFLOW (CFM)			
ESP (in W.C.)			
FLUID FLOW (GPM)			
FLUID PRESSURE DROP (FT)			
ENTERING WATER TEMP (F)			
FLUID dT (F)			
ENTERING AIR DB/WB (F/F)			
HEATING MBH			
HEATING KW			
LEAVING AIR DB (F)			
HEATING LEAVING AIR (F)			
VOLTAGE/PHASE/HZ			

FLA (FULL LOAD AMPS)			
MOCP (MAX. OVERCURRENT PROTECTION)			
NUMBER ROWS			
SIZE			

Provide completed table as shown below with each type of equipment listed.

SECTION 23 37 13.00 - DIFFUSERS, REGISTERS, AND LOUVERS

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. Rectangular and square ceiling diffusers.
 - 2. Linear slot diffusers.
 - 3. Fixed Face Register
- B. Related Sections:
 - 1. Section 23 05 03 "Submittals for HVAC".
 - 2. Section 23 07 13 "Duct Insulation".

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Rectangular and Square Ceiling Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Metalaire, Inc.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
 - h. Warren Technologies.
2. Material: Steel
3. Finish: Baked enamel, white.
4. Face Size: 24 by 24 inches.
5. Face Style: Plaque.
6. Mounting: T-bar.
7. Pattern: Fixed.

2.2 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company.
 - b. Carnes.
 - c. Metalaire, Inc.
 - d. Nailor Industries Inc.
 - e. Price Industries.
 - f. Titus.
 - g. Tuttle & Bailey.
 - h. Warren Technologies.
2. Material - Shell: Steel.
3. Material - Pattern Controller and Tees: Aluminum.
4. Finish - Face and Shell: Baked enamel, black.
5. Finish - Pattern Controller: Baked enamel, black.
6. Finish - Tees: Baked enamel, white.
7. Slot Width: 2"
8. Number of Slots: 1 slot
9. Length: On Drawings
10. Insulated plenum boot.
11. Accessories: and T-bar slot

B. Fixed Face Grille

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anemostat Products; a Mestek company
 - b. Carnes
 - c. Nailor Industries Inc.
 - d. Price Industries
 - e. Titus
 - f. Tuttle & Bailey.
 - g. Warren Technologies.
2. Material: Steel or Aluminum in moist areas such as locker rooms and shower areas.
3. Finish: Baked enamel, white.
4. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid core.

5. Core Construction: Integral.
6. Frame: 1-1/4 inches wide.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13.00

SECTION 26 05 01.00 – COMMON REQUIREMENTS FOR ELECTRIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division-1 Specification sections, apply to work of Division 26 sections.
- B. E-series drawings apply to work of Division 26 sections and vice versa.

1.2 SPECIAL CONDITIONS

- A. Owner's representative or engineer may relocate luminaire(s), wiring device(s) or equipment outlet(s) prior to installation within a 15 foot limit at no additional charge.
- B. Complete work, or part(s) thereof, at such time as may be designated by the owner's representative, so that it can be used for temporary or permanent use. Do not construe such use of the system as an acceptance of same by Owner.
- C. Review load summaries of power distribution equipment prior to rough-in or installing conductors, and after coordinating with suppliers and other trades, including relevant submittals. Bring abnormal conditions to the attention of the design professional, such as significant load conditions, and unusual phase imbalances.

1.3 GENERAL STANDARDS

- A. Provide work in compliance with applicable provisions of the following standards. Provide UL listing and UL label for electrical materials, equipment luminaires, devices, etc.
- B. Provide work in strict accordance with the latest edition of applicable codes including (but not limited to) the following codes and standards.
 - 1. National Electrical Code (NEC), NFPA 70
 - 2. Life Safety Code, NFPA 101
 - 3. Other Provisions of NFPA as applicable
 - 4. Local Electrical Codes
 - 5. Local utility company requirements
 - 6. ADA/ADAAG requirements
 - 7. ASME
 - 8. International Building Code
 - 9. IECC 2009
 - 10. Ohio Building Code

1.4 PERMITS AND REGULATIONS

- A. Provide written notification to Engineer's office with list of inspection agency choices if multiple electrical plan review or inspection agencies are permitted in the jurisdiction of the project. The final agency selection belongs to the Engineer.
- B. Provide electrical materials, installation methods, workmanship, testing, etc., unless otherwise specified, that conforms with the latest rules, regulations and specifications of the National

Electrical Code, the National Board of Fire Underwriters, local and state codes having jurisdiction and applicable utility companies.

- C. If a discrepancy between Division 26 drawings and specifications, and codes, laws, ordinances, rules and regulations is discovered, immediately notify the engineer and proceed no further with related work until response is received.
- D. Obtain and pay for permits, certificates of inspection and approval, etc. required for this branch of the work.
- E. Furnish owner with certificates of final inspection and approval prior to final acceptance of this branch of the work.

1.5 SPECIFICATIONS AND TERMINOLOGY

- A. Unless otherwise indicated in specifications or on drawings, wherever the term "furnish" appears in documents, interpret to mean "supply and deliver to project site, ready for installation, and install". See definition of "install" in paragraph below.
- B. Wherever the term "install" appears in documents, or is intrinsically included as part of "furnish" and/or "provide" in paragraphs above and below, interpret to mean "Assemble, wire and connect loose-shipped components on site. Place in position for service or use, including material, labor, accessories, services, and testing. Wire, connect, and render fully operational for intended use". Note that most products to be installed shall also be furnished under Division 26, though some products require only installation under Division 26 - depending on context and application.
- C. Wherever the terms "provide", "include", "shall be", "to be", "equip with", "consisting of", or similar terms appear in documents, interpret to mean "Furnish and Install".
- D. Wherever the word "work" appears in documents, interpret to mean "material, labor, accessories, services, testing, etc. as required to render respective work fully operational".
- E. Wherever the words "equal" or "equivalent" or similar terms are used in documents in reference to products other than basis-of-design, equivalency shall be as determined by Design Professional.
- F. Wherever the word "flush" appears, interpret to mean "recessed in respective surface with visible face flush and even with respective surface".
- G. Wherever the words "(the) (this) contractor", "(the) (this) subcontractor", "E.C./EC", "electrical contractor", "electrical subcontractor" or similar terms appear in Division 26 specifications or on electrical drawings, they refer the entity responsible for providing electrical work indicated on electrical drawings, and in Division 26 Project Manual sections.
- H. Interpret the term "Architect" to mean "Engineer's Representative".

1.6 EXPLANATION AND PRECEDENCE OF DRAWINGS

- A. For the purposes of clearness and legibility, drawings are essentially diagrammatic and although size and locations of equipment are drawn to scale wherever possible, make use of data on drawings and verify information at building site.
- B. The drawings indicate required size and points of termination of conduit and partially suggest proper routes to conform to the structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate necessary offsets. Install conduit and equipment in such

manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear without further instructions.

- C. Coordinate work with affected entities and installers. Locate and install equipment and devices accordingly. Refer to coordination drawings of other trades.
- D. Locate apparatus be located symmetrical with architectural elements and install at exact height and locations as shown on architectural drawings.
- E. Fully research peculiarities and limitations of space available for installation of work along with materials to be furnished and installed. Exercise due and particular caution to ensure that parts of the installed work are made quickly and easily accessible. Although the locations of the equipment and conduit may be shown on the drawings in certain positions, be guided by the architectural details and conditions existing at the job site, correlating electrical work with that of others. Provide offsets as required to provide a neat workmanlike arrangement.
- F. Where connecting lines are shown outside the confines of a building, serving indoor or exterior wall-mounted luminaires, devices, outlets, etc., they are shown for circuiting clarification and are not intended to be installed outside of the building. Provide such conduit, raceway and cabling work within the confines of the building, concealed wherever possible.

1.7 SUBMITTALS

- A. Refer to Division 1 Section pertaining to Submittals.
- B. Refer to Section 260503, Submittals for Electrical Systems.
- C. Provide Equipment List for items of material and equipment, which must be reviewed by the Engineer prior to the start of work. Provide submittals in a timely manner allowing for long lead items. No item of equipment will be permitted on the site until acceptance of that equipment has been given. Provide copies of drawings and manufacturer cuts and performance data for Engineer's review. Organized in same order as listed in equipment list and include reference to page and paragraph numbers of the specifications. Do not purchase material until the final versions of the submittals are reviewed by the Design Professionals as "No Exceptions" or as "Exceptions Noted".
- D. Clearly indicate sufficient definition in submittals so they can be properly reviewed for compliance with documents.
- E. Failure of a design professional to identify an error or omission during submittal review, site observation, etc. does not relieve the contractor from being responsible for furnishing and installing electrical work as defined and specified under Division 26.

1.8 MATERIALS AND EQUIPMENT

- A. Unless specifically indicated otherwise provide (furnish and install) all specified and drawn equipment, raceway, boxes, luminaires, controls, wiring, cabling, supports and other materials as required to render all electrical and electrically operated equipment, luminaires, devices, etc. fully operational. Unless specifically indicated otherwise provide (furnish and install) all materials that are specified under Division 26. Discrepancies or uncertainties perceived by a bidder, or other questionable interpretations by a bidder, are subject to final interpretations and decisions by the owner's representative unless addressed before bidding by addendum or unless qualified or excepted within bids.

- B. Provide material manufacturers equivalent in quality, performance, aesthetics, and product support (factory and local) to that specified as basis of design. Other products, materials, articles, devices, luminaires or forms of construction not mentioned as basis of design, required or acceptable is subject to review by the Design Professional and possible rejection. Listing of a manufacturer by name alone as an acceptable product within these specifications shall not necessarily equate another manufacturer or model to what is specified. Provide materials with manufacturing, aesthetic, durability, duty, dimensional and performance characteristics equal to or exceeding the quality, performance and characteristics of the basis-of-design specifications and products.
- C. Provide materials that are new, full weight, of the best quality. Provide similar materials that are of the same type and manufacturer. Provide materials, apparatus and equipment with Underwriter's Laboratory, Inc. label where regularly supplied.
- D. Maintain safety and good condition of the materials and equipment installed until final acceptance by the Owner. Store materials to prevent damage and weathering prior to installation.
- E. When several materials, products or items of equipment are specified by name for one use, select one of those specified.
- F. Bear costs, if any, incurred from deviation from basis-of-design equipment, luminaires, materials, methods, etc. Use of equipment, luminaires, materials, methods, etc. that deviate from the basis of design will be considered as a statement that clearances, arrangements, performance, etc. have been checked, found satisfactory, and is compliant with applicable codes and regulations.
- G. Wire and connect electrical equipment furnished under this branch of work, other branches of work and by the owner. Review documents of other trades to identify electrically operated/controlled equipment that is furnished or installed by the owner, or by other trades. Provide power connections and local disconnects for same. Provide control wiring (including relays, starters, etc.), as required to render equipment fully operable unless indicated otherwise on drawings or in project manual. Determine exact requirements in field from respective equipment installer.
- H. Test and field-verify the following conditions prior to applying power to any luminaires, equipment, etc. Take corrective action if necessary to ensure systems and equipment are energized safely and to proper and properly configured power sources.
 - 1. Proper and expected voltages and service configurations exist at service entrance(s).
 - 2. Proper and expected voltages and configurations exist at all facility power sources.
 - 3. Current-carrying conductors are connected to the correct lines/phases.
 - 4. Grounded (neutral) conductors are properly referenced and connected.
 - 5. Grounding electrode and equipment grounding conductors are properly referenced and connected.
 - 6. Ground resistance complies with NFPA 70 and other specified requirements.
- I. In cases where luminaires, devices, equipment, or other electrical materials are furnished by Owner or others, provide the following services: receive, transport and securely store materials on site; remove materials and components from packaging; assemble all materials and components per factory instructions; install, wire and connect materials and components as recommended by manufacturer for a fully operational installation.
- J. Provide selectively coordinated overcurrent protection (OCP) for applicable branch(es) of power as required and defined in NFPA 70, including all OCP for affected service(s), feeders, branch circuits, etc., relative to "upstream" OCP so that only the OCP closest in the circuit to the load or fault opens the circuit upon an overcurrent or fault condition. Do not use or apply series-ratings to any OCP in any of these branches of power. Provide coordination study and furnish compliant results with equipment submittals. If fault current values are not indicated at nodes on drawings, also provide fault current calculations and furnish results with equipment submittals. Provide

equipment and OCP rated to meet or exceed the calculated available selectively coordinated fault current at the respective node in the power distribution system, and to clear fault/overcurrent events at the node closest to the fault/overcurrent condition. Furnish electronic copies of the electrical documents, and final planned feeder lengths, sizes and other pertinent information, to the manufacturer's representative and/or equipment supplier so that properly rated and braced equipment is provided under base bid.

- K. Except where otherwise indicated, provide fully-rated or series-rated overcurrent protection (OCP). If fault current values are not indicated at nodes on drawings, also provide fault current calculations and furnish results with equipment submittals. Provide equipment and OCP rated to meet or exceed the calculated available series-rated fault current at the respective node in the power distribution system. Furnish electronic copies of the electrical documents to the manufacturer's representative and/or equipment supplier so that properly rated and braced equipment is provided under base bid.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Deliver equipment and materials according to factory shipping requirements. Pack components in factory-fabricated protective containers. Deliver units in sections of such size as will pass through available openings.
- B. Store equipment and materials in clean dry place and protect from weather and construction traffic. When stored inside, do not exceed structural capacity of the floor.
- C. Handle and rig work for equipment and products as recommended by the manufacturer. Do not install components and equipment damaged during shipment or handling - return damaged components to the manufacturer and replace with new.

1.10 QUALITY ASSURANCE

- A. Provide references on request that demonstrate ability to perform work of this division, including list of past projects similar in size, scope of work and complexity.
- B. Interpret specifications in connection and conjunction with the drawings. If work is shown on drawings and not mentioned in the specifications, or vice versa, provide the work as though clearly set forth by both.
- C. Provide materials and labor required to fully complete the work even though each item necessarily involved may not be specifically mentioned or shown. Provide such work and materials of the same grade or quality as the parts actually specified and shown.
- D. Provide the quantity and quality levels indicated as a minimum. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Should there be a conflict between the plans and specifications, provide the greater quantity and better quality.
- E. Install equipment and materials in strict accordance with manufacturer's written instructions.
- F. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified by applicable UL Standards. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Ensure that sealing grommets expand to form watertight seal.

- G. Upon completion of installation of equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.
- H. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Prior to energizing, test wires and cables for proper phase to phase connections, for electrical continuity and for short-circuits. Ensure that direction of rotation of each motor fulfills requirement.
- I. Furnish the service of an experienced superintendent who is constantly in charge of the work, together with qualified journeymen, wiremen and specialists as required to properly install, connect, adjust, start, operate and test the work involved.
- J. The superintendent's qualifications are subject to the review and acceptance by the owner's representative. Unless the owner's representative grants prior special permission, utilize the same electrical superintendent throughout the duration of the project.

1.11 CLEANING EQUIPMENT AND PREMISES

- A. Clean parts of the apparatus and equipment. Clean exposed parts of cement, plaster and other materials. Remove oil and grease spots. Carefully wipe such surfaces and neatly scrape out corners and cracks.
- B. Brush down exposed metal work with steel brushes to remove rust and other spots and leave them smooth and clean. Remove trapped elements during cleaning and flushing period, after which replace and adjust them.
- C. During the progress of the work, clean up and leave the premises and portions of the building in which work has occurred in a clean and safe condition. Provide this cleaning on a per-shift basis.

1.12 PROGRAMMABLE AND SOFTWARE OPERATED EQUIPMENT

- A. This subsection applies for systems that incorporate microprocessor based equipment and components. The systems themselves are specified elsewhere within Project Manual.
- B. Provide detail design, accessories, equipment, devices, wiring, and programming as required to render systems fully operable. Program, check, and test each system using respective certified factory technician. After making tests and corrections, demonstrate systems to owner's representatives and authorities having jurisdiction.
- C. Provide complete design and installation drawings using information supplied by respective system supplier. Show layouts, conduit sizes, number and types of cables/conductors required to components, and detailed wiring connections required at each type of device. Provide these submittals, as part of the submittals of the respective specification section, in full compliance with requirements of authorities having jurisdiction.
- D. Provide latest release of system software (furnished, installed and adapted). Provide upgrade(s) at final close-out of project, where system software originally installed has been upgraded since it was originally installed.
- E. Provide custom programming described below for programmable systems, and for systems with room number identifications that are required for successful system operation. Wherever the term "programming" is used below, interpret it to mean "programming, configuration and identification".

1. Provide custom programming. Room names and numbers may change from architectural drawing names and numbers to actual operational room names and numbers. Contact Design Professionals and Owner to determine actual operating room names, room numbers, etc. and program using actual operational information. Provide interim and permanent programming and configuration work as required to render and maintain systems in full operation.
 2. Provide programming related services (including machine language, English language, etc.) associated with rendering work fully operational, and neatly document in detail. Archive intermediate and final programming work.
 3. Provide custom and detailed programming to a level satisfactory to the Owner, including correct operational room numbers, and room names. Provide neatly typed orderly and logical submittal of proposed programming for review; prior to entering data; revise this submittal as much as required to satisfy the Owner. Determine project-specific requirements in field.
 4. Provide programming for auxiliary control and interface functions. Provide custom programming for address labels. Provide detailed English language print statements for each system point/address, and for each respective auxiliary control sequence. Include in these print statements as many characters, sentences, lines, or paragraphs required to provide extremely detailed descriptions of system status including alarm or trouble condition, and status of related auxiliary controls. Provide level of detail acceptable to the Owner. Provide clear specific English language descriptions for remote annunciators.
- F. Become familiar with existing characteristics, devices, equipment, cabling, configuration, components and programming of affected systems so that expansions, extensions, and retrofits are fully compatible with the existing conditions. Provide a complete fully operable systems accordingly.
- G. Provide programming services for new work, for retrofit work, and for interfaces with new and existing systems. Provide schedule for cross-reference of new system labels to nomenclature used to enter them into existing systems.
- H. Verify that the system is in proper working order prior to beginning work on an existing system. If not, bring defects to the attention of the owner's representative. If no notification occurs, it is assumed that the system was in working order. Provide remedial work for subsequent system problems that occur, if any.
- I. Account for, and indicate, differentiation for construction phasing and sub-phasing on submittals. Provide custom services and programming (including machine language, English language, etc.), testing, certification, and documentation after each phase (and sub-phase) of the project (for projects with multi-phase construction) as required to render systems fully operable after each construction phase. Change room names and numbers from architectural drawing names and numbers to actual operational room names and numbers, after each phase of construction. Provide these services also at the end of construction phases, including programming of final room names and numbers.
- J. Provide interim, and permanent, programming and configuration work. Provide, replace and re-burn EPROM's, and other integrated circuits, as required to accommodate construction schedules and multiple construction phases. Do not begin warranty periods until final acceptance of work by the Owner after completion of the final construction phase.

1.13 PROJECT CLOSEOUT

- A. General
1. Refer to Division 1 Section pertaining to Project Closeout.
 2. Refer to Section 260503.00, Submittals for Electrical Systems.

3. Final payment will not be made until receipt, review and acceptance, by the owner's representative, of documentation defined under Project Closeout and in Section 260503.00, Submittals for Electrical Systems.
4. Test electrical work and ensure that it rings entirely free from ground.
5. Provide proper instruction of equipment and systems to the satisfaction of the owner's representative.
6. Make arrangements for meetings at such times as will be convenient to entities concerned for the purpose of instructing the designated personnel on the correct operation and maintenance of each individual system furnished and each system installed.

B. Record Documents

1. Obtain two complete sets of electrical prints and use them to provide progress record drawings which are separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed (including routing of conduit and cables). These drawings also serve as work progress report sheets. Make notations, neat and legible thereon daily as work proceeds. Make these drawings available for inspection at all times and keep them at the job at a location designated by the owner's representative.
2. Maintain the clean, undamaged set of prints of drawings as well as a set of submittal drawings and coordination drawings. Mark the sets to show the actual installation where the installation varies from the Documents as originally shown. Include locations of underground and concealed items if placed other than shown on the Documents. Do not permanently conceal construction until this required information is recorded. Mark which drawing is most capable of showing conditions fully and accurately. Where shop drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
3. Show changes in: size, type, capacity, etc., of material, device or piece of equipment, location of device or piece of equipment; location of outlet or source of building service systems; routing of piping, conduit, or other building services. Record location of concealed equipment, electrical service work, conduits and other piping/work by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building. Indicate approved substitutions, modifications, and actual equipment and materials installed.
4. Affix near the titleblock on each drawing the Contractor's Company Name(s), signature of Contractor's Representative(s) and current date.
5. For electrical work installed below slabs, pavements, grade, etc., record location of nearby concealed water piping, sewers, wastes, vents, ducts, conduit and other piping, etc. by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building and from adjacent electrical work. Show invert elevation of underground electrical work relative to work installed by other trades.

1.14 WARRANTY/GUARANTEE

A. General

1. Provide a warranty/guarantee in written form stating that work, materials, equipment and parts are warranted to be free of defect for a period of one year from the date of owner's final acceptance, and defects will be repaired, revised or replaced (owner's option) at no cost to the owner if such defects occur within the guarantee period. Also state in written form that occurrences arising during the warranty/guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner. Replace defective items to the satisfaction of the owner's representative and the Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260501.00

SECTION 26 05 02.00 - COMMON ELECTRIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL

- A. Furnish and install all labor and material, tools and equipment necessary to render all systems complete and operational, and ready for turnover to Owner.

1.2 ACTION SUBMITTALS

- A. Refer to Section 260503, Submittals for Electrical Systems.
- B. Product Data: For lock-out/tag-out devices, access doors, sealants and fire/smoke stopping products.

1.3 INFORMATIONAL SUBMITTALS

- A. Refer to Section 260503, Submittals for Electrical Systems.
- B. Welding Certificates.

1.4 WELDING

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 HEIGHT OF BOXES

- A. Outlet mounting heights as indicated on the plans are approximate. Determine the exact mounting heights (and locations) of outlets in the field with relation to architectural detail and equipment being served. Coordinate outlet location with equipment, with furniture plans and with architectural elevation plans. Where mounting heights are not detailed or dimensioned, contact the owner's representative for direction.
- B. Prior to rough-in, coordinate final mounting heights of system outlet boxes in field with Owner's representative. Install boxes at heights as follows, to center of box, unless directed otherwise in field or otherwise noted on E-series drawings or architectural plans. In cases where using center of box for measurement would result in a switch-height device having an operable component higher than 48 inches above finished floor, install boxes lower as needed so that uppermost part of operable component is no higher than 48 inches. Height of boxes dimensioned from ceiling apply to rooms having ceilings 9' or less; in rooms having higher ceilings, locate these as directed in the field.

Switches – Counters:	44" (field verify & match counter recept. heights)
Switches – Elsewhere:	46"
Occupancy Sensors – Wallbox:	46"
Occupancy Sensors – Elsewhere:	As recommended by manufacturer
Receptacles – Counters:	44" (field-verify)
Receptacles – Elsewhere:	18"

Circuit Breaker Panelboards:	72" to top of panel unless code dictates otherwise
Wall Mounted Luminaires:	As noted on plans or as directed by Architect
Control Stations:	46"
Communication Outlets:	18"
Other Outlets/Fixtures/Equipment	As directed by Architect

1.6 ACCESS DOORS

- A. Do not use access doors unless special prior written permission is granted from the Owner's representative. Install pull boxes, junction boxes, etc. in areas which are accessible after completion of construction. Do not install pull boxes or junction boxes above gypsum board or similar inaccessible ceiling systems. Where there is no other recourse but to provide an access door/panel, and where approval of Owner's representative has been obtained, provide required access doors/panels as required for a complete code-compliant electrical installation as defined below.
- B. For installation in masonry, concrete, ceramic tile and wood paneling provide 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors. For gypsum wallboard and plaster provide perforated flanges with wallboard bead. For full-bed plaster applications provide galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- C. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces. Adjust hardware and panels after installation for proper operation. Provide locking devices that are flush screwdriver-operated cam locks.
- D. Provide factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Provide continuously welded steel joints and seams, with welds ground smooth and flush with adjacent surfaces. Provide frames that are 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast or cast-in-place concrete, ceramic tile and wood paneling. Provide Standard Flush Panel Doors that are 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint. Provide Fire-Rated Units that are insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- E. Provide unit assemblies that are rated for the respective fire and/or smoke rating of the surface to which they are installed.
- F. Subject to compliance with requirements, provide products by one of the following:
 - 1. Bar-Co., Inc.
 - 2. J.L. Industries.
 - 3. Karp Associates, Inc.
 - 4. Milcor Div. Inryco, Inc.
 - 5. Nystrom, Inc.

1.7 LOCK-OUT TAG-OUT DEVICES

- A. Provide permanently installed lock-out tag-out devices compliant with NFPA 70 and OSHA, with padlocking provisions, at source overcurrent devices for the following applications.
 - 1. Where the normal NFPA 70-compliant location of the disconnecting means is impracticable or introduces additional or increased hazards to persons or property.
 - 2. Where otherwise required by NFPA 70.
 - 3. Where required by OSHA.
 - 4. Where otherwise required by any other authority having jurisdiction.
 - 5. Where indicated in specifications.
 - 6. Where indicated on drawings.

1.8 ELECTRICAL INSTALLATIONS

- A. Install work conduit, wiring, outlet box type work in finished areas concealed. Such work installed in unfinished areas may be exposed at the discretion of the Owner's representative.
- B. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.
- C. Provide systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible.
- D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and architectural/structural components.
- E. Install electrical equipment to facilitate servicing, maintenance, and repair and replacement of equipment components. Install equipment for ease of disconnecting, with minimum of interference with other installations. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope. Protect the structure, furnishings, finishes, and adjacent materials.
- F. Verify dimensions by field measurements. Take measurements and be responsible for exact size and locations of openings required for the installation of work. Figured dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, follow direction of the owner's representative.
- G. Provide branch subfeeder circuits as shown on the plans. The symbols used to indicate the purpose of which the various outlets are intended are identified in the Electric Legend. Where outlets are indicated by letters on plans, provide corresponding switches to control them.
- H. Provide no wire size smaller than No. 12 for branch circuits unless otherwise noted on plans for control circuits. Provide larger sizes where required by prevailing codes or indicated on contract documents. Provide neutral conductor for all multi-pole feeders. Provide neutral conductor(s) for all multi-pole feeders and branch circuits unless this contractor determines in field that the affected load(s) will never have need for a neutral conductor and NEC does not mandate otherwise. Provide minimum 3/4" conduit size.
- I. Do not install device wall outlets directly back to back, where located on opposite sides of common walls. Offset outlets by at least two feet for applications in fire rated walls and smoke rated walls and applications in acoustically treated walls. Offset outlets by at least one foot for other applications.
- J. Provide wires continuous from outlet to outlet and properly splice joints. Provide insulation value for joints 100% in excess of that of the wire. Mechanical wire splicers may be used. Where friction and rubber tape is used, provide tape conforming to Federal Specifications HH-T-11 and HH-T-111. Where plastic electrical tape is used, provide Scotch #33, or approved equal. Provide minimum 8" tail for conductors terminating at each wired outlet at their outlet fittings to facilitate installment of devices, luminaires, etc.
- K. Use of synthetic or plastic "tie-wraps", "zip ties", "wire ties" and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.
- L. If during construction it becomes apparent that some specific minor changes in layout will effect a neater job or better arrangement, make such alterations without additional compensation and without having to offer credit.. Obtain Engineer's review before making such changes.

- M. Provide workmanship throughout that conforms to the standards of best practice. Marks, dents and finish scratches are prohibited on exposed materials, luminaires, fittings, etc. Clean inside of panels and equipment boxes.

1.9 CONNECTORS

- A. Provide complete assembly of materials for each type of required electrical connection, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.
- B. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 90 degrees C.
- C. Provide electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals, and that are recommended by equipment manufacturer for intended applications.
- D. Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts, cable ties, etc. as recommended for use by accessories manufacturers for intended applications.
- E. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Cover splices with electrical insulating material to achieve insulation at least 100 percent in excess of electrical insulation rating of those conductors being spliced. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Do not "ring" copper conductors while skinning wire.
- F. There may be cases where circuit or feeder conductor sizes are too large or too small to fit into the lugs normally supplied with the end-use equipment, due to circumstances such as increasing conductor sizes to offset voltage drop, unusual breaker frame sizes, etc. In such cases provide appropriate factory lug kits for affected equipment if recommended by manufacturer; elsewhere provide insulated butt-splices with tails sized to fit respective lugs.
- G. Provide connectors that are specifically UL listed and labeled for the exact splicing/termination application, including for instances where solid conductors are spliced/connected to stranded conductors.
- H. Ground metal frames of portable and stationary direct-wired electrically operated equipment by connecting frames to the circuit equipment grounding conductor and to grounded metal raceway. Provide necessary electrical connections between the specified equipment and junction boxes, disconnect switches, and starters near equipment with flexible metallic conduit and matched connectors. Do not expose flexible conduit in finished areas.
- I. Connect electrical equipment furnished under this branch of work, other branches of work and by the owner. Review documents of other trades to identify electrically operated/controlled equipment that is furnished or installed by the owner, or by other trades. Provide power connections and local disconnects for same. Provide control wiring (including relays, starters, etc.), as required to render equipment fully operable unless indicated otherwise on drawings or in project manual. Determine exact requirements in field from respective equipment installer.

1.10 COORDINATION

- A. Commence with coordination in a timely manner. Subsequent additional compensation, special allowances, additional construction time, etc. will not result from failure to coordinate (including providing related information to other trades for review) in a timely manner. Do not fabricate or install work before properly coordinating with other trades.
- B. Plans are diagrammatic indicating design intent and indicating required size, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended that drawings indicate fully coordinated conduit routing, necessary offsets, etc. The drawings are an outline to indicate the approximate location and arrangement of ductwork, piping, equipment, outlets, raceways, cables, etc. Install piping, conduit, raceways, cable assemblies, etc. as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items. Work in and on the building installed diagonal to building members is prohibited.
- C. Consult the plans of other trades while planning installations and before installing work so that work will not interfere with that of other trades.
- D. Refer to Section 260533.00, Raceways and Boxes for Electrical Systems, for special material and installation requirements that relate to coordination.
- E. Participate in multi-trade coordination efforts. Participate in preparation of coordination drawings by other trades, prior to fabrication or installation of equipment, materials, etc. Coordinate actual clearances of installed equipment. Coordinate exact location of electrical outlets, lighting fixtures, conduits, raceways, equipment, cable assemblies, applicable devices, etc. well in advance of installation so there will be no interferences at installation between the various trades.
- F. Ensure that work and working clearances in electrical rooms and similar spaces complies with NEC Article 110. This also applies to finalizing locations of disconnects, starters, contactors and other electrically operated equipment that may require testing or maintenance while energized. Layout all affected equipment on paper, and meet with electrical inspector on-site as needed, prior to ordering related materials or commencing with installations, to ensure compliance with NEC Article 110.
- G. Coordinate and correct conflicts in equipment and materials prior to installation. If a conflict cannot be resolved, refer the matter to the owner's representative for a final decision as to method and material.

1.11 CUTTING, PATCHING AND SEALING

- A. Related Requirements:
 - 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.
 - 2. Section 260544.00 "Sleeve and Sleeve Seals for Electrical Raceway and Cabling" for penetrations.
- B. General
 - 1. Comply with requirements of Division 07 "Thermal and Moisture Protection".
 - 2. Provide cutting and patching for the admission of work. Perform cutting, fitting, and patching for electrical equipment and materials as required to:
 - a. Uncover Work to provide for installation of ill-timed Work.
 - b. Remove and replace defective Work.
 - c. Remove and replace Work not conforming to requirements of the Contract Documents.
 - d. Remove samples of installed Work as specified for testing.

- e. Install equipment and materials in existing buildings.
 3. Upon written instructions from the owner's representative, uncover and restore work to provide for observation of concealed work by owner's representative or by inspection authority having jurisdiction.
 4. During cutting and patching operations, protect adjacent installations (structure, finishes, furnishings, etc.). Where applicable, provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to system components and components of other trades.
 5. Patch surfaces and building components using new materials matching existing materials as applicable and using experienced Installers. Refer to Division 1 for definition of experienced "Installer" or determine qualifications as directed in field by owner's representative.
 6. Patch through fire rated walls and enclosures in a manner that does not diminish the rating of that wall or enclosure. Provide materials used for patching to meet or exceed the smoke and fire rating of the respective surface being patched.
 7. Neatly cut and drill openings in walls and floors required for the installation. Secure approval of Owner's Representative before cutting and drilling in work that is already in place. Neatly patch openings cut.
 8. Hold cutting and patching to a minimum by arranging with other trades for sleeves and openings before construction is started.
 9. Provide factory-assembled watertight wall and floor seals, of types and sizes required; suitable for sealing around conduit, pipe, and tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
 10. Fabricate pipe sleeves from Schedule 40 rigid, heavy wall, full weight galvanized steel pipe; remove burrs. Use sleeves which are two standard sizes larger than conduit passing through respective sleeve.
 11. Provide sleeve seals for piping which penetrates foundation walls below grade, exterior walls and roofs, caulk between sleeve and pipe with non-toxic, UL-classified caulking material to ensure watertight seal. Elsewhere modular provide mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
 12. Provide standard Schedule 40 black steel pipe sleeves two sizes larger than pipes passing through floors, bearing walls and masonry construction. Cut sleeves through walls flush with both faces. Extend sleeves through floors one inch above floor top elevation. Provide a pipe curb assembly equal to Pate Co. for piped penetrating roof. Furnish and set forms required in masonry walls and foundations to accommodate pipes.
 13. Seal all new floor, ceiling, wall, slab, etc. penetrations to match or exceed existing assembly fire ratings. Provide sleeve seals for all sleeves, provide sleeves for all penetrations. All penetrations of fire-rated or smoke-rated wall, floors ceilings, etc. shall be sealed immediately after raceways are installed. All new electrically related work shall be supported directly from building structural members. New electrically related work shall not be supported from ductwork, ductwork hanger, ceiling supports, existing conduit support, etc. All conduits (and cable assemblies, where applicable) shall be routed parallel to building structural members. Any and all noncomplying work installed by the electrical contractor shall be removed and reinstalled to the satisfaction of the owner's representative and the engineer, at the expense of the electrical contractor.
- C. Grout
1. Provide non-shrink, nonmetallic grout, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.
- D. General Joint Sealer Application
1. Provide joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

2. Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.
 3. Clean affected surfaces, joints, etc. immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
 4. Apply sealant primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of sealant, using masking tape. Remove tape immediately after tooling without disturbing seal.
 5. Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 6. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealers.
 7. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
 8. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 9. Provide colors for exposed seals that are selected by the Owner's representative from manufacturer's standard colors.
- E. Elastomeric Joint Sealers
1. Comply with requirements of Division 07 Section "Joint Sealants".
 2. Provide one-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 3. Provide one-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide silicone sealant equal to the following:
 - a. "Dow Corning 790", Dow Corning Corp.
 - b. "Gesil N SCS 2600", General Electric Co.
 - c. "Dow Corning 786", Dow Corning Corp.
- F. Acrylic-Emulsion Sealants
1. Provide one-part, non-sag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications of interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 600", Bostik Construction Products Div.
 - b. "AC-20", Pecora Corp.
 - c. "Sonolac", Sonneborn Building Products Div.
 - d. "Tremco Acrylic Latex 834", Tremco, Inc.
- G. General Fire Stopping Material Application
1. Fire stopping requirements/locations are not indicated on electrical drawings. Review architectural and other drawings to determine fire/smoke rated walls and floors and rating requirements of same. Provide required fire stopping work associated with electrically related penetrations. Provide fire stop pillows, putty or sealant, as applicable, with minimum UL classification for 3 hour fire and cold side temperature ratings.
 2. Clean affected surfaces, joints, etc. immediately before applying fire stopping to comply with recommendations of manufacturer.
 3. Comply with fire stop material manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 4. Install fire stop materials, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

5. Caulk between sleeves and pipes with rockwool and caulk around sleeves with sealing compound that meets applicable fire ratings required.
 6. Provide patch equal to rockwool, firestop, caulk or approved "rated" patch.
 7. Where a smoke or fire-resistance classification is indicated on architectural drawings or otherwise, provide the following as applicable.
 - a. Fire stop pillows, putty or sealant with minimum UL classification for 3 hour fire and cold side temperature ratings for electrically related penetrations.
 - b. Access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating required; Provide UL Label on each fire-rated access door.
- H. Wall/Floor Opening Fire Stopping for Work Likely to Need Ongoing Moves/Adds/Changes
1. Provide Fire Stop Putty equal to Nelson FSP #AA400 series, UL Classified for 3 hour fire and cold side temperature ratings, reusable when penetrating items are removed or added and requiring no special tools, mixing, curing or drying time.
- I. Fire Stopping for Other Wall and Floor Openings
1. Provide Fire Stop Sealant equal to Nelson #AA491 series, UL Classified for 3 hour fire and cold side temperature ratings, non-sagging, permanently flexible, non-toxic, non-shrinking, water/air/smoke-tight and easily re-penetrated. Provide firestopping materials for the following locations:
 - a. For Floor Openings
 - b. For Wall Openings
 - c. For Insulated Pipes
 - d. For Fill Areas
 2. Apply sealant primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.
 3. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or that are not approved by sealant manufacturer.

PART 2 - PRODUCTS (INCLUDED IN PART 1 ABOVE AS APPLICABLE)

PART 3 - EXECUTION (INCLUDED IN PART 1 ABOVE AS APPLICABLE)

END OF SECTION 26 05 02.00

Submittal Form - 260502.00 – Common Electrical Materials and Methods

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Access Door Manufacturer: _____

Submitted Sealant Manufacturer: _____

Submitted Fire/Smoke Stopping Product Manufacturer(s): _____

	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Welder Certificates included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturer's warranties meet or exceed the warranty period specified?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Lock-out/Tag-out devices, Sealants, Fire/Smoke-Stopping and Access Doors included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 05 03.00 – SUBMITTALS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 26 Common Requirements for Electric.
- B. Submittal Forms are included at the end of most Division 26 specification sections, addressing action submittals and applicable information submittals. Include the form as the secondary cover sheet for action submittals and applicable information submittals of each affected section. Note that other submittals are also required as part of the project, even though they may not be addressed in these Submittal Forms.

1.2 SUMMARY

- A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.
- B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

- A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

- A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:
 - 1. Supply of one or more products.
 - 2. Installation of one or more products.
 - 3. Integration of one or more products.
 - 4. Programming of one or more products.
 - 5. Creation of one or more deliverable products.
 - 6. Labeling of one or more products.
 - 7. Contractor-based design or engineering of one or more products or systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

- A. Submittals shall be routed through established Project channels as identified by the Owner's representative.
- B. Coordinate, assemble, title, transmit and track Project submittals.
- C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall have the same appearance and organization as those of other Sections.
- D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents.
- E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.
- F. Design Professional reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis.
- G. The cost for preparation and transportation of submittals is Work of the Contract.
- H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.
- I. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.
- J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.
- K. Organize submittals as identified in the Contract Documents.
- L. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. This allows for tracking and processing efficiency, so that:
 - 1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
 - 2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
 - 3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.
- M. Use of Electronic Drawings from the Owner's Design Team:
 - 1. Plan drawings for the Project were created with Revit.
 - 2. Revit files are not available. If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of published two-dimensional plan drawings may be made available for the creation of shop and as-built drawings for a fee of \$100 per division group for projects that were designed in Revit and must be converted to an AutoCAD or Navisworks format. Divisions 21 and 22 are one group, Division 23 is a second group, and Divisions 26, 27 and 28 are a third group.
 - 3. Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Design Professional.
 - 4. The Request Drawings form can be accessed, filled out and submitted at the following internet address (scroll down to bottom of home page): <http://www.klhengrs.com>.

3.2 SUBMITTAL TYPES

- A. The following are the common submittal types referenced in this Section:
1. Quality Assurance (QA).
 2. Quality Control (QC).
 3. Product Data (PD).
 4. Shop Drawing (SD).
 5. Samples (SS).
 6. Training (TG).
 7. Field Observation Response (FO).
 8. Closeout Submittal (CO).

3.3 SEQUENCE

- A. Quality Assurance Submittal:
1. When not expressly requested to be supplied with bid, the Quality Assurance submittal(s) shall be supplied upon request. When requested the submittal shall be delivered to the Design Professional within 16 business hours.
- B. Product Data Submittal:
1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.
- C. Shop Drawing Submittal:
1. Submit for review prior to commencement of fabrication and installation.
 2. Submit concurrently with Section-specific Product Data submittals.
- D. Samples Submittal:
1. Submit concurrent with, or soon after, product data and shop drawings and prior to installation of Work.
- E. Training Submittal:
1. Submit thirty (30) days prior to the first training session.
- F. Field Observation Report Submittal:
1. Submit five (5) business days prior to punch list walkthrough.
- G. Closeout Submittal:
1. Submit following completion of onsite work but not more than ten (10) business days following successful Acceptance Testing.

3.4 IDENTIFICATION

- A. Identify each submittal uniquely.
- B. Identify each submittal by specification Section number, submittal type, and submittal iteration.
- C. The format for labeling the submittals shall be as follows:
1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
 2. Examples:
 - a. First Product Data Submittal for section 261513: “261513-PD-00.”
 - b. Revised Product Data Submittal for section 261513: “261513-PD-01.”
 - c. Second Revised Product Data Submittal for 261513: “261513-PD-02.”

3.5 CONTENTS

- A. General:
1. Transmittal:
 - a. Supply a dedicated transmittal for submittals for each individual Section.
 - b. Itemize the specific submittals included by Section, submittal type, and iteration.
 2. Title Sheet:
 - a. Include a separate title sheet with each submittal, of each type.
 - b. Title sheets for each Section, for each submittal type, shall have the same appearance.
 - c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.
 - d. Title sheets for drawings shall be the same size as the associated drawings.
 - e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.
 3. Index:
 - a. Include an index outlining and identifying the contents of the submittal.
 - b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.
 4. Checklists:
 - a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and within individual Sections.
 5. Title Blocks:
 - a. Drawing submittals shall be created on the Contractor's, manufacturers, or vendor's own title block. The title blocks of the Owner, Architect, Engineer, Design Professional or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.
 6. Legend:
 - a. Drawing submittals shall include a legend of symbology.
 7. Resubmittals:
 - a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.
- B. Quality Assurance:
1. List of Subcontractors to be used on the Project along with a description of the role each shall play on the Project.
 2. The last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value. References shall include:
 - a. Owner's name and current contact information.
 - b. Project address.
 - c. Description of the system(s) and scope of actual work performed.
 - d. Monetary contract value of the Work performed.
 3. Financial Disclosure of the Contractor: Prior to contract award, upon request.
- C. Product Data Submittals:
1. Bill of Materials (BOM):
 - a. Separate list for each system:
 - 1) When a Section covers products for use in multiple systems, supply separate BOM for each unique system covered by the Section. Label each with the system name, space/room name, and room number.
 - b. Include the following:
 - 1) Make, model, and description of each product.
 - 2) Quantity estimates for each product.
 - 3) Section paragraph number from which the product requirement is derived. Use drawing and detail references when the requirement is derived from the Drawings.

- c. Organize the BOM to follow the order in which products appear within the Section. Products shown on the Drawings but not enumerated within the Specifications shall be placed at the end of the list and include a reference to the Drawing from which the product requirement was derived.
 2. Product Datasheets:
 - a. Separate manufacturer datasheets for each product.
 - b. Datasheets shall be manufacturer originals or first generation printed versions (i.e., from PDF) of the manufacturer's official electronic datasheet:
 - 1) Distributor modified, distributor branded, and/or html based "web" datasheets are not acceptable.
 - 2) Datasheets shall include size and technical support data.
 - c. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or with bold visible arrows the model(s), version(s) and option(s) being supplied. Exact catalog number(s) shall be indicated.
 - d. Each datasheet shall be labeled with the Section paragraph reference number. Datasheets shall include the Drawing reference when no specific paragraph reference exists within the Section.
- D. Shop Drawing Submittals:
 1. General:
 - a. Drawing descriptions identify the required contents of common drawings required under the Contract.
 - b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Design Professional, are required.
 - c. Drawing Scales:
 - 1) Floor plans shall be drawn to scale.
 - 2) Section drawings shall be drawn to scale.
 - 3) Elevation drawings shall be drawn to scale.
 - 4) Details of physical items shall be drawn to scale.
 - 5) Rack layouts and custom furniture and console drawings shall be drawn to scale.
 - 6) System drawings and schematic drawings shall be drawn 1:1 (no scale).
 - d. Sizes:
 - 1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Design Professional.
 2. Floor Plans:
 - a. Location of system devices and faceplates.
 - b. Primary and secondary system cabling pathway(s).
 - c. Location of equipment racks.
 - d. Location of equipment-housing furniture.
 - e. Location of equipment enclosures.
 - f. Location of major system components.
 - g. Location of equipment that is Work of another Section to which Work interconnects.
 3. Reflected Ceiling Plans:
 - a. Location of ceiling devices, coordinated with devices that are Work of others, and existing devices (where applicable).
 4. System Diagrams:
 - a. Hybrid schematic / block wiring diagram.
 - b. System products depicted.
 - c. Product inputs, outputs and other ports depicted.
 - d. System cables depicted.
 - e. Product brand, model, description, options, and accessories declared.
 - f. Interconnections depicted between system products.
 - g. Interconnections depicted between system products and related system products.

- h. Declaration of the cable types, including brand, model, description and color. An accurate cable key is acceptable.
 - i. Unique identification (e.g., number) assignment for each cable.
 - j. Cable color coding schema.
 - k. Termination typicals, keyed to diagram interconnections.
 - 5. Custom Assemblies and Products:
 - a. Manufacturer.
 - b. Materials.
 - c. Finish and color(s).
 - d. Parts list.
 - e. Nomenclature sizes, colors.
 - f. Dimensions.
 - g. Schematic diagram(s), where applicable.
 - 6. Mounting Details:
 - a. Depicting the materials and means of securing installed products.
 - b. Finishes and colors of exposed parts.
- E. Training Submittals:
 - 1. Proposed schedule.
 - 2. Training agendas for each session.
 - 3. Identification of personnel that will conduct training.
 - 4. Handouts proposed for distribution during training.
- F. Field Observation Reports Submittals:
 - 1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:
 - a. The response shall include a copy of the original Field Observation Report.
 - b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.
- G. Closeout Submittals:
 - 1. Certificates of Final Inspection and Approval:
 - a. Furnish certificates of final inspection and approval prior to final acceptance of this branch of the work.
 - 2. As-Built Drawings:
 - a. General:
 - 1) Requirements for Shop Drawings apply to "As-Built" drawings.
 - b. Required Drawings:
 - 1) Title Sheet.
 - 2) Floor Plans.
 - 3) Power Distribution Diagrams.
 - 4) Labeling Schema.
 - 5) As-built version of each Project shop drawing.
 - 6) Coordination drawings and similar construction-related documentation.
 - c. Drawing Formats:
 - 1) Non-Editable: PDF file format
 - 2) Sheets shall be the same size and feature consistent title block information in the lower-right corner.
 - d. Drawing Organization:
 - 1) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.
 - 3. Operation and Maintenance Manuals:
 - a. Manual Format:
 - 1) Hard-cover 3-ring type binder.
 - 2) Front clear plastic cover pocket complete with Project and system Information insert.
 - 3) Clear plastic spine pocket with Project and system Information insert.

- 4) Binder sized to suit the contents only, neither oversized nor undersized.
- 5) Maximum binder thickness: 3 inches.
- b. Manual Contents and Organization:
 - 1) General:
 - a) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
 - b) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).
 - c) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
 - d) Insert labeled tabs within binder to identify separate contents of the manual.
 - e) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.
 - 2) Project Information Cover:
 - a) Title of Project.
 - b) Name and address of Owner, Design Professional, Architect, Contractor of Record and Subcontractor.
 - c) System name and specification references.
 - 3) Index:
 - a) Contents of the manual.
 - 4) Warranty Statement:
 - a) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
 - b) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 1 year parts and labor).
 - c) A separate warranty statement shall be supplied for each system.
 - d) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
 - e) Supply standard out-of-warranty service rates and service contact information.
 - 5) Bill of Materials:
 - a) List of products supplied.
 - b) Serial numbers of each product.
 - c) IP addresses of those products configured to have static IP addresses.
 - d) MAC addresses of products featuring network communication ports (wired and/or wireless).
 - e) Network device names for those products configured for DHCP.
 - 6) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):
 - a) Manufacturer datasheets for each product supplied.
 - 7) Manufacturer Owner / User Manuals:
 - a) Manufacturer's Owner's or User's manual for each product.
 - b) Manufacturer's Installation instructions and other documentation supplied with the product.
 - 8) Spare and Replacement Parts Schedule:
 - a) Complete spare parts schedule for components of equipment furnished, which are not factory generic information, but accurate for the equipment actually provided.

- b) Itemized list of each piece of mechanical equipment having electrical connections with circuit and panelboard locations; also list with each item related expendable equipment required such as fuse size and type, pilot lights, catalog numbers of fuses, overloads, etc. as applicable.
- c) Itemized list of each luminaire type with catalog number of replacement lamps, ballasts, trims, lenses and accessories.
- 9) Maintenance Procedures:
 - a) Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- 10) Function and Operating Descriptions:
 - a) Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
- 11) Operating Procedures:
 - a) Manufacturer's printed operating procedures including start-up, break-in, normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.
- 12) Test Reports and Checklists:
 - a) Test reports, checklists, and other forms generated and completed during the course of the Project.
- 13) Training Information:
 - a) Photocopy of training outlines / agendas.
 - b) Photocopy of training session handouts.
 - c) Photocopy of training sign-in sheets.
 - d) Photocopy of signed delivery receipt for each training session recording (applicable to those Sections/systems requiring recording).
 - e) Separate CD-ROM (or CD-ROM set), labeled, for audio/video-recorded instructions to owner, for operations and maintenance for each system.
- 14) As-Built Drawings:
 - a) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.
 - b) The electronic manual shall contain electronic PDF version of the as-built drawings.
- 15) Software (electronic manual only):
 - a) Editable configuration files for system equipment.
 - b) Software source code use in supplied products.
 - c) Compiled versions of configuration files and source code.
 - d) Software required for reviewing and editing supplied files.

3.6 QUANTITY

A. General:

1. The quantity of submittals required shall be the greater of the following:
 - a. Quantity identified within Division 01.
 - b. Quantity identified within the individual Section.
 - c. Quantity identified herein.
2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
3. The Design Professional shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

- B. Product Data Submittals:
 - 1. One (1) Hardcopy.
 - 2. One (1) Electronic.
- C. Shop Drawings Submittals:
 - 1. One (1) Hardcopy.
 - 2. One (1) Electronic.
- D. Training Submittals:
 - 1. One (1) Hardcopy.
 - 2. One (1) Electronic.
- E. Field Observation Reports Submittals:
 - 1. One (1) Hardcopy.
 - 2. One (1) Electronic.
- F. Samples Submittals:
 - 1. One (1) Hardcopy.
 - 2. One (1) Electronic.
- G. Closeout Submittals:
 - 1. One (1) Hardcopy.
 - 2. One (1) Electronic.

3.7 REJECTION

- A. The following items are representative reasons that submittals may need to be revised and resubmitted:
 - 1. Binding submittals for multiple Sections together.
 - 2. Failing to supply separate transmittal for submittals for each Section.
 - 3. Failing to include a submittal title sheet.
 - 4. Failing to use and accurately complete the published title sheet.
 - 5. Failing to supply and accurately complete the submittal checklists.
 - 6. Failing to supply product data and shop drawings at the same time.
 - 7. Failing to include a detailed BOM with the product data.
 - 8. Failing to supply product data sheets.
 - 9. Failing to supply product data sheets with the correct product and required accessories enumerated.
 - 10. Failing to supply shop drawings.
 - 11. Failing to supply shop drawings with required information.
 - 12. Failing to supply accurate information.
 - 13. Failing to supply relevant information required by the Specifications.
 - 14. Failing to supply products that are in compliance with the Specifications.
 - 15. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

- A. Revise and Resubmit:
 - 1. When a submittal is rejected and flagged as "Revise and Resubmit," the entire submittal shall be reviewed, revised and resubmitted in totality.
 - 2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.
- B. Exceptions Noted:

1. When a submittal is flagged as "Exceptions Noted," the specific actions identified shall be taken.
2. If the reviewer's comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.

C. Resubmittals shall:

1. Include a copy of the reviewer's previous comments.
2. Include a written description of the action(s) taken.
3. Be labeled chronologically.
4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

- A. Provide electronic submittal files that are compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard.
- B. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.
- C. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.
- D. Single File Submission:
 1. Option 1 – Single File, PDF Format:
 - a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
 - b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, BOM, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
 - c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.
 - d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model. Entries shall be organized in a sorted manner, first by make, then by model.
 - e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
 - f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., <xx>1513-PD-01.pdf).
 - 1) Where the Design Professional directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:
 - a) 261513-PD-01 (1 of 3).pdf
 - b) 261513-PD-01 (2 of 3).pdf
 - c) 261513-PD-01 (3 of 3).pdf
 2. Option 2 – Single File, Zip Format:

- a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible ".zip" file.
- b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 02-BOM, 03-Datasheets, 04-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.
- c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing, separate file for each BOM).
- d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
- e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial.
- f. Consult the Design Professional for supplement instructions should the WinZip file exceed 50 Megabytes in size.
- g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., <xx>1513-PD-01.zip).
 - 1) Where the Design Professional directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:
 - a) 261513-PD-01 (1 of 3).zip
 - b) 261513-PD-01 (2 of 3).zip
 - c) 261513-PD-01 (3 of 3).zip

END OF SECTION 260503.00

XXXXXXXXXX
SHOP DRAWING CHECKLIST
(Form: Sub-8)

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
260000-PD-00

SECTION TITLE:
Section Name

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address 1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: <u>xxxxxxxx@xxxx.xx</u>
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XXXXXXXXXX
 SHOP DRAWING CHECKLIST
 (Form: Sub-8)

PRODUCT DATA SUBMITTAL

CHECKLIST
 (Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet		
Project Name		
Spec Section number		
Submittal iteration number. (0 for first iteration, 1 + for each subsequent iteration (e.g. 261513-0 ,261513-1))		
Contractor of Record identified		
Sub-contractor / vendor / supplier name identified		
Title Sheet appearance consistent with sample title sheet		
Bill of Materials		
Section paragraph and/or drawing reference identified		
Make		
Model		
Product Description		
Quantity		
Separate lists included for each system.		
Checklists included		
This checklist		
Previous submittal review, with contractor actions and comments		
Product Datasheets included		
Datasheets are manufacturer originals		
Datasheets for each product included		
Section paragraph and/or drawing reference on each datasheet		
Product accessories and options identified		
Products organized by paragraph (or alphabetically by brand)		
No photocopies, faxes and other illegible datasheets included.		
Shop Drawings included		
Shop drawings accompany this product data submittal		
This submittal contains product data for one section only		

This checklist serves as simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to the 260503 "Submittals for Electric" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and supplied along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 26 05 05.00 - EXISTING CONDITIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

- A. Perform a detailed pre-bid walk-through field inspection to review the existing structures and premises, to determine existing conditions, and to determine scope of required electrically related work. Include applicable accessible ceiling cavity areas in this inspection.
- B. It is not the intent of this section, or of drawings, that existing conditions be accurately shown. Existing electrical work is shown to a very limited extent on drawings and is shown for general planning reference only. Locations and information were derived from cursory visual observations or from portions of documents that were prepared for previously installed work (not from record drawings or "as-builts").
- C. Do not reuse removed electrical materials unless specifically indicated in project manual or on drawings. Existing wiring systems may be utilized only to the extent indicated in project manual, or on drawings, or as directed by Owner's representative in field.
- D. Hold routing of new raceways in existing buildings as tightly as possible to the structure above. Obtain approval of owner's representative prior to installation.
- E. If required to accommodate construction related activities temporarily remove, store in protected location on site, and reinstall conflicting electrical equipment, luminaires, or devices that are to remain or to be relocated.
- F. The following applies to electrical materials that will remain or be reused under this project.
 - 1. Protect during construction activities.
 - 2. Clean and re-lamp luminaires immediately prior to occupancy of the finished construction area.
 - 3. Clean and service (if service is required) equipment in the construction area immediately prior to occupancy of the area.

1.2 AFFECT ON ADJACENT OCCUPIED AREAS

- A. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by owner's representative. Provide temporary service during interruptions to existing facilities. Schedule momentary outages when necessary for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove related wiring that has been abandoned.
- B. Carefully coordinate work and system shutdowns in advance with owner's representative, and with affected trades so that normal building activities and other construction trades are minimally affected. Perform electrically related construction work, which will affect an occupied area (including those which are located outside the immediate area of project work) at special times as directed by owner's representative in field.
- C. Provide work in a manner that ensures existing systems and components remain fully operational in occupied spaces during occupied periods.

- D. Provide and maintain temporary partitions and dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and other system components. Protect adjacent installations during cutting and patching operations. Remove protection and barriers after demolition operations are complete.

1.3 EXISTING POWER DISTRIBUTION EQUIPMENT

- A. This subsection applies for adding components to existing power distribution equipment.
- B. Unless specifically indicated otherwise on drawings or in specifications provide new breaker in instances where new circuits or feeders are shown connected to existing circuit breaker type power distribution equipment.
 - 1. Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings required. Provide breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct breakers for mounting and operating in any physical position, and operating in a minimum ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated. All branch circuit breakers shall be full ambient compensated thermal magnetic molded case with quick-make and quick-break action and positive handle trip indication, both on manual and on automatic operation.
 - 2. Breakers shall be of the over-the-center toggle operating type with the handle going to a position between "on" and "off" to indicate automatic tripping. All circuit breakers shall be full size. Do not use "tandem" or "split" breakers. All multi-pole breakers shall have internal common trip with all load side box lugs of one breaker in the same gutter. All circuit breakers shall have sealed cases to prevent tampering.
 - 3. All 15 and 20 ampere branch circuit breakers shall be UL Listed as SWD (switching duty). All 15-70 ampere branch circuit breakers shall be HACR Type. All branch circuit breakers serving all ballasted (fluorescent/HID) lighting loads shall be HID rated. Provide handle lock-on devices of the non-padlocking type for life safety, special systems and other essential circuits.
- C. Provide components that are manufactured by the same manufacturer as the existing equipment in which they will be installed, and that are intended by the manufacturer to be installed in said equipment. Provide components with fault current (A.I.C.) ratings that meet or exceed the ratings of the existing power distribution equipment.
- D. Update and fill out the panelboard's circuit directory card upon completion of installation work. Directories shall be neatly typewritten. All panelboard directories shall include the actual room names/numbers that are selected for interior signage/designation.
- E. All specific scheduling shown on drawings is shown to indicate new branch circuiting requirements. Exact numbering sequence of circuits shall be determined by this contractor in field after this contractor has performed final balancing.
- F. Determine which existing branch circuits must remain active. Reconnect (or maintain in operation as applicable) and schedule them. Completely re-type panelboard directories for panelboards affected by this project using accurate "as-built" information. Where applicable for multi-wire branch circuits that are reused to feed new or replacement equipment designated on drawings, replace existing single-pole breakers with multi-pole breakers compliant with NFPA 70. Where applicable ensure that reconnected shared neutrals are properly balanced with the correct phase conductors. Where applicable, provide correct color-coding for insulation of reconnected conductors in a manner compliant with NEC.

1.4 PRE-EXISTING CODE VIOLATIONS

- A. Inspect existing electrical work in areas accessed under this project and bring into compliance with current NEC. This applies only to the extent that such work is uncovered in the immediate project areas affected by construction activities, and only to the limited extent that it applies to pre-existing general installation methods such as missing J.B. plate, open J.B. knockout, minor conduit re-anchoring and minor exposed wiring/connections.
- B. If more extensive code or safety violations are discovered, immediately bring them to the attention of the Owner's representative (detailed in writing) along with proposed cost for corrections and impact (if any) on the construction schedule.

1.5 POWER CONTINUITY REQUIREMENTS

- A. The following notes broadly define some of the specialty base bid scope of work required to provide special temporary power for existing facilities to accommodate utility power interruptions. Field-verify all specifics and provide materials, normal time labor, premium time labor, services, safety measures, etc. for all work under base bid, including but not limited to the following.
 - 1. Minimize risks to individuals and property throughout the duration of the project. Keep full electrical services online during all periods of time that any affected facility is occupied. Coordinate with and obtain approval from the owner and engineer for all materials, methods, steps, locations, installations, etc. prior to commencement of work. Determine and employ means and methods as required to safely and securely implement all related work.
 - 2. Do not interrupt electrical utility service(s) to the facility unless permitted under the following conditions and then only after providing temporary electrical service(s).
 - a. Do not energize any new service or distribution equipment without notification to and permission from the owner.
 - 3. During construction related electrical outages, switchovers, disconnections, reconnections, etc., provide all temporary insulated conductors, taps, jumpers, etc. to and from existing and new or temporary electrical equipment, including but not limited to, conductors, splices, lug fittings, rework, etc.
 - 4. Schedule outages in advance with owner, at days of week and times of day or night as directed by owner, as necessary to accommodate all construction related electrical outages, switchovers and related connections and disconnections.

1.6 INTERIM LIFE SAFETY WORK

- A. Provide temporary plastic covers, obtained from smoke detector manufacturer or obtained from a third party and specifically approved for such use by smoke detector manufacturer, over existing smoke detectors within project area, and in adjacent areas that are exposed to construction-related dust or airborne particulates, during working periods. Remove covers after each shift.
- B. Provide temporary emergency egress lighting along egress routes affected by this project. Remove this work when no longer needed.
- C. Provide temporary emergency exit lighting along egress routes affected by this project. Remove this work when no longer needed.
- D. Provide temporary fire alarm system pull station if required to accommodate an egress route. Remove this work when no longer needed.
- E. Provide temporary fire alarm system audio/visual annunciation devices along all affected egress routes. Remove this work when no longer needed.

1.7 INTERIM AIR QUALITY (IAQ) WORK

- A. Prevent airborne dust and particulate matter resulting from electrical work from entering occupied spaces, and from entering air intakes to operating HVAC systems.
- B. Make required electrical openings through walls and floors immediately prior to installation of work. Properly and permanently seal electrical openings immediately after installation of work. Provide temporary seals for applications where penetrations are made but can not be permanently sealed within four hours.
- C. Meet with HVAC installer to determine special IAQ requirements related to electrical that may apply to this project. Cooperate fully with HVAC IAQ requirements that affect electrical work and are affected by electrical work.

1.8 DEMOLITION

- A. Where the term "demolition" is used herein, interpret it to mean "demolition" or "selective demolition" as applicable.
- B. Provide electrical demolition work as required to accommodate project demolition and as required to accommodate new construction.
- C. Disconnect and remove work to be abandoned, and as required to accommodate work of other trades, in areas affected by this project unless specifically noted otherwise on plans or determined otherwise during pre-demolition survey.
- D. Remove accessible abandoned, inactive and obsolete raceway systems. Remove abandoned, inactive and obsolete wiring and controls. Remove abandoned, inactive and obsolete equipment, luminaires and devices. Abandoned raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove abandoned electrical materials above accessible ceilings.
- E. Remove related abandoned unused raceway back to the nearest respective "upstream" junction box that remains active even if outside of the confines of the project area.
- F. Remove abandoned unused wiring back to its source even if sources are outside the confines of the project area.
- G. Extend raceway and wiring as required to accommodate new or relocated electrical work.
- H. Locate, identify, and protect electrical services passing through demolition areas and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- I. It is recognized that there may be some conduit systems rendered inactive by demolition, causing disconnection of "downstream" outlets, etc. Investigate these types of conditions (for all systems) prior to demolition. Provide necessary corrective electrical work prior to demolition to ensure that such "downstream" devices remain permanently active throughout demolition, during new construction, and after project completion.
- J. Perform cutting and patching required for demolition.
- K. Coordinate work carefully with owner prior to beginning electrical demolition work.
- L. Maintain (or reconnect if applicable) remaining wiring.
- M. Remove and relocate wiring, devices, conduit, etc. that conflict with construction related work of other trades as necessary to accommodate new work of respective trade.

- N. Provide electrical disconnections, and reconnections where applicable, for equipment to be removed (or relocated) by other trades.
- O. Existing branch circuit and systems conduit, not conflicting with new construction and not conflicting with overhead or ceiling cavity requirements, may be re-used at the discretion of the electrical installer after all abandoned conductors and cables have been removed from them. Do not exceed NEC required conduit fill and do not install wiring fed from different sources in common conduit (see Section 26 05 33).
- P. Refer to owner's representative for disposal instructions for abandoned electrical materials removed during demolition and thereafter. Neatly store electrical materials that the Owner elects to retain at the site as designated by the owner's representative. Legally dispose of materials that the Owner elects not to retain.
- Q. Disconnect and remove electrical materials designated for salvage (removal and reuse, or for turning over to Owner) undamaged. Disconnect and remove wiring and "whips" from equipment terminal points.
- R. Clean components to be reused inside and out, and reinstall where indicated on drawings. Modify and extend related existing wiring in conduit accordingly.
- S. Carefully transport salvaged electrical materials to a protected on-site storage location as directed in field and neatly store them grouped by system type.

END OF SECTION 260505.00

SECTION 26 05 19.00 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wires and cables rated 600 V and less.
 - 2. Connectors, splices, and terminations rated 600 V and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.
 - 1. Alcan Products Corporation; Alcan Cable Division.
 - 2. Alpha Wire.
 - 3. Belden Inc.
 - 4. Encore Wire Corporation.
 - 5. General Cable Technologies Corporation.
 - 6. Southwire Incorporated.
 - 7. American Insulated Wire Corp
 - 8. Republic Wire
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658. Refer to Part 3 of this section for allowable types specific to this project.
- C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658. Refer to Part 3 of this section for allowable types specific to this project.
- D. MC Cable:
 - 1. Provide Type MC Cables that are minimum 90 degrees C rated, with components and fittings listed for grounding, and compliant with the following.
 - a. NEC Articles 250 and 330.

2. Provide cable formed from continuous length of spirally wound, interlocked zinc coated or galvanized (inside and outside) strip steel or aluminum jacket. Provide cables with full parity insulated equipment ground conductor.
3. Provide compatible steel fittings with integral red plastic insulated throat bushings, compliant with NEC 330.

2.2 CONNECTORS AND SPLICES

- A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.
1. AFC Cable Systems, Inc.
 2. Gardner Bender.
 3. Hubbell Power Systems, Inc.
 4. Ideal Industries, Inc.
 5. IlSCO; a branch of Bardes Corporation.
 6. NSI Industries LLC.
 7. O-Z/Gedney; a brand of the EGS Electrical Group.
 8. 3M; Electrical Markets Division.
 9. Tyco Electronics.
 10. Square D, a Schnieder Electric Company
 11. Thomas & Betts
 12. Arrow-Hart Div, Crouse-Hinds Co
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. Provide wire, cable and connectors suitable for the temperature, conditions and location where installed.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Stranded copper conductors .
- B. Branch Circuits: Stranded copper conductors.
- C. Where applicable for electrical equipment connections for aluminum wiring, provide the following supplemental requirements and work regardless of who furnishes the equipment or what type of equipment is affected.

1. Review equipment submittals, installation documents and nameplates to determine if there are any warranty or UL limitations regarding copper versus aluminum wiring connections at equipment.
2. If there are any limitations, provide local non-fused disconnect at or near equipment (external to the equipment) and terminate aluminum conductors to the line side terminals of the disconnect switch. Provide copper conductors from load side terminals of the disconnect switch to the respective equipment factory disconnect or terminals as applicable.
3. Provide UL-Listed AA-8000 series compact-stranded conductors with XLPE insulation. Provide appropriately UL-Listed connectors as recommended by conductor manufacturer.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Provide conductor insulation rated at 600VAC and 90 degrees C.
- B. Provide THHN/THWN insulation for conductors size 500 kcmil (MCM) and larger, and for conductors # 8 AWG and smaller. Provide THW or THHN/THWN insulation for other sizes as appropriate for the locations where installed.
- C. Provide XHHW-2 insulation for wiring below grade and for wiring subject to moisture conditions.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Provide grounded ("neutral") conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.
- B. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- C. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- D. Use manufacturer UL approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- H. Use of synthetic or plastic "tie-wraps", "zip ties", "wire ties" and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.
- I. Install wire in raceway unless specifically permitted otherwise in this specification section, under other Division 26 sections, or on electrical drawings.
- J. Provide dedicated parity sized neutral conductor for each branch circuit phase conductor fed from 15 ampere and 20 ampere branch circuit breakers.

- K. Provide grounded (“neutral”) conductor for all multi-pole feeders. Provide grounded (“neutral”) conductor(s) for all multi-pole feeders and branch circuits unless this contractor determines in field that the affected load(s) will never have need for a grounded (“neutral”) conductor and NEC does not mandate otherwise.
- L. Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.
- M. Connect wires #6 AWG and larger to panels and apparatus by means of approved lugs or connectors large enough to enclose all strands of the conductors. Provide solderless type connectors
- N. Do not pull wire until raceways are complete, plastering is complete, and raceways are free of moisture. Install joints and splices only at NEC approved panels, accessible junction boxes, or accessible outlet boxes. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary to prevent damage to conductors. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to wire or cable. Conceal work in finished spaces.
- O. Neatly dress work. Install work parallel and perpendicular to surfaces and exposed structural members, and follow surface contours where possible. Keep conductor splices to minimum. Install splice and tap connectors that possess equivalent, or better, mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors that are compatible with conductor material. Install wires continuous from outlet to outlet. Provide insulation value of joints at least 100 percent in excess of wire. Provide adequate length of conductors within electrical enclosures, and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- P. Derate cables per NFPA 70 where bundled, where passing through insulation, and where otherwise required to be compliant with NFPA 70 based on field conditions and/or means and methods that will be used.
- Q. Derate conductors per NFPA 70 where required based on quantities of conductors within raceways, and where otherwise required to be compliant with NFPA 70 based on field conditions and/or means and methods that will be used.
- R. Provide factory splice kits (U.L. approved for submersion in water and direct burial) for wire splicing in outdoor grade, or slab on grade, junction boxes and for all other wet locations.
- S. Type MC cable may be utilized only if NEC approved and if approved by local authority having jurisdiction and if included in the limited applications defined below.
 - 1. Provide for final connections to luminaires that are installed in accessible tile ceiling systems (limited to 6' maximum in length and limited to “whips” from building electrical system junction boxes down to luminaires). Do not install Type MC cable from fixture to fixture unless a special properly listed and labeled UL approved system is specifically indicated.
 - 2. Provide for new 15 and 20 ampere branch circuit drops to outlets in existing hollow partitions for remodeling work. This applies only under all of the following circumstances and conditions.
 - a. Basis of design includes cutting and patching for such applications. Type MC cable may be used only where Owner or Architect specifically directs installer case-by-case not to slot walls (limited to 10 feet maximum cable length from overhead conduit system junction box to respective wall outlet box).

- b. Provide only where concealed (install wiring for exposed applications in raceway).
- c. Route cables perpendicular and parallel to the building architectural lines, surfaces, and structural members, keeping offsets to a minimum and following surface contours where possible. Maintain a uniform elevation for cable runs wherever possible. Support and anchor cables at maximum 4 foot intervals and within 12" of box or outlet in a manner that prevents sagging. Install cables in a manner that prevents overheating. Fasten cables directly to the structure using factory clamps and clips specifically designed for the respective cable (Caddy or equal).

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 8 inches of slack.
- D. Provide complete assembly of materials for each type of required electrical connection, including but not limited to, pressure connectors, terminal (lugs), electrical insulating tape, heat shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.
- E. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 90 degrees C.
- F. Provide electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals, and that are recommended by equipment manufacturer for intended applications.
- G. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Cover splices with electrical insulating material to achieve insulation at least 100 percent in excess of electrical insulation rating of those conductors being spliced. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Do not "ring" copper conductors while skinning wire.
- H. There may be cases where circuit or feeder conductor sizes are too large or too small to fit into the lugs normally supplied with the power distribution equipment or end-use equipment, due to circumstances such as increasing conductor sizes to offset voltage drop, unusual breaker frame sizes, type of conductors used, etc. In such cases provide appropriate factory lug kits for affected equipment if recommended by manufacturer; elsewhere provide insulated butt-splices with tails sized to fit respective lugs.
- I. Ground metal frames of portable and stationary direct-wired electrically operated equipment by connecting frames to the circuit equipment grounding conductor and to grounded metal raceway. Provide necessary electrical connections between the specified equipment and junction

boxes, disconnect switches, and starters near equipment with flexible metallic conduit and matched connectors. Do not expose flexible conduit in finished areas.

3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 CONDUCTOR SIZING

- A. Conductor sizes indicated are based on copper unless specifically indicated otherwise on single-line diagram on drawings.
- B. Provide minimum #12 AWG conductor size.
- C. Provide the following minimum wire sizes based on distances from panel to first device of a 15 or 20 ampere general lighting or receptacle branch circuit. In addition to upsizing conductors as required for voltage drop, provide minimum #10 AWG conductors to the last device for branch circuits more than 150 feet in length.

<u>Distance</u>	<u>AWG Wire Sizes</u>
-----------------	-----------------------

Up to 60 feet	#12
61 to 90 feet	#10
91 to 150 feet	#8
151 to 240 feet	#6

- D. Provide the following minimum AWG conductor sizes for general branch circuiting that is not indicated on drawings, based on using copper conductors. Where applicable, increase as required to accommodate voltage drop and to accommodate special conditions. Provide grounded ("neutral") conductors that are at least parity-sized with corresponding phase ("hot") conductors for all applications.
- E. Do not derate any grounded (neutral) conductors.

<u>Source Breaker/Fuse</u>	<u>AWG Wire Size</u>	<u>Eq. Grounding AWG Wire Size</u>
15 Ampere	#12	#12
20 Ampere	#12	#12
25 Ampere	#10	#10
30 Ampere	#10	#10
35 Ampere	# 8	#10
40 Ampere	# 8	#10
45 Ampere	# 6	#10
50 Ampere	# 6	#10
60 Ampere	# 4	#10
70 Ampere	# 4	# 8
80 Ampere	# 3	# 8
90 Ampere	# 2	# 8
100 Ampere	# 2	# 8

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

END OF SECTION 260519.00

Submittal Form – 260519.00 – Low-Voltage Electrical Power Conductors and Cables

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Conductor Manufacturers (list conductor type and manufacturer): _____ _____		
Submitted Cable Manufacturers (list cable type and manufacturer): _____ _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturers' warranty meets or exceeds the warranty period specified within this specification? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Submitted components meet all requirements listed within this specification? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Type MC Cable includes continuous length of spirally wound, interlocked zinc coated or galvanized (inside and outside) strip steel? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Type MC Cable includes parity-sized insulated equipment grounding conductor? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 26 05 26.00 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Grounding systems and equipment.

1.2 RELATED DOCUMENTS

- A. Division 27, Section 270526.00 "Grounding and Bonding for Communications" for communications grounding busbars and conductors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with ANSI/TIA/EIA-607, "Commercial Building Grounding and Bonding Requirements for Telecommunications."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Except as otherwise indicated, provide copper electrical grounding and bonding systems and materials with assembly of materials including but not limited to cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products that comply with NEC, UL, and IEEE requirements, and with established industry standards for those applications indicated. Utilize compatible metallic materials throughout system to eliminate galvanic action.
- B. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide conductors and connectors as specified in Section 260519. Subject to being equivalent and subject to compliance with requirements, provide other grounding related

materials by Erico (as a standard of quality), or other equivalent available manufacturers where not otherwise specified in Division 26.

2.2 CONDUCTORS

- A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.

2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel (copper molecularly bonded to nickel-sealed high-strength steel core); 3/4 inch in diameter by 10 feet in length. Sectional rods may be used when rods are longer than 10 feet.
- B. Copper Plates: Sheet copper plate electrodes that are 20-gage by 36" by 36", made from high-conductivity sheet, with cable attachments (minimum quantity of 2), sized for cables as necessary to fulfill project grounding requirements.

2.5 INSPECTION WELLS

- A. Provide inspection well for each connection to underground grounding electrodes.
 - 1. At service entrances and/or in paved areas provide inspection well equal to Erico Eritech Inspection Well 416D or 416F series depending on application, with the following characteristics.
 - a. Constructed of polymer concrete.
 - b. 10,000 lb. load rating.
 - c. Bolt-down cover.
 - d. Skid-resistant surface.
 - e. Gray color.
 - f. "Ground" embossed in the lid.

2. In unpaved areas provide inspection well equal to Erico Eritech Inspection Well 416B or 416C series depending on application, with the following characteristics.
 - a. Constructed of high density polyethylene.
 - b. Acid and chemical resistant.
 - c. Green or black color.
 - d. "Ground" embossed in the lid.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Where to be installed underground, bury at least 36 inches below grade.
- C. Grounding Conductors in corrosive areas: Install tinned copper conductor, No. 2/0 AWG minimum. Where to be installed underground, bury at least 36 inches below grade.
- D. Conductor Terminations and Connections:
 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 3. Connections to Ground Rods at Test Wells: Minimum two hole bolted connectors.
 4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors as required by NFPA 70 and as otherwise required. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 1. All feeders.
 2. All branch circuits.
 3. Flexible raceway runs.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

C. Telecommunications Grounding Requirements

1. At minimum, bond together telecommunications racks, cabinets, tray, ladder rack, and risers in each telecommunications equipment room (ER) and telecommunications wiring closet/room (TR) to the busbar in the respective room. Bond each TR busbar to the ER busbar. Bond the ER busbar to the to the grounding electrode system and the electrical grounding system at the main building ground point. Bond additional points where indicated in the drawings and where required by NFPA 70. Provide a common ground with the building's grounding electrode system for the Telecommunications Infrastructure components.
2. Bond the Main telecommunication service entrances to the electrical service equipment ground using the most direct route possible to minimize conductor length.
3. Provide copper grounding conductor from main building grounding electrode system at service entrance to ground bus at the Telecommunications Entrance Facility.
4. Provide copper bus bars on plywood backboard in each ER and TR. See Division 27, Section 270526.00 for bus bar specifications.
5. Provide copper grounding conductors, in conduit, from the electric service ground busbar to each ER and TR ground busbar.
6. Provide minimum #6 AWG bonding jumper (12 inches maximum) with appropriate lugs at each cable tray joint, or provide manufactured braided copper grounding jumper equal to B-Line #CAM-GJ, T&B #BD12, OZ/Gedney type "FB", or Mono-Systems equal.
7. Provide minimum #6 AWG insulated (green insulation) grounding conductor with appropriate lugs from side of cable trays to each ER and TR ground busbar. Drill and tap side of cable trays (for appropriate size bolt, 1/4 inch by 20 min.), and provide bolted connections making sure that bolts do not extend into wire management part of trays.
8. Provide isolation for grounding busbars from the structure support with a 2 inch minimum separation using manufacturer's recommended insulating stand-offs and hardware.
9. See detail(s) on drawings.

3.4 LABELING

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.
- B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.
 1. Label Text: "GROUND SYSTEM - If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Make tests at ground rods before any conductors are connected.

END OF SECTION 260526.00

Submittal Form – 260526.00 – Grounding and Bonding for Electrical Systems

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Manufacturers:		
Busbars: _____		
Conductors: _____		
Connectors: _____		
Electrodes: _____		
Inspection Wells: _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 05 29.00 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS/WORK

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. It shall be the responsibility of the electrical contractor to supervise the installation of and pay for all additional members, wood or metal and labor which may be required to support any type of permanent or temporary electrical apparatus employed in the execution of the electrical contractor's work. Provide supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment as required.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Provide equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

- A. Product Data: For the following:
 - 1. Metal support systems and assemblies
 - 2. Conduit/raceway and cable support components
 - 3. Equipment supports
 - 4. Plywood equipment boards

1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates upon request, if applicable.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

1.8 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly. Construct with 9/16" dia. holes, nominal 2" o.c. on top surface, with standard factory finish, and with the all necessary fittings which mate and match with U-channel.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Allied Tube & Conduit
 - b. Caddy
 - c. Cooper B-Line, Inc.; a division of Cooper Industries
 - d. ERICO International Corporation
 - e. GS Metals Corporation
 - f. Hilti
 - g. Powers
 - h. Thomas & Betts Corporation
 - i. Unistrut; Tyco International, Ltd.
 - j. Wesanco, Inc.
 - k. Perma-Cote
 - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

1. Riser clamps for supporting rigid metal conduit; galvanized steel; with 2 bolts and nuts, and 4" ears.
 2. Clevis hangers: For supporting rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
 3. Galvanized steel clamps; 1/2" rod size.
 4. Galvanized steel clamps, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2".
 5. One-hole conduit straps for supporting 3/4" rigid metal conduit; galvanized steel.
 6. Two-hole conduit straps for supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
 7. Offset conduit clamps for supporting rigid metal conduit; galvanized steel.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Powder/Gas-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used. Where specified on drawings as a corrosive area, expansion anchors shall be stainless steel.
 - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel galvanized springhead type, 3/16" x 4".
 7. Hanger Rods: Threaded steel, Galvanized steel rods; 1/2" dia min.

8. Clevis hangers: For supporting rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
9. Galvanized steel rod reducing couplings, 1/2" x 5/8".
10. Galvanized steel clamps; 1/2" rod size.
11. Galvanized steel clamps, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2".
12. Hexagon nuts for 1/2" rod size; galvanized steel.
13. Lead expansion anchors, 1/2".

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. All electrically related work shall be supported directly from building structural members. Electrically related work shall not be supported from ductwork, ductwork hangers, ceiling supports, existing conduit supports, etc.
- C. Use of synthetic or plastic "tie-wraps", "zip ties", "wire ties" and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.
- D. All conduits, raceways and cables (where applicable) shall be routed parallel and perpendicular to building structural members. Any and all noncompliant work installed by the electrical contractor shall be removed and reinstalled by the electrical contractor to the satisfaction of the Owner's representative and the Engineer, at the expense of the electrical contractor.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure. Install supports with spacing's indicated and in compliance with NEC requirements. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- F. Stem lengths of all pendant fixtures shall be as directed by the owner's representative.
- G. All fasteners, hangers and method of hanging exposed work in finished areas shall be submitted to the owner's representative for review before installation. Fasteners shall be zinc-coated, type, grade, and class as required for a neat finished installation.
- H. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70 as a minimum. Minimum rod size shall be 1/4 inch in diameter.
- I. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.
 1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps, or single-bolt conduit clamps using spring friction action for retention in support channel as applicable.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Do not suspend overhead hangers, or support any other overhead electrical work, from roof decks.
- C. Install work so that no raceway or cable is within six inches below roof deck(s).
- D. Suspend and support overhead electrical from roof trusses and joists/joist girders only at panel points, at top cord only, unless otherwise indicated.
- E. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- F. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through-bolts. Provide Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent. Provide marine grade products where subject to moisture conditions. Provide Simpson Strong Tie (or equal) expansion screw anchors. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads.
 - 2. Attachments to Wood Structural Members: Provide bolts installed through members.
 - 3. To New Concrete: Provide channel-type concrete inserts and bolt to inserts, or provide expansion anchors for applications where inserts are not practical.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
 - 6. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 7. Instead of expansion anchors, powder/gas-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick. Do not use for work anchored to newly installed concrete. Only use this method where other methods cannot or should not be used, and only after receiving case-by-case permission from Owner and design professionals.
 - 8. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, or beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, clamped to flanges of beams or on upper truss chords of bar joists.
 - 9. To Light Steel: Sheet metal screws.
 - 10. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- G. Install work so that no raceway or cable is within six inches below roof deck(s).
- H. Coordinate all work with all other trades prior to commencement of the work.

- I. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 ELECTRICAL EQUIPMENT ANCHORAGE

- A. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- B. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
- D. Provide female expansion anchors, and install studs and nuts after equipment is positioned.
- E. Bushings for Floor-Mounted Equipment Anchors: Provide to allow for resilient media between anchor bolts/studs and mounting hole in concrete.
- F. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Provide to allow for resilient media where equipment and equipment-mounting channels are attached to wall.
- G. Torque bolts and nuts on studs to values recommended by equipment manufacturer.
- H. Size and provide concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.

3.5 PAINTING

- A. Touchup Painting: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529.00

Submittal Form – 260529.00 – Hangers and Supports for Electrical Systems

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Manufacturers:		
Metal support systems and assemblies: _____		
Conduit/raceway/cable support components: _____		
Equipment supports: _____		
Plywood equipment boards: _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 05 33.00 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Nonmetal conduits, tubing, and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Nonmetal wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Boxes, enclosures, and cabinets.
 - 7. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
 - 1. Section 26 05 53.00 "Identification for Electrical Systems" for raceway related identification requirements.

1.3 DEFINITIONS

- A. EMT: Electric metallic tubing.
- B. FMC: Flexible metallic conduit.
- C. GRC: Galvanized rigid steel conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquid-tight flexible metallic conduit.
- F. RNC: Rigid nonmetallic conduit.
- G. Types of electrical boxes and fittings specified in this section include the following:
 - 1. Outlet boxes.
 - 2. Junction boxes.
 - 3. Pull boxes.
 - 4. Bushings.
 - 5. Locknuts.
 - 6. Knockout closures.

1.4 ACTION SUBMITTALS

- A. Refer to Section 260503, Submittals for Electrical Systems.

- B. Product Data: For surface raceways, wireways and fittings, boxes, hinged-cover enclosures, and cabinets.
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- D. Samples: For wireways, nonmetallic wireways, and surface raceways and for each color and texture specified, 12 inches long. Furnish samples if requested by Owner's representative.

1.5 INFORMATIONAL SUBMITTALS

- A. Refer to Section 260503, Submittals for Electrical Systems.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. AFC Cable Systems, Inc.
 - 2. Allied Tube & Conduit; a Tyco International Ltd. Co.
 - 3. Anamet Electrical, Inc.
 - 4. Electri-Flex Company.
 - 5. O-Z/Gedney; a brand of EGS Electrical Group.
 - 6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
 - 7. Republic Conduit.
 - 8. Robroy Industries.
 - 9. Southwire Company.
 - 10. Thomas & Betts Corporation.
 - 11. Western Tube and Conduit Corporation.
 - 12. Wheatland Tube Company; a division of John Maneely Company.
 - 13. Steel city.
 - 14. Regal.
 - 15. Efcor.
 - 16. LTV.
 - 17. Carlon.
 - 18. Cantex.
 - 19. Walker/Wiremold.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering interior outlet box products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Adalet.
 - 2. Appleton Electric.
 - 3. Bell Electric.
 - 4. Bowers.
 - 5. Eagle Electric Mfg Co., Inc.
 - 6. Midland-Ross Corp.
 - 7. OZ/Gedney.
 - 8. Pass and Seymour, Inc.
 - 9. RACO.
 - 10. Hubbell.
 - 11. Thomas & Betts Co.
 - 12. Thepitt.

- C. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. GRC: Comply with ANSI C80.1 and UL 6.
 - 1. Provide zinc coating fused to inside and outside walls of conduit.
- E. IMC: Comply with ANSI C80.6 and UL 1242.
- F. EMT: Comply with FS WW-C-563, ANSI C80.3 and UL 797.
- G. FMC: Comply with FS WW-C-566 and UL 1; zinc-coated steel .
 - 1. Provide flexible metal conduit formed from continuous length of spirally wound, interlocked zinc-coated or galvanized (inside & outside) strip steel. Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type, with insulated throats. Provide Straight Terminal Connectors consisting of one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end with locknut. Do not use 45 degree or 90 degree Terminal Angle Connectors for flexible or water-tight flexible metal conduit in locations that will not be fully accessible after completion of construction. Provide full size green insulated ground wire for all applications, regardless of length.
- H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
 - 1. Provide liquid-tight flexible metal conduit formed from continuous length of spirally wound, interlocked, double-wrapped galvanized (inside & outside) strip steel. Provide liquid-tight jacket of flexible polyvinyl chloride (PVC). Provide smooth-wall type jackets (not a corrugated look) for finished area furniture whip (and similar) applications. Provide Liquid-Tight Flexible Metal Conduit Fittings compliant with FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat. Provide Straight Terminal Connectors that are one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end with locknut. Provide Terminal Angle Connectors that are 45 degree or 90 degree two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut. Do not use 45 degree or 90 degree Terminal Angle Connectors for flexible or water-tight flexible metal conduit in locations that will not be fully accessible after completion of construction. Provide full size green insulated ground wire for all applications, regardless of length.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
 - 1. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Compression or set screw.
 - c. Note: Provide galvanized or zinc-coated concrete-tight fittings. Do not use die-cast fittings.
 - 2. Fittings for GRC:
 - a. Material: Steel.
 - b. Type: Threaded (galvanized or zinc coated after threading.)
 - 3. Expansion Fittings: Material to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 - 4. Provide terminal conduit fittings with insulated throats, or plastic bushings for conduits 2" and larger where insulated throats may not be readily available.
 - 5. Provide locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening. Provide screw type grounding terminal for metal bushings of standard or insulated type.
 - 6. Provide miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that are specifically designed for their particular application.

7. Provide galvanized cast-metal (steel) conduit bodies of types, shapes and sizes as required to fulfill job requirements and NFPA 70 requirements. Construct conduit bodies with threaded-conduit-entrance ends, with removable covers, either cast or of galvanized steel, and with corrosion-resistant screws.
- J. Joint Compound for Threaded Conduit: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Cooper B-Line, Inc.
 2. Hoffman; a Pentair company.
 3. Mono-Systems, Inc.
 4. Square D; a brand of Schneider Electric.
 5. Steel city.
 6. T&B.
 7. Regal.
 8. Efcor
 9. Wheatland.
 10. Allied.
 11. LTV.
 12. Carlon.
 13. Cantex.
 14. Walker/Wiremold.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 for indoor applications and Type 3R for outdoor applications unless otherwise indicated, and sized according to NFPA 70.
 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Provide electrical wireways of types, grades, sizes, and number of channels for each type of applicable service.
 3. Provide lay-in wireways with hinged covers in accordance with UL 870, and with components UL-listed, including lengths, connectors, and fittings. Provide units that allow fastening of hinged cover closed without use of parts other than standard lengths, fittings and connectors. Provide units capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.
 4. Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature. Provide NEMA 3R units where used outdoors or in areas subject to moisture.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type for indoor applications and Flanged-and-gasketed type for outdoor applications unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish. Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Provide plate-finished hardware to prevent corrosion. Protect screws installed toward inside of wireway, with spring nuts to prevent wire insulation damage.

2.3 BOXES, ENCLOSURES, AND CABINETS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Adalet
 2. Cooper Technologies Company; Cooper Crouse-Hinds
 3. EGS/Appleton Electric
 4. Erickson Electrical Equipment Company
 5. FSR Inc.
 6. General Electric Company
 7. Hoffman; a Pentair company
 8. Hubbell Incorporated; Killark Division
 9. Kraloy
 10. Milbank Manufacturing Co.
 11. Mono-Systems, Inc.
 12. O-Z/Gedney; a brand of EGS Electrical Group
 13. RACO; a Hubbell Company
 14. Robroy Industries
 15. Siemens/ITE
 16. Spring City Electrical Manufacturing Company
 17. Square D Company
 18. Stahlin Non-Metallic Enclosures; a division of Robroy Industries
 19. Tay-Mac
 20. Thomas & Betts Corporation
 21. Westinghouse/Cutler-Hammer
 22. Wiremold / Legrand
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
1. Provide galvanized-coated flat rolled code-gage non-gangable sheet-steel outlet/junction/pull boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations.
 2. Construct outlet boxes with mounting holes and with cable and conduit-size knockout openings in bottom and sides where applicable. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
 3. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Provide with stainless steel nuts, bolts, screws and washers.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

- I. Box extensions used to accommodate new building finishes shall be of same material as recessed box and shall extend to the finished wall surface.
- J. Bushings, knockout closures and locknuts:
 - 1. Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.
- K. Device Box Dimensions: 4 inches square by 1-1/2 inches deep or 4 inches square by 2-1/8 inches deep, depending on device depths and wiring fill, with single-gang plaster/"mud" rings where only one device is being installed. Provide wider boxes for applications where more than two devices will be installed. Provide internal metal dividers where required under NFPA 70 for varying voltages, multiple circuits, etc..
- L. Gangable boxes (using multiple single-gang boxes to assemble multi-gang boxes) are prohibited.
- M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor applications and Type 3R for outdoor applications with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- N. Weathertight outlet boxes and covers:
 - 1. Provide corrosion-resistant weathertight/raintight outlet wiring boxes, of types, shapes and sizes, including depth of boxes, with threaded conduit holes for fastening electrical conduit, suitably configured for each application, including face plate gaskets and corrosion-resistant plugs and fasteners. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.
 - 2. Provide weatherproof covers that mount on a single gang horizontal or vertical (depending on application) junction box to ensure weather protection for a standard outlet. Provide covers that can mount on indoor or outdoor junction boxes and that include a weatherproof cover/base assembly with gasket, two universal inserts, and mounting hardware. Provide weatherproof cover that provides flexibility in installation. Provide covers that meet or exceed UL requirements for wet locations while in use, that meet requirements of NFPA 70 Article 410-57(b), and are NEMA 3R rated. Provide weatherproof cover constructed of UV stabilized high impact polycarbonate material. Provide clear cover for the part that encloses the cord set, to allow visual inspection. Provide cover that meets agency requirements for cold impact at negative 60 degrees Fahrenheit (negative 51 degrees C). Provide covers with useable inside depth to accommodate plug head. Provide assemblies for outdoor applications, unless indicated otherwise on drawings, and for indoor applications that serve permanent or extended-use cord & plug load connected equipment.
 - 3. Provide minimal profile assemblies that rated NEMA 3R While In Use and that employ recessed box and cover design, equal to Thomas & Betts "Red Dot" series. Provide trim color(s) as directed by Architect.
 - 4. Where shown indoor at switches or outlets to provide visual deterrence from being used by unauthorized personnel, provide conventional cast aluminum or cast zinc cover plate units and paint to match surrounding wall surfaces.
- O. Cabinets:
 - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: GRC or IMC or EMT .
 2. Exposed and Subject to Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock
 - b. Areas where driven/ridden mechanized equipment is operated
 3. Concealed Conduit, Aboveground in Dry and Noncorrosive Locations Not Subject to Physical Damage: EMT.
 4. Concealed Conduit, Aboveground in Damp Locations, Wet Locations, Corrosive Locations, Where Not Subject to Physical Damage: IMC.
 5. Concealed Conduit, Aboveground in Damp Locations, Wet Locations, Corrosive Locations, Where Subject to Physical Damage: GRC.
 6. Underground Conduit For Branch Circuit and Similar Scale Work: RNC, Type EPC-40-PVC. See details and/or notes on drawings for applications where concrete (or other) encasement is required.
 7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
 8. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R .
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Minor Physical Damage: EMT .
 3. Exposed and Subject to Moderate Physical Damage: GRC or IMC. Raceway locations include the following:
 - a. Loading dock
 - b. Mechanical rooms
 4. Exposed and Subject to Moderate or Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock
 - b. Corridors and pathways used for traffic of mechanized carts, forklifts, and pallet-handling units
 5. Concealed in Cavities of Ceilings and Interior Walls and Partitions: EMT.
 6. Above-Grade Damp or Wet Locations: GRC or IMC.
 7. Below-Grade (and for special conditions if so noted on drawings or other Division Sections): RNC.
 8. Vertical Risers from Below-Grade: GRC.
 9. Cells of Precast Concrete Panels: FMC, except use LFMC in damp, wet or otherwise corrosive locations (Leave sufficient slack in flexible conduit to permit movement from expansion and contraction.)
 10. Embedded in Concrete or Masonry: GRC.
 11. Final 72 inches from accessible outlet/junction boxes to recessed luminaires that are located in accessible ceiling systems: FMC. Type AC/MC cable may be used for such "whips"; refer to Section 260519.
 12. Final 24-72 Inches at Connections to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp, wet or otherwise corrosive locations (Leave sufficient slack in flexible conduit to permit movement from vibration without adversely affecting conduits and connections.)

13. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

- A. General Installation.
1. Minimum Raceway Size: 3/4-inch trade size.
 2. Locate junction and pull boxes so they remain accessible after all construction work is complete. Coordinate all work with all other trades prior to commencement of the work.
 3. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.
 4. Layout all proposed raceway routing, elevations, installation methods, etc. on coordination drawings and coordinate all proposed raceway routing with all affected trades prior to commencing with work. In addition review the information with Owner and design professionals for all areas where the raceways will be visible after completion of construction, to ensure a neatly organized installation occurs. Where raceways must be exposed in finished areas install them in a manner that minimizes detrimental effects on room aesthetics. Install so raceways are as out of site as reasonably possible. For instance, where applicable and if so directed by the design professionals or the Owner, make drops near corners, window casings, door casings, etc. Likewise if a receptacle needs to be installed at the center of a wall, install the raceway down the wall in a corner of the room then transition and run horizontally to the outlet location if so directed by the Architect or the Owner. Use compression fittings for EMT applications in these areas. Do not use strut or fasteners that stand off from wall for wall applications in these areas. Install exposed wall-mounted conduits tight to wall using one-hole straps for conduits 1-1/4 inches and smaller, and use two-hole straps for conduits 1-1/2 inches and larger.
 5. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 6. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
 7. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.
 8. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.
 9. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
 10. Do not use access doors unless special prior written permission is granted from the owner' representative. Install pull boxes, junction boxes, etc. in areas that are accessible after construction. Do not install pull boxes or junction boxes above gypsum board, plaster or similar ceiling systems, nor above ductwork or equipment that renders them inaccessible.
 11. Provide knockout closures to cap unused knockout holes where blanks have been removed.
 12. Install electrical boxes in those locations that ensure accessibility to enclosed electrical wiring.
 13. Do not install boxes back-to-back in walls. Provide not less than 6" (150 mm) separation in general, not less than 16" separation for acoustically rated walls and not less than 24" separation for the following applications: fire walls, fire barriers, smoke barrier walls, and fire partitions. Where outlet boxes are shown back-to-back on common walls, offset accordingly when installed.

14. Neatly cut openings for boxes so that standard size (not "midway" or "jumbo") cover plates will cover all parts of the opening.
15. Position recessed outlet boxes accurately to allow for surface finish thickness. Do not use round boxes.
16. Fasten electrical boxes firmly and rigidly to substrates and structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry as applicable. Provide box supports that are independent of conduit. Refer to Sections 260529 and 260548 for further supporting requirements. Protect boxes from construction debris and damage subsequent to installation of boxes.
17. Use of synthetic or plastic "tie-wraps", "zip ties", "wire ties" and similar products are not permitted as a permanent means of anchoring, securing, supporting or otherwise installing any cables, conductors, conduits, raceways, devices, equipment or other electrical work.
18. Consider the outlet, junction, and pull box locations indicated on drawings approximate. Study the general construction with relation to spaces and equipment surrounding each outlet, and neatly install outlets accordingly.
19. Record junction and pull boxes on record drawings. Permanently mark and label (using methods approved by owner's representative) junction/pullboxes as to which types of electrical services are within. Refer to Section 260502 for further related requirements.
20. Install wiring for different power voltages in raceway systems separate from each other.
21. Install wiring for the various electrical systems in raceway systems that are separate from each other.
22. Install normal system power wiring, emergency system wiring and standby system wiring all in separate raceways from each other. Install normal system power wiring, emergency/life safety system wiring, critical system wiring and standby system wiring all in separate raceways from each other.
23. Install wire in raceway/conduit (sized per NFPA 70) unless specifically permitted otherwise elsewhere in Division 26 sections, or on drawings.
24. Do not install or embed conduits within slabs .
25. Do not install conduits beneath slabs on grade, except where specifically indicated otherwise on drawings, or unless special case by case permission is obtained from owner's representative in the field.
26. Provide steel conduit and steel fittings for indoor above-slab applications, as specified in this section.
27. Provide conduit fittings with insulated throats. Plastic bushings may be used for conduits 2" and larger where insulated throats may not be readily available.
28. Provide pullboxes for conduit runs exceeding 100 feet in length, or having in excess of 270 degrees of offset.
29. Provide maximum of 40 percent fill for raceways, or a threshold of less if required by NFPA 70.
30. Keep raceways at least 12 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above liquid and steam piping. Level and square raceway runs, and install at proper elevations and heights.
31. Do not begin installation of conductors and cables until electrical raceways are complete and until installation locations (end to end) are in a weatherproof environment.
32. Clean inside of conduit before wiring is pulled. Cap and plug conduit ends with standard accessories as soon as conduit has been permanently installed.
33. Comply with requirements in Section 260529 and Section 260548 for hangers and supports.
34. Arrange stub-ups so curved portions of bends are not visible above finished grade or slab.
35. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.
36. Conceal conduit and tubing within finished walls, ceilings, and floor cavities unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

37. Support conduit within 12 inches of enclosures to which attached. Properly support and anchor raceways for their entire length using structural materials. Do not span any space unsupported.
38. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
39. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Fasten conduit terminations in sheet metal enclosures with two locknuts. Install locknuts inside and outside enclosure.
40. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
41. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
42. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean. Field-bend conduits with benders designed for purpose so as not to distort, nor vary, internal diameters. Bring joints to a shoulder. Provide suitable supports and fasteners for conduit.
43. Install exposed conduit parallel to walls, and plumb on walls. Secure to walls and ceiling with pipe straps at intervals not exceeding six feet. Support conduit by approved straps, fasteners and hangers. Provide hangers suspended from rods. Do not use perforated strap.
44. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use, using properly selected and attached manufactured cap (tape of any sort is not permissible).
45. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
46. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
47. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated. In cases where using center of box for measurement would result in a switch-height device having an operable component higher than 48 inches above finished floor, install boxes lower as needed so that uppermost part of operable component is no higher than 48 inches.
48. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
49. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Coordinate all such separations with Architect in advance to ensure boxes are located properly for each application.
50. Locate boxes so that cover or plate will not span different building finishes.
51. Support boxes from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
52. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
53. Provide properly wired electrical connections within enclosures. Anchor enclosures ensuring that they are level, and permanently and mechanically secure.
54. Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for applications as needed to render electrical work fully operational.

55. Mechanically fasten together metal conduits, enclosures, and raceways to form continuous electrically conducting equipment grounding path. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly. Conduit shall be continuous between outlets to make a complete installation and to provide a continuous ground.
 56. Do not use dissimilar metals throughout the systems to eliminate possibility of electrolysis. Where dissimilar metals will be unavoidably in contact, coat surfaces with corrosion inhibiting compound before assembling.
 57. Use rough-in dimensions of electrically operated equipment furnished by equipment installer. Install conduit and boxes for connection to equipment only after reviewing respective equipment and clearance dimensions, and after coordinating with other trades.
 58. Do not use electrical "handy" boxes with surface raceway installations.
 59. Do not cross shafts, or ventilating duct openings, with raceways. Keep raceways a minimum distance of 12" from parallel runs of flues, hot water pipes or other sources of heat. Support risers at each floor level with suitable hangers.
 60. Do not use running threads at conduit joints and terminations - use 3-piece union, or split coupling.
 61. Provide joints made tight with water-tight couplings matching conduit. Install corners with long radius sweep bends, except conduit sizes 1 inch and over where standard elbows may be used.
 62. Provide fasteners that are lead expansion shields in block and concrete, toggle bolts in hollow walls, machine screws on metal surfaces, and wood screws on wood construction.
 63. Provide sleeves in member for conduits passing through structural members.
 64. Where moisture conditions within conduits are encountered above grade, drill a hole at the lowest point in the conduit run so that drainage will not interfere with conditions below.
 65. Where conduit is capped at wall for future additions, do not extend more than threads-length past wall (maximum of 3/4 inch past wall for EMT).
 66. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to, walls of building.
 67. Install exposed conduit work so there is no interference with ceiling inserts, lights, or ventilation ducts or outlets.
 68. Where conduits for outlets on waterproof walls must be installed exposed, set anchors for supporting conduit on waterproof wall in waterproof cement.
 69. Requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces.
 70. Provide a 4 inch reinforced casing of concrete (3000-PSI minimum) around conduits that are installed in cinders or cinder concrete, to protect them.
 71. Install raceways concealed, except in unfinished electrical and mechanical type rooms where raceways may be exposed.
- B. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- C. Stub-ups To Above Accessible Ceilings (TAAC):
1. Use EMT, IMC, or RMC for raceways.
 2. Provide sweep bends and drag line for each application.
 3. Use a conduit bushing or insulated-throat fitting to terminate stub-ups.
 4. Extend conduits to joist space above an accessible ceiling system.
 5. Permanently identify the purpose of the conduit stub at the end of the conduit above the ceiling.
- D. Exposed Conduits and Raceways:
1. Review proposed installation materials, methods, routing, etc. case-by-case and area-by-area for each application with the Architect and Owner prior to installation. Accordingly, prepare installation drawings and submit to design professionals for review and com-

- ment. Revise and resubmit as required based on comments from design professionals. Coordinate with all trades while preparing the installation drawings. Show elevations and routes relative to adjacent work of all trades.
2. Group conduits together in tight banks when routed in the same direction in a given space. Coordinate with mechanical trades and route the conduit banks along common paths wherever possible, and at common elevations unless the conduit banks can be installed directly above or below the mechanical work. Review proposed routes and elevations with design professionals prior to installation.
 3. Install conduits that peel off from banks in a manner that results in the conduits being progressively taken off from the sides of the banks, one at a time without crossing over or under other conduits in the bank. Rise and drop conduits at the same elevation in areas with common visibility.
 4. Provide clean, tight and uniform bends and offsets for all conduits and conduit banks.
 5. Route overhead work perpendicular and parallel to architectural and structural building lines. Do not install work below skylight assemblies or in front of clerestory window assemblies.
 6. Provide surface conduit and raceway for wall-mounted applications only where it is impossible to fish or cut/patch, or only where specifically indicated on drawings, or only where specifically directed by Architect. Improper sequencing of work at walls shall not be used as a reason to surface-mount conduit, boxes or raceways; install all such work concealed as the walls are constructed. Provide conduit in areas that are exclusively utilitarian, such as dedicated mechanical or electrical rooms. Provide finished surface raceway systems for applications in all other areas. Consult with design professionals in advance of any installation for final direction on where to use conduit versus surface raceway systems.
 7. Install conduits and raceways in a manner that minimizes detrimental effects on room aesthetics. For instance, as applicable, rise from below for wall switches, general receptacle outlets and communications wall outlets; drop from above for wall mounted lights, and other system outlets that are installed high on wall; make drops near corners, window casings, door casings, etc.).
 8. Install conduits and raceways as out-of-site as reasonably possible. For instance if an receptacle outlet needs to be installed at the center of a wall and there is no possibility of feeding from below the floor, route the drop in a corner of the room then transition and run horizontally to the outlet location.
 9. Install conduit and raceway with a minimum 2-inch radius control at bend points.
 10. Secure conduit and raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight section. Support according to manufacturer's written instructions.
 11. Utilize supports for wall-mounted applications that cleanly conform to the shape of the conduit or raceway and do not in any way protrude out past the outer contours of the conduit or raceway. As an example, install wall-mounted conduit using two-hole straps instead of conduit hangers. Tape, glue, tie-wraps, clips, wedges, etc. are not acceptable support methods.
 12. Review all proposed mounting means and methods with design professionals for luminaires, devices, outlets, equipment, etc. that will be suspended overhead.
 13. Do not use "trapeze" mounting methods for suspensions unless case-by-case permission is granted by design professionals.
- E. Seals for Common Conduit and Raceways in Dissimilar Environments: Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 2. Where an underground service raceway enters a building or structure.
 3. Where otherwise required by NFPA 70.

- F. Insulation for Common Conduit and Raceways in Dissimilar Environments: Provide insulation on the exterior of conduit on the warm side of penetrations between dissimilar environments to prevent condensation from forming. Insulate with 1.5-inch polyisocyanurate closed cell pipe insulation with an overall PVC jacket for a minimum distance of 48" from the penetration. Applications include, but are not limited to, the following:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.

- G. Expansion-Joint Fittings:
 - 1. Provide expansion fittings at all locations where conduits cross building or structure expansion joints, wherever deflection is expected and as otherwise required to accommodate similar movement.
 - 2. Provide expansion fittings with ground bonding jumpers that are long enough to accommodate respective expansions and movement.
 - 3. Install in each run of aboveground EMT, GRC and IMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 4. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- H. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement, and for transformers and motors. Use LFMC in damp or wet locations.

3.3 INSTALLATION OF EXPOSED CONDUIT OUTDOORS

- A. Only install conduit exposed outdoors when it is impossible to do otherwise, or only if specifically indicated for such installation case-by-case elsewhere in documents. Installation convenience, financial considerations, lack of coordination with other trades and similar rationale are not sufficient reasons for doing so. In cases where conduits must be installed at outdoor locations, de-rate conductors and modify conduit sizes per NFPA 70 (National Electrical Code, NEC). Provide expansion fittings, which are UL listed and labeled for the respective applications, at all building expansion joints and at maximum distances of 100 feet. Paint all such conduits with at least two coats of UV-resistant weatherproof paint. Provide colors to match respective surrounding surfaces; submit colors to Architect for review in advance of procuring paint.

3.4 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies, at penetrations of abutted perimeter walls for building expansions/additions, and where expansion joints are used at walls. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.5 FIRESTOPPING

- A. Fire walls, fire barriers, smoke barrier walls and fire partitions:
 - 1. Steel outlet boxes that do not exceed 16 square inches in area may be used in fire walls, fire barriers, smoke barrier walls, and fire partitions only if the total area of such openings

does not exceed 100 square inches for any 100 square feet of wall area. Verify with local authorities having jurisdiction prior to commencing with related rough-in work.

2. Provide a minimum of 24 inches of separation between outlet boxes on opposite sides of a common wall.
3. Provide outlet boxes, equipment back-boxes, etc. in fire walls, fire barriers, smoke barrier walls, and fire partitions that are of the type tested for use in fire-resistance-rated assemblies. Install in accordance with the tested assembly, and with the instructions included in the listing.

- B. Install firestopping at penetrations of fire-rated floor and wall assemblies. Refer to Section 260502 "Common Electric Materials and Methods". Comply with requirements in Section 078413 "Penetration Firestopping."

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533.00

Submittal Form – 260533.00 – Raceways and Boxes for Electrical Systems

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Raceway Manufacturers (list conduit/raceway type and manufacturer): _____ _____		
Submitted Box Manufacturers (list box type and manufacturer): _____ _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Manufacturers' warranty meets or exceeds the warranty period specified within this specification? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Submitted components meet all requirements listed within this specification? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Will RNC conduits rising from below grade/slab-on-grade be transitioned to GRC conduits as specified? If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>
Confirm yes that no conduits will be embedded in or "scratched-in" just below slabs. If No, Explain _____	<input type="checkbox"/>	<input type="checkbox"/>

SECTION 26 05 53.00 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for raceways.
 - 2. Identification of power and control cables.
 - 3. Identification for conductors.
 - 4. Underground-line warning tape.
 - 5. Warning labels and signs.
 - 6. Instruction signs.
 - 7. Equipment identification labels.
 - 8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Refer to Section 260503, Submittals for Electrical Systems.
- B. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less
 - 1. Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Vinyl Labels for Empty "Spare" conduits
 - 1. Provide labels with description of purpose, and location of opposite end, on each end of conduits provided for future.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
 - 1. Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide (where permitted by NEC for large feeder and sub-feeder conductors).

- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 - 2. Workspace Clearance Warning for 0-150 volts to ground equipment: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.6 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
 - 1. Engraved legend with black letters on white face.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 EQUIPMENT IDENTIFICATION LABELS

- A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background for normal applications. Minimum letter height shall be 3/8 inch.
- B. Provide white letters on a black background for normal power distribution system equipment.
- C. Provide white letters on a red background for power distribution system equipment that is part of an emergency/life safety backup power system.
- D. Provide white letters on a dark gray background for power distribution system equipment that is part of a standby backup power system.
- E. Provide 1/16" thickness for units up to 20 sq. in. or 8" length; provide 1/8" thickness for larger units.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. All equipment & system identification nomenclature shown on drawings and listed herein is shown for general design and installation reference only. Field-verify the actual nameplate, etc. nomenclature prior to fabrication. Prepare record documents accordingly. Unless determined otherwise in field, provide text matching terminology and numbering of the contract documents and submittals.
- C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- D. No labeling is required for raceways with readily identifiable terminations within the same room.
- E. In accessible ceiling spaces and exposed in unfinished areas, label conduit with panel and circuit numbers of conductors routed through the conduit. Label conduit at all wall penetrations and connections to all panels, junction boxes, and equipment served.
- F. Apply identification devices to surfaces that require finish after finish work is complete.
- G. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- H. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- I. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- J. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- K. Cable Ties: For attaching tags. Cut off excess lengths after installing ties. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. Indoors: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less: Identify with self-adhesive vinyl label. Locate at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas. Do not install in finished occupied areas.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Power

- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use color-coding to identify the phase. Color shall be factory applied to conductor insulation or field applied for sizes No. 4 AWG and larger, if authorities having jurisdiction permit. These colors apply for factory-assembled cables as well as for individual insulated conductors.
1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for conductors.
 - a. Colors for 208/120-V Circuits:
 - 1) Phase A: Black
 - 2) Phase B: Red
 - 3) Phase C: Blue
 - 4) Neutral: White
 - b. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown
 - 2) Phase B: Orange
 - 3) Phase C: Yellow
 - 4) Neutral: Gray
 - c. Color for Equipment Grounding:
 - 1) Green
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes, or self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1.
 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 1. Comply with 29 CFR 1910.145.
 2. Identify system voltage with black letters on an orange background.
 3. Apply to exterior of door, cover, or other access.

4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
 - c. Other equipment and components with multiple power or control sources.

- K. Operating and Warning Instruction Signs: Provide pre-manufactured operating and warning signage if indicated on drawings and where required by NEC or local authority having jurisdiction. Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label for normal conditioned areas, and mechanically-fastened engraved, laminated acrylic or melamine label for areas with adverse environments (unconditioned, high humidity, detrimental vapors, etc.). Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
 - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, mechanically fastened.
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure. Secure to substrate with stainless steel fasteners on main switchboards and switchgear and in locations where adhesives cannot be expected to work long-term due to environmental conditions
 2. Equipment to Be Labeled: (Project may not include all pieces of equipment.)
 - a. Panelboards (also including typewritten directory of circuits in the location provided by panelboard manufacturer, and also including clear description of upstream equipment and device from which the power originates).
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear (also include descriptive labels for each section, switch, overcurrent protection device, etc., and also including clear description of upstream equipment and device from which the power originates).
 - e. Switchboards (also include descriptive labels for each section, switch, overcurrent protection device, etc.; additionally include name of engineering firm, name of installing contractor and year of installation for service-entrance switchboards, and also including clear description of upstream equipment and device from which the power originates).
 - f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary, and also including clear description of upstream equipment and device from which the power originates.
 - g. Substations (also include descriptive labels for each section, switch, overcurrent protection device, etc., and also including clear description of upstream equipment and device from which the power originates).
 - h. Emergency system boxes and enclosures.

- i. Motor-control centers (also include descriptive labels for each section, switch, overcurrent protection device, etc., and also including clear description of upstream equipment and device from which the power originates).
 - j. Enclosed switches.
 - k. Enclosed circuit breakers.
 - l. Enclosed controllers/starters.
 - m. Variable-speed controllers.
 - n. Push-button stations.
 - o. Power transfer equipment.
 - p. Contactors.
 - q. Remote-controlled switches, dimmer modules, and control devices, via engraved wall plates.
 - r. Miscellaneous Control Stations.
 - s. Battery-inverter units.
 - t. Battery racks.
 - u. Power-generating units (also include descriptive labels for each output overcurrent protection device, etc.).
 - v. Frequency changers.
 - w. Monitoring and control equipment.
 - x. UPS equipment (also include descriptive labels for each major component section, switch, overcurrent protective device, etc. if not provided by factory).
 - y. Other similar equipment designated by owner's representative, architect or engineer in field.
- M. Emergency Systems: Provide permanent identification for boxes, enclosures, etc. that are associated with emergency system work. Paint and identify emergency system pull boxes, junction boxes, and other access/pull points (boxes and covers) in accordance with NEC. Provide emergency system equipment panelboards, cabinets, enclosures, etc. with engraved nameplates (white letters on red background) with the first line of text to read "EMERGENCY CIRCUITS" and the remaining lines to include the necessary descriptive text.
- N. Fire Alarm Systems: Provide permanent identification for boxes, enclosures, etc. that are associated with fire alarm system work. Paint and identify fire alarm system pull boxes, junction boxes, and other access/pull points (boxes and covers) in accordance with NEC/NFPA. Provide fire alarm system control panel equipment cabinets, enclosures, etc. with engraved nameplates (white letters on red background) with the first line of text to read "FIRE ALARM" and the remaining lines to include the necessary descriptive text.

END OF SECTION 260553.00

Submittal Form - 260553.00 – Identification for Electrical Systems

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep.: _____ Electrical Supplier Rep.: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep. email: _____ Electric Supplier Rep. email: _____

	Yes	No
Are identification products and installation methods included for raceways?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Are identification products and installation methods included for conductors & cables?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Are identification products and installation methods included for equipment identification labels?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Are identification products and installation methods included for other applicable identification products and methods?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Is identification schedule included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted information meets all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 05 84.00 – MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including the following apply to this section:
 - 1. General and Supplementary Conditions
 - 2. Division 01 Specification Sections
 - 3. Division 21 Specification Sections
 - 4. Division 22 Specification Sections
 - 5. Division 23 Specification Sections

1.2 SUMMARY

- A. Section Includes:
 - 1. Supplemental information related to electrical work associated with mechanical equipment and other equipment furnished and/or installed under all other divisions or by others.

1.3 ACTION SUBMITTALS

- A. No submittal actions are required under this specification section. Refer to applicable specification sections for related submittal requirements.

PART 2 - PRODUCTS

2.1 REFER TO APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 GENERAL

- A. Common Requirements
 - 1. Provide all necessary electrically related work as required to render all mechanical equipment (including plumbing, heating, ventilating and air conditioning equipment) fully operational and fully compliant with NEC. This includes, prior to ordering materials or commencing with rough-in, reviewing equipment submittal data and coordinating with installing contractors to ensure the correct size, rating and quantity of conductors are provided.
 - 2. Provide the following supplemental work for aluminum conductor electrical equipment connections, regardless of who furnishes the equipment.
 - a. Provide local disconnect at or near equipment (external to the equipment) and terminate aluminum conductors to the line-side lugs/terminals of the disconnect

switch. Provide copper conductors from load-side lugs/terminals of the disconnect switch to the respective equipment factory disconnect or lugs/terminals as applicable.

- b. Coordinate all related work with all affected installers.
3. Drawn locations of equipment and devices are shown only for schematic indication of wiring requirements. Coordinate with locations and rough-in requirements as required to determine actual locations and termination requirements. Refer to all contract documents for additional electrical requirements and concerns, and for further representation of this work.
 4. Provide raceway, wiring, connections, and terminations for power and interlocks for electrically operated equipment. Provide starters and disconnect switches for mechanical equipment unless specifically indicated otherwise herein or on the drawings.
 5. Provide disconnect switch ahead of all equipment, including controls, unless the mechanical equipment comes with integral NEC-compliant disconnect(s). Provide NEMA 3R enclosures where installed outdoors and where installed indoors in areas subject to moisture. Ground metal frames of equipment by connecting frames to the grounded metal raceway or to a full size green ground conductor or both. Provide the necessary electrical connections between the specified equipment and the junction box near equipment with flexible metallic conduit (liquid-tight outdoors) and matched connectors (see Section 26 05 33). Where mechanical equipment lugs cannot accommodate conductor sizes shown on drawings, provide ILSCO ClearTap Insulated Multi-Tap Connectors.
 6. Sizes, electrical ratings, etc. of equipment and wiring shown on drawings are based on the respective equipment design base manufacturers. If different manufacturer(s) or model(s) are actually supplied, provide necessary coordination in field (prior to ordering materials and prior to rough-in) and provide the necessary size of related electrical equipment, wiring, conduit, etc.
 7. Prior to furnishing submittals and prior to rough-in, determine exact electrically related characteristics, loads, voltages, disconnect and starter requirements, locations, mounting heights, connection points, etc. of mechanical equipment.
 8. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc.
- B. HACR Breakers
1. Coordinate in field with the respective trades and determine case by case, which equipment is factory listed for use with Heating and Air Conditioning Rated (HACR) breakers. In an effort to minimize requirements for stocking of fuses by the owner, utilize HACR breakers at the source panelboards as the NEC required overcurrent protection wherever possible (in lieu of fusing local disconnect switches).
- C. Disconnect Switch and/or Starter Locations
1. Locations shown on drawings are indicated for schematic purposes only. Determine exact locations in field so that they are compliant with NEC Article 110.26.
- D. Maintenance Receptacles for Equipment.
1. Provide duplex receptacle within 25 feet of all electrically operated equipment of any nature that requires periodic testing or maintenance. Provide Type WR duplex GFCI weatherproof receptacle for outdoor applications and for applications subject to high humidity or

moisture. Provide Type WR duplex GFCI weatherproof receptacle at rooftop within 25 feet of all electrically operated rooftop equipment of any nature that requires periodic testing or maintenance.

E. Heating, Ventilating and Air Conditioning (HVAC) Equipment

1. Refer to HVAC / Electrical Coordination Schedule (HECS) on drawings. Provide disconnects, starters, accessories, wiring, connections, services, etc. where defined as "EC" in the schedule. Information in this section supplements the information in the HECS.
2. Provide power wiring and connections for all equipment (including motor dampers and accessories where applicable) as required to render equipment fully operational.
3. Provide engraved plates at all local disconnects and starters with equipment identification and mark indicated.
4. Install local disconnects and starters at 48 inches to top of outlet box or enclosure as applicable above finished floor/slab/grade; provide flush mounted units in finished areas. Provide key operated manual starters where accessible to general staff and general public.

F. Heating, Ventilating and Air Conditioning (HVAC) Control Wiring

1. General
 - a. Unless specifically indicated as empty conduit on drawings or herein, provide electrical control and interlock work as shown on drawings. Provide additional control work as specifically indicated herein.
 - b. Coordinate HVAC thermostat and sensor locations in field (case by case) with Architect, Owner's Representative and equipment installer to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. Field-verify these wall locations case by case, prior to rough-in, since locations shown on drawings are schematic only.
2. Schematic Thermostat and Sensor Locations
 - a. Refer to HVAC drawings and documents.
3. Low Voltage Thermostats and Sensors
 - a. Provide 4 inch square by 2-1/8 inch deep wall outlet boxes at 46 inches above finished floor to center of outlet box (with single-gang rings) for each unit. Provide one 3/4 inch empty conduit from each location, turned out above accessible ceilings (in joist space or against overhead slab/deck). Identify conduit in ceiling cavity; provide sweep bends, bushings and drag line.
4. Line Voltage Thermostats and Sensors
 - a. Provide 4 inch square by 2-1/8 inch deep wall outlet boxes at 46 inches above finished floor to center of outlet box (with single-gang rings) for each unit. Provide line voltage power wiring, in 3/4 inch conduit, and connections from thermostats and sensors to respective equipment that is to be controlled by same. Install thermostats and sensors.

END OF SECTION 260584.00

SECTION 26 09 23.00 – LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. RELATED SECTIONS

1. See Section 26 05 53.00 for special identification-related requirements.
2. See Section 26 05 33.00 for damp and wet location box and cover plate requirements.
3. See Section 26 27 26.00 for manual lighting control devices.
4. See Section 26 27 26.00 for cover plates and related specialties.

1.2 SUMMARY

- A. Section includes:
1. Occupancy sensors
 2. Emergency shunt relays

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all manual lighting control devices, occupancy sensors and time/light-based lighting controls.
 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
1. Include plans, elevations, sections, and details.
 2. Include diagrams for power, signal, and control wiring for occupancy sensors and time/light-based lighting controls.
- C. Special Additional Submittal Requirements for Occupancy Sensors
1. Sensor quantities, types and locations shown on drawings are shown only for schematic representation that a room or area is to have occupancy sensor control. Provide actual sensor quantities, types and locations as needed to provide fully operational coverage for each affected area, and based on submittal review comments by engineer, architect and/or owner.
 2. Submit lighting plans clearly marked by manufacturer showing proper product, location, orientation and coverage (ultrasound or infrared or both as applicable) of each sensor along with quantity of sensors required to provide proper coverage for the respective room or space. Crop all coverage patterns at the extents of the room. Within each space state the ceiling height and the expected mounting height of device to provide 100% coverage.
 3. Select and locate sensors so that controlled lights automatically turn on immediately upon entering the room or space.

4. Select and locate sensors so that controlled lights will not be turned on by motion that occurs outside of the respective room or space (including applicable when doors are open).
5. Select and locate sensors so that full coverage for the respective room/area is provided.
6. Submit interconnection diagrams per major subsystem showing proper wiring.
7. Submit standard catalog literature that includes performance specifications indicating compliance to the specification.
8. Submit catalog sheets that clearly state load restrictions when used with electronic ballasts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain lighting controls (including sensors, etc.) and lighting-control power distribution components from single manufacturer.

2.2 MANUAL LIGHTING CONTROL DEVICES

- A. See Section 262726 "Wiring Devices".

2.3 AUTOMATED LIGHTING CONTROL

2.4 OCCUPANCY SENSORS

- A. General
 1. Related Work
 - a. Provide labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of completely operational occupancy sensor lighting controls, as described herein.
 - b. Provide products supplied from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years.
 - c. Provide occupancy sensors for entire project that are all made by the same manufacturer, regardless of where the materials are specified in Division 26 documents. Provide components that are all made by the same manufacturer in cases where occupancy sensor components are also connected to a building lighting control system, regardless of where the materials are specified in Division 26 documents.
 - d. Provide components that are U.L. listed, offer a five (5) year warranty and meet state and local applicable code requirements.
 - e. Provide products manufactured by an ISO 9002 certified manufacturing facility with a defect rate of less than one-third of one percent.
 - B. General Standards
 1. Provide sensors capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
 2. Provide sensors with coverage that remains constant after sensitivity control has been set. Automatic reduction in coverage due to the cycling of air conditioner or heating fans is not permitted.

3. Provide sensors with readily accessible, user adjustable settings for time delay and sensitivity. Locate settings on the sensor (not the control unit) and recess to limit tampering.
 4. Provide bypass manual override on each sensor to accommodate failures. Configure so that when bypass is utilized, lighting remains on constantly or control diverts to a wall switch until sensor is replaced. Recess this control to prevent tampering.
 5. Provide sensors with an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
 6. Where specified, provide sensor with internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Do not use sensors that utilize separate components or specially modified units to achieve this function.
 7. Provide sensors with UL rated, 94V-0 plastic enclosures.
- C. Basis-of-Design Product: WattStopper (model numbers as specified further below).
- D. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution prior to final addendum for inclusion.
1. Cooper Greengate CA
 2. Hubbell
 3. LC&D
 4. Leviton
 5. Lutron
 6. Sensor Switch
 7. Phillips
- E. Passive infrared sensors
1. Provide sensors that utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion and that provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line). Provide sensors that also have multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.
- F. Dual technology sensors
1. Provide sensors that are either wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas. Provide passive infrared and ultrasonic or microphonic technologies for occupancy detection.
- G. Ultrasonic sensors
1. Provide sensors that utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space. Crystal control operating frequency at 25 kHz within $\pm 0.005\%$ tolerance, 32 kHz within $\pm 0.002\%$ tolerance, or 40 kHz $\pm 0.002\%$ tolerance to assure reliable performance and eliminate sensor cross-talk. Do not use sensors with multiple frequencies.
- H. Ceiling Sensors
1. Provide Standard of Quality equal to WattStopper: WT-605, WT-600, WT-1105, WT-1100, WT-2205, WT-2200, WT-2250, WT-2255, WP-605, WP-1105, WP-2255, WP-2205, W-500A, W-1000A, W-2000A, W-2000H, UT-300, UT-305, UT-355, WPIR, HB-100, HB-150, DT-200, DT-205, DT-300, DT-305, DT-355, CX-100, CX-105, CI-200, CI-205, CI-300, CI-305, CI-355, CI-12 or CI-24 series.
- I. Wall Switch Sensors

1. Provide Standard of Quality equal to WattStopper: PW-100, PW-100-24, PW-200, WI-200, WI-300, WS-200, WD-170, WD-180, WD-270, WD-280, WN-100-120, WN-100-277, UW-100, UW-100-24, UW-200, DW-100, DW-100-24 or DW-200 series.
2. Provide wall switch sensors capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
3. Provide units that accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and that have 180° coverage capability.
4. Provide wall switch products that utilize Zero Crossing Circuitry to increase relay life, protect from the effects of inrush current, and increase sensor's longevity.
5. Provide wall switch sensors that have no leakage current to load, in manual or in Auto/Off mode for safety purposes, and that have voltage drop protection.
6. Where specified, provide wall switch sensors with field selectable option to convert sensor operation from automatic-ON to manual-ON.
7. Where specified, provide vandal resistant wall switch sensors that utilize hard lens with minimum 1.0mm thickness. Do not provide products that utilize a soft lens.

J. Power and Auxiliary Packs

1. Provide Standard of Quality equal to WattStopper: B120E-P, B277E-P, BZ-100, LC-100, C120E-P, C277E-P, S120/277-P, AT-120 or AT-277 series.

K. Circuit Control Hardware

1. Control Units - For ease of mounting, installation and future service, provide control units that are able to be externally mounted through a 1/2" knock-out on a standard electrical enclosure and be integrated, self-contained units consisting internally of isolated load switching control relay and transformer to provide low-voltage power. Provide control units that provide power to a minimum of two (2) sensors.
2. Provide Relay Contacts with ratings of:
 - a. 20A - 120 VAC Ballast
 - b. 20A - 277 VAC Ballast
3. Provide control wiring between sensors and controls units that is Class II , 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums.
4. Provide minimum #12 AWG wire gauge to and from the circuit control hardware relays.

2.5 EMERGENCY SHUNT RELAY

A. Basis-of-Design Product: WattStopper.

B. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.

1. Lighting Control and Design; Acuity Lighting Group, Inc.
2. Bodine

C. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.

1. Coil Rating: 120V or 277V; as indicated on drawings.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation

1. Provide grounded ("neutral") conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.
2. Install equipment and devices only in electrical boxes that are clean, free from building materials, dirt, and debris, and after wiring work is completed. Install wall plates only after respective wall surfaces have received their final finish.
3. Prior to energizing circuits, test wiring for electrical continuity and for short-circuits. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

3.2 OCCUPANCY SENSORS

A. Installation

1. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Provide ninety (90) to one hundred (100) percent coverage in rooms to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the rooms. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. Provide additional sensors if required to properly and completely cover the respective room.
2. Arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
3. Exercise proper judgment in executing the installation to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
4. Provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing controls.

B. Factory Commissioning

1. Upon completion of the installation, provide complete commissioning for controls by the manufacturer's factory authorized technician who will verify adjustments and sensor placement to ensure trouble-free occupancy-based lighting controls.
2. Provide the owner, the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of related work, including fine tuning, provide factory authorized technician training to the owner's personnel in the adjustment and maintenance of the sensors.

END OF SECTION 260923.00

Submittal Form – 260923.00 – Lighting Control Devices

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Lighting Control Manufacturers (list type and manufacturer):		

	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Product data is included for each lighting control device?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Shop drawings are included for each lighting control device that is part of a system?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Special Additional Submittal Requirements for Occupancy Sensors are all included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 24 16.00 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Refer to Section 26 43 13.00 "Surge Protection for Low-Voltage Electrical Power Circuits" for requirements related to suppressors and surge protection devices.

1.2 SUMMARY

- A. Section Includes:
 - 1. Lighting and appliance branch-circuit panelboards

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Field Quality-Control Reports:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Provide two keys for each type of panelboard cabinet lock.
 - 2. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 3. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- B. NECA Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with NFPA 70.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards. Protect during construction.
- B. Handle and prepare panelboards for installation according to either NECA 407 or NEMA PB 1 as applicable.

1.9 PROJECT CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding minus 22 deg F for panelboards with fused switches and 23 deg F to plus 104 deg F for panelboards with circuit breakers.
 - b. Altitude: Not exceeding 6600 feet.
- B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 1. Notify Architect, Construction Manager or Owner no fewer than two days in advance of proposed interruption of electric service.
 2. Do not proceed with interruption of electric service without Architect's, Construction Manager's, or Owner's written permission.
- C. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Enclosures: Refer to electrical drawings and single line diagram for cabinet mounting type (i.e. flush, surface, flush and surface).
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 2. Hinged Front Cover: Entire front trim hinged to box, and with standard door within hinged trim cover. Provide dead front behind standard trim door, bolted in place, to cover bare wiring, lugs, bussing and terminal bars.
 3. Refer to drawings if the additional options are required.
 - a. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.

- b. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
 - 4. Finishes:
 - a. Panels and Trim: Galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel
 - 5. Directory Card:
 - a. Provide neatly typewritten circuit directory card for each panelboard upon completion of installation work. Include the actual room names/numbers that are selected for interior signage/designation.
- B. Incoming Mains Location: Provide incoming main locations (top or bottom, or top and bottom) based on means and methods conduit/raceway layouts that are planned for installation.
- C. Phase, Neutral, and Ground Buses: Refer to electrical drawings, single line diagram and schedules for additional information on requirements for Buses, as applicable.
 - 1. Material: Tin-plated copper.
 - 2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box; minimum 50 percent rated.
- D. Conductor Connectors: Suitable for use with conductor material and sizes.
 - 1. Material: Tin-plated aluminum
 - 2. Main and Neutral Lugs: Mechanical type.
 - 3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
 - 4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 - 5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 - 6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
- E. Future Devices: Provide all mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Fault Current Ratings
 - 1. Provide electrical distribution related equipment with appropriately braced bussing and properly rated breakers, fuses, etc. for the available fault currents.
 - 2. In existing buildings where fault current values are not indicated on drawings, coordinate with existing "upstream" distribution equipment, and provide equipment AIC ratings that meet or exceed same.
- G. Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information.
- H. Provide panelboards with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.
- I. Provide panelboards that are new and manufacturer's latest standard catalog design. Provide panelboards that bear UL labels for their specific applications. Provide panelboards suitable for service voltage with number of branch circuits of capacity scheduled.

- J. Provide panelboards, and sections thereof if applicable, with main-lugs-only of capacity equal to, or greater than, the rating or setting of the overcurrent protective device next back on the line.
- K. Provide panelboard branches as scheduled on the drawings. Provide circuit breaker panelboard bus assemblies with distributed (sequence) type bussing throughout, so that any two adjacent single-pole breakers, or spaces, are replaceable by a two-pole internal common trip breaker, and so that any three adjacent single-pole breakers, or spaces, are replaceable by a three-pole internal common trip breaker. This applies for branch breakers sized 15 amp through 70 amp inclusive, without disturbing any other breaker.
- L. Provide panelboards that are UL listed and labeled for use as service entrance equipment. Provide dead-front safety type panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types, and with arrangement shown. Provide with anti-turn solderless pressure type main lug connectors approved for use with copper or aluminum conductors.
- M. Provide full-sized (100 percent) neutral bus as a minimum; provide 200 percent rated neutral buses where/if indicated on drawings. Provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide panelboards with bare uninsulated grounding bars suitable for bolting to enclosures.
- N. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution
 - 3. Siemens Industry, Inc.
 - 4. Square D; a brand of Schneider Electric
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Refer to electrical drawings and single line diagram for type of mains required. If none are indicated contractor shall confirm with engineer prior to ordering of equipment.
- D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- F. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit
 - 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution

3. Siemens Industry, Inc.
 4. Square D; a brand of Schneider Electric
- B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
 3. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Mounting: Designed to be mounted and operated in any physical position, and to be operated in a minimum ambient temperature of 40 degrees C.; with mechanical screw type removable connector lugs, AL/CU rated.
 - e. Size: Full size, no "tandem" or "split" breakers.
 - f. Position: All load-side box lugs of each breaker in the same gutter.
 - g. Common Trip: Common trip for multi-pole breakers so overload on one pole will trip all poles simultaneously. Provide multi-pole breakers with common trip or with handle-ties (if needed because breakers have already been installed) for applications where it is determined that a common disconnecting means is required for multi-wire branch circuits serving, or within, the same enclosure, outlet box, equipment, or device.
 - h. SWD Type: Provide 15 and 20 ampere branch circuit breakers that are UL Listed as SWD (switching duty).
 - i. HACR Type: Provide 15 through 70 ampere branch circuit breakers that are HACR Type.
 - j. Spares: Place all spare circuit breakers in the 'OFF' position and provide with breaker locks.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

2.4 ACCESSORIES

- A. Provide panelboard accessories and devices including, but not necessarily limited to, branch circuit breakers, neutral & ground busses, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.
- B. Provide distribution equipment with ground bus bars. Except where used as service entrance equipment, or as a derived system, provide insulated stand-off for neutral bus bars.
- C. Provide a minimum of 20 handle, lock-on devices of the non-padlocking type for life safety, special systems and other essential circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to either NECA 407 or NEMA PB1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to either NECA 407 or NEMA PB1.1. Provide enclosures fastened firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are level, and permanently and mechanically secure, plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- C. Mount top of trim 90 inches above finished floor unless top most breaker handle would end up being above 79 inches in which case the top of trim shall be mounted so that the top most breaker handle would be below 79 inches.
- D. Provide properly wired electrical connections for panelboards within enclosures.
- E. Install overcurrent protective devices and controllers not already factory installed.
 - 1. Set field-adjustable, circuit-breaker trip ranges.
- F. Install filler plates in unused spaces.
- G. Provide neatly typewritten circuit directory card for each panelboard upon completion of installation work. Include the actual room names/numbers that are selected for interior signage/designation. Scheduling shown on drawings is shown to indicate feeder and branch circuiting requirements. Determine exact numbering sequence of circuits in field after performing final balancing.
- H. If applicable, arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.
- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 05 53.00 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 05 53.00 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 05 53.00 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. Panelboards will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as indicated.
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
 - 1. Measure as directed during period of normal system loading.
 - 2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
 - 4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416.00

Submittal Form – 262416.00 – Panelboards

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep. email: _____ Electric Supplier Rep email: _____

Submitted Manufacturer: _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified in this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed in this specification and on drawings?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Product data submittal information specified in this section is all included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Shop drawing submittal information specified in this section is all included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Fault current bracing meets or exceeds the available fault current at each component?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Fault current ratings for all overcurrent protective devices meet or exceed the available fault current at the respective overcurrent protective device?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submittals were prepared after coordinating information shown on drawings in power eqt. schedules, in misc. eqt. schedules, in feeder schedule and on single-line or riser diagram?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 27 26.00 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. See Section 26 05 33.00 for weatherproof cover plate requirements.
- C. See Section 26 05 53.00 for special identification-related requirements.
- D. See Section 26 09 23.00 for Occupancy Sensors.
- E. See E-series drawings for Occupancy Sensors.

1.2 SUMMARY

- A. Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color selections with Owner's representative.
- B. Section Includes:
 - 1. Receptacles
 - 2. Switches
 - 3. Communications outlets
 - 4. Device wall plates

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge protection device.
- F. Tamper-resistant: This term and "safety type" shall be taken to mean the same thing for receptacles.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Receptacles for Owner-Furnished Equipment: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper)
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell)
3. Hubbell Incorporated; Wiring Device-Bryant (Hubbell)
4. Leviton Mfg. Company Inc. (Leviton)
5. Pass & Seymour/Legrand (Pass & Seymour)
6. Lutron Electronics, Inc. (Lutron)
7. Hubbell Incorporated (Hubbell)
8. Wiremold/Legrand (Wiremold)
9. FSR Inc. (FSR)

- B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.
- C. For receptacle circuits protected with 15A breakers, provide NEMA 5-15R equivalents for the devices shown below.

- D. Provide Weather-Resistant Receptacles with UL "WR" marking, compliant with NEC 406.8, for all applications in wet or damp locations.
- E. Where GFI protected receptacles are shown on drawings, provide a separate GFI receptacle for each one shown. Do not feed downstream receptacles from load-side (GFI-protected) terminals of upstream receptacles.

2.3 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R (20A) or 5-15R (15A), UL 498, and FS W-C-596.
 - 1. Provide duplex and single specification grade receptacles, 2-pole, 3-wire grounding, self-grounding, green grounding screw, ground terminals and poles internally connected to mounting yoke, color coded base, 20-amperes, 125-volts, with metal plaster ears, back & side wiring, NEMA configuration 5-20R.
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), CR5362 (duplex)
 - b. Hubbell; HBL5351 (single), HBL5352 (duplex)
 - c. Bryant; 5351 (single), 5352A (duplex)
 - d. Leviton; 5351 (single), 5362 (duplex)
 - e. Pass & Seymour; 5351 (single), 5362 (duplex)

2.4 GFCI RECEPTACLES

- A. General Description:
 - 1. Straight blade, feed-through or non-feed-through type depending on application.
 - 2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
 - 3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; VGF20.
 - b. Hubbell; GF20#LA.
 - c. Bryant; GF20#LA.
 - d. Pass & Seymour; 2095.
 - e. Leviton; 6490

2.5 TWIST-LOCKING RECEPTACLES

- A. Devices specified below are 125 V, 20 A. Provide equivalent quality devices by manufacturers listed in subparagraphs hereafter for cases where different voltage, amperage and/or NEMA configurations are indicated on drawings.
- B. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; CWL520R

- b. Hubbell; HBL2310
 - c. Bryant; 70520FR
 - d. Leviton; 2310
 - e. Pass & Seymour; L520-R
- C. Single Receptacles, 125 V, 30 A: Comply with applicable requirements of NEMA, Configuration L5-30R, and UL.
- 1. Products: Subject to compliance with requirements, provide product equivalent to the following:
 - a. Hubbell; HBL2610.
 - b. Bryant; 70530FR

2.6 TOGGLE SWITCHES

- A. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- B. Switches, 120/277 V, 20 A:
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Single Pole:
 - 1) Cooper; AH1221.
 - 2) Hubbell; HBL1221.
 - 3) Bryant; 1121
 - 4) Leviton; 1221-2.
 - 5) Pass & Seymour; CSB20AC1.
 - b. Two Pole:
 - 1) Cooper; AH1222.
 - 2) Hubbell; HBL1222.
 - 3) Bryant; 4902
 - 4) Leviton; 1222-2.
 - 5) Pass & Seymour; CSB20AC2.
 - c. Three Way:
 - 1) Cooper; AH1223.
 - 2) Hubbell; HBL1223.
 - 3) Bryant; 4903
 - 4) Leviton; 1223-2.
 - 5) Pass & Seymour; CSB20AC3.
 - d. Four Way:
 - 1) Cooper; AH1224.
 - 2) Hubbell; HBL1224.
 - 3) Bryant; 4804
 - 4) Leviton; 1224-2.
 - 5) Pass & Seymour; CSB20AC4.
- C. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors, or other applications, with factory-supplied key in lieu of switch handle.
- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L
 - b. Hubbell; HBL1557L
 - c. Bryant; 4921L
 - d. Leviton; 1257L
 - e. Pass & Seymour; 1251L

2.7 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
 - 1. Plate-Securing Screws: Metal with head color to match plate finish.
 - 2. Material for Finished Spaces: satin finish stainless steel, equal to Leviton Type 430 series
 - 3. Material for Unfinished Spaces with surface-mounted outlet boxes: Galvanized steel
 - 4. Material for Indoor Damp Locations: satin finish stainless steel, equal to Leviton Type 430 series
 - 5. with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant. Refer to Section 26 05 33.00.

2.8 FINISHES

- A. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: Gray unless otherwise indicated or required by NFPA 70 or device listing.
- B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Provide grounded ("neutral") conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.
 - 2. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 3. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 4. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

5. Existing Conductors:
- a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
10. Install wiring devices only in electrical boxes that are clean; free from building materials, dirt, and debris. Install wiring devices after wiring work is completed. Install wall plates only after respective wall surfaces have received their final finish.
11. Consider locations indicated on the drawings to be approximate (unless specifically dimensioned on drawings). Determine exact locations of each floor outlet, case by case, after consulting with Owner and Architect, and after reviewing architectural documents so outlets are properly located to accommodate the final furniture and equipment layouts. Study the general construction with relation to spaces and equipment surrounding each outlet.
12. Do not use aluminum products in concrete.
13. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Support boxes independent of conduit.

- E. Receptacle Orientation: Install receptacles so that the ground pin is oriented in a consistent manner throughout the facility, so that the orientation is compliant with all prevailing codes and regulations, and so that the orientation is acceptable to the electrical inspector. Where no existing building standard or owner project requirement, install receptacles with ground pin down. Where receptacles are installed horizontally, install such that neutral connection faces up.

- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

- G. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

- H. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install feed-through-type GFCI receptacles where downstream receptacles are fed from the line side of the GFCI receptacle.

3.3 IDENTIFICATION

- A. Comply with Section 26 05 53.00 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
- B. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- D. Wiring device will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 262726.00

Submittal Form – 262726.00 – Wiring Devices

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Submitted Manufacturers (list device type and manufacturer):		

	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Wiring device colors have been coordinated with Architect?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Product data submittals are clear, crisp and distinctly legible – including graphics?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Product data submittals are clearly marked as to exactly which devices are submitted for review with the understanding that all unmarked devices will be ignored during review?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 28 13.00 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cartridge fuses rated 600-V ac and less.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - 1. Ambient temperature adjustment information.
 - 2. Current-limitation curves for fuses with current-limiting characteristics.
 - 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
 - 4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three (3) of each size and type.

1.6 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Comply with UL 248-11 for plug fuses.

1.7 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.8 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Mersen, Inc.
 - 4. Littelfuse, Inc.

2.2 GENERAL REQUIREMENTS

- A. Characteristics:
 - 1. 50 through 60 Hz., with 200,000 RMS symmetrical interrupting current rating.
 - 2. 250V rated, for projects with service-entrance line to line voltage not exceeding 240V.
 - 3. 600V rated, for projects with service-entrance line to line voltage not exceeding 600V.
 - 4. Provide rejection type fuses for fuses 1 ampere through 600 amperes.
 - 5. Provide Hi-Cap, bolt type fuses for fuses 601 amperes through 6000 amperes.
 - 6. Provide each fuse with clear factory markings indicating classification, characteristics, ampere ratings, voltage ratings, etc.

2.3 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. For protecting transformers, motors, circuit-breakers, service entrances, and distribution feeders above 600 amperes:
 - 1. Provide UL Class L Current-Limiting/Time-Delay Fuses. Provide fuses that are current-limiting, time-delay, dual-element type (with pure silver links), equal to Bussman #KRP-C (low peak).
- B. For protecting service entrances, and distribution feeders 600 amperes and below:
 - 1. Provide UL Class RK-1 Current-Limiting/Time-Delay fuses Provide fuses that are current-limiting, time-delay, dual-element type (with pure silver links), equal to Bussman #LPS-RK1 (600V) or Bussman #LPN-RK-1 (250V) as applicable.
- C. For protecting general duty motors:
 - 1. Provide UL Class RK-5 Current-Limiting/Time-Delay fuses Provide fuses that are time-delay, dual-element type (with pure silver links), equal to Bussman #LPS-RK5 (600V) or Bussman #LPN-RK-5 (250V) as applicable. Provide fuses that are rated 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install plug-fuse adapters in Edison-base fuseholders and sockets. Ensure that adapters are irremovable once installed.
- C. Provide fuses as required to render related electrical, and electrically operated, equipment fully operational. Do not ship fuses installed in switches. Do not install fuses in equipment until the equipment is ready to be energized.
- D. Field verify recommended fuse size and type from respective equipment installer and/or manufacturer prior to installing fuses for protection of specific equipment, motors, etc. Contact engineer if a conflict in fuse size or type arises between manufacturer's recommendations and above specifications.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813.00

Submittal Form – 262813.00 – Fuses

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep. email: _____ Electric Supplier Rep email: _____

Submitted Manufacturer: _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified in this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed in this specification and on drawings?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Product data submittal information specified in this section is all included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Fault current bracing meets or exceeds the available fault current at each component?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Fault current ratings for all overcurrent protective devices meet or exceed the available fault current at the respective overcurrent protective device?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submittals were prepared after coordinating information shown on drawings in power eqt. schedules, in misc. eqt. schedules, in feeder schedule and on single-line or riser diagram?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 28 16.00 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

1. Switches.
2. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 1. Enclosure types and details.
 2. Current and voltage ratings.
 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.
 1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.
- B. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.
- B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NFPA 70.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 2. Altitude: Not exceeding 6600 feet (2010 m).

1.9 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc.
- B. Fault Current Ratings
 1. Provide electrical distribution related equipment with appropriately braced terminals and properly rated breakers, fuses, etc. for the available fault currents.
 2. In existing buildings where fault current values are not indicated on drawings, coordinate with existing "upstream" distribution equipment, and provide equipment AIC ratings that meet or exceed same.

2.2 SWITCHES

- A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.
1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Industry, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Characteristics:
1. 50 through 60 Hz., with 200,000 RMS symmetrical interrupting current rating.
 2. 250VAC rated, for projects with service-entrance line to line voltage not exceeding 240V.
 3. 600VAC rated, for projects with service-entrance line to line voltage not exceeding 600V.
- C. Type HD, Heavy Duty, Single Throw: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate required fuses where applicable, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Accessories:
1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 4. Lugs: Mechanical type, suitable for number, size, and conductor material.
 5. Service-Rated Switches: Labeled for use as service equipment.

2.3 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location. Refer to drawings for NEMA type. Provide the following enclosure types if not noted on drawings, or if not noted otherwise on drawings.
1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Other Wet or Damp, Indoor Locations: Type 3R.
 4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install individual wall-mounted units with tops at uniform height unless otherwise indicated, or unless units must be stacked vertically, or unless field conditions otherwise dictate.
- B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- C. Install fuses in fusible devices.
- D. Comply with NECA 1.
- E. Install disconnect switches within sight of controller position unless otherwise indicated.
- F. Size units according to load being served or as noted on drawings, whichever requirement is larger. Provide units with horsepower ratings suitable to the loads where applicable. Install overloads and fuses as necessary to fulfill requirements of each application as applicable.
- G. Subsequent to completion of installation of equipment, energize circuits and demonstrate capability and compliance with requirements. Begin by demonstrating switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure and inspect interiors, inspect mechanical and electrical connections, inspect fuse/overload installations, and verify accuracy of type and rating of fuses/overloads installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

3.3 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each unit, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges

END OF SECTION 262816.00

Submittal Form – 262816.00 – Enclosed Switches and Circuit Breakers

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep. email: _____ Electric Supplier Rep email: _____

Submitted Manufacturer: _____		
	Yes	No
Manufacturers listed as basis of design or listed equivalent manufacturers?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers' warranty meets or exceeds the warranty period specified in this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted components meet all requirements listed in this specification and on drawings?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Product data submittal information specified in this section is all included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Shop drawing submittal information specified in this section is all included?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Fault current bracing meets or exceeds the available fault current at each component?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Fault current ratings for all overcurrent protective devices meet or exceed the available fault current at the respective overcurrent protective device?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submittals were prepared after coordinating information shown on drawings in power eqt. schedules, in misc. eqt. schedules, in feeder schedule and on single-line or riser diagram?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

SECTION 26 51 00.00 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Interior luminaires, lamps, and ballasts
 - 2. Exit signs
 - 3. Luminaire supports
- B. Related Sections:
 - 1. Section 26 09 23.00 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multi-pole lighting relays and contactors.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories (including but not limited to ballasts, drivers, power supplies, lamps, LED cards, etc.): Listed and labeled as defined in NFPA 70 section , by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

1.4 DEFINITIONS

- A. BF: Ballast factor.
- B. CCT: Correlated color temperature.
- C. CRI: Color-rendering index.
- D. HID: High-intensity discharge.
- E. Labeled: Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
- F. LER: Luminaire efficacy rating.

- G. Listed: Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.
- H. Lumen: Measured output of lamp, luminaire, or both.
- I. Luminaire: Complete lighting unit consisting of lamps or sources, and some or all of the following components: optical control devices, sockets, mechanical components to support or attach the luminaire, and electrical and electronic components to start, operate, dim or control and maintain the operation of the lamps or LEDs.

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Arrange luminaire submittals in booklet form with separate sheets for each luminaire, assembled by luminaire "type" in alphabetical order.
 - 2. Submit details indicating compatibility with ceiling grid system.
 - 3. Provide lamp or source and ballast/low voltage transformer/LED driver schedules (by luminaire type). Provide technical submittal data in separately tabbed sections for lamp or source submittals and for ballast, low voltage transformer or LED driver submittals.
 - 4. If third party components are provided with a luminaire to meet the specification, the product data sheet for these components must also be provided with the luminaire product data sheet; simply "marking up" the luminaire product data sheet is unacceptable.
 - 5. Product data sheets prepared solely by a Distributor or Contractor are unacceptable. Product data sheets shall be submitted with the manufacturer's representative's header on each sheet. Failure to provide product data sheets in this format will result in immediate return of the submittal package without review.
- B. Only fully complete submittals will be reviewed. Failure to provide lamp/source and ballast/ low voltage transformer/LED driver submittals at time of luminaire submittal will result in immediate return of submittal package without review.
- C. Submit Lighting Control Device, System and Accessory submittal(s) at the same time and in conjunction with the Luminaire submittal to verify that all associated components are verified with each other. None of the submittals will be reviewed apart from the other; they will be returned, marked "Revise and Resubmit". Failure to provide all submittals pre-coordinated and concurrently will result in immediate return of submittals, without review, and marked "Revise and Resubmit" with no further comments. This applies for the following specification sections.
 - 1. 26 09 23.00 Lighting Control Devices.
 - 2. 26 27 26.00 Wiring Devices.
- D. Include data sheets for the following:
 - 1. Luminaire
 - a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
 - b. Datasheets shall include dimensions, finishes and technical support data including energy efficiency data. Provide data sheets for applicable luminaire support and accessories.

- c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet.
 - d. Where datasheets depict multiple products, versions or options, the Contractor shall highlight (indicate with an arrow) all applicable model(s), version(s) and option(s) applying to the specific product the Contractor will be providing. The submitted items must be from "approved materials".
 2. Lamps
 - a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
 - b. Datasheets shall include all technical data described in this section and data including, but not limited to, life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
 - c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet.
 3. Ballasts
 - a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
 - b. Datasheets shall include all technical data described in this section and energy-efficiency data.
 - c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet
 4. Low voltage transformer/systems.
 - a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
 - b. Datasheets shall include all technical data described in this section and energy-efficiency data.
 - c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet
 5. LED Source and Driver System
 - a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
 - b. Datasheets shall include:
 - c. Voltage
 - d. Input watts
 - e. Energy efficiency data
 - f. Initial Lumen output
 - g. Source correlated color temperature (CCT)
 - h. Source color rendering index (CRI) value
 - i. Provide verification the system has been tested to IES LM-79-2008 standards
 - j. The system is RoHS compliant, lead free and mercury free
 - k. Name the LED manufacturer
 - l. Provide verification the LED's have been tested to IES LM-80-2008 standards and the rated life of the system in hours
 - m. Warranty for LED's and driver
 - n. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet
 6. Exit signs.
- E. Within 16 business hours of request by the Designer or Owner's Representative, submit the following for review:
 1. Quality Assurance support documentation, as identified in each this section.
 2. Bill of Materials, with unit pricing.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.
1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes. List by luminaire "type".
 2. Provide a list of all ballast types used on Project; use ANSI and manufacturers' codes. List by "type".
 3. Provide a list of all LED sources and driver types used on Project; use ANSI and manufacturers' codes. List by luminaire "type".

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps: 15 for every 100 of each type and rating installed. Furnish at least four of each type.
 2. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 3. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 COORDINATION

- A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products indicated on Drawings . Provide products of one of the manufacturers listed in this section for products that are not defined on the Luminaire Schedule. Provide specification grade luminaires that comply with minimum requirements as stated therein. If a particular "type" does not include basis of design manufacturer or model number, provide "pre-approved equivalent" manufacturer's and model numbers compliant with, and equivalent to: quality, performance, dimensions, and aesthetics as the respective basis of design for Designers review no less than five business days prior to bid due date.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

- A. Luminaires designated by letters are defined as indicated on the Luminaire Schedule.
- B. Provide luminaires, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lampholders, reflectors, energy efficient ballasts, starters and wiring. Ship luminaires factory-assembled, with components required for a complete operating installation.
- C. Recessed Luminaires:
 - 1. Comply with NEMA LE 4 for ceiling compatibility for recessed luminaires.
 - 2. Provide recessed luminaires with necessary gypsum board, plaster frames, and surface trim.
 - 3. Provide recessed luminaires that are constructed without rolled edges and that are post-painted.
 - 4. Provide door frames on troffer style luminaires with spring latches on door frames.
 - 5. Provide static air function for luminaires unless otherwise noted.
 - 6. Provide luminaires that are non-IC constructed unless otherwise noted.
 - 7. Provide junction boxes and serviceable components (ballasts, thermal protection devices, fuses, etc.) for recessed luminaires that are accessible for service and replacement from below the ceiling, without removing ceiling components.
 - 8. Where plaster frames are inferred for luminaires (either by narrative, or by catalog number, or by application) interpret the actual function to mean for mounting within gypsum board, wet plaster or similar type inaccessible ceiling system. Field verify related requirements and provide required accessories, such as frames, accordingly.
 - 9. Provide UL approved (listed and labeled) thermal protection per latest edition of NFPA/NEC for recess mounted luminaires.
 - 10. Provide recessed fluorescent luminaires that are suitably constructed to operate with "P" rated ballasts as specified hereafter.
- D. Surface Luminaires: Install surface mounted ballasted luminaires with air spaces between luminaire and surface per latest edition of NFPA/NEC. Provide factory luminaire wiring that is per NEC, #16 AWG minimum. Wire luminaires having medium base and mogul base sockets with not smaller than No. 16 or No. 14 wire respectively in accordance with the latest requirements of the National Electric Code.
- E. Review drawings and specifications of other trades to verify ceiling types, modules, and suspension systems appropriate to installation.
- F. Incandescent Luminaires: Comply with UL 1598.
- G. Fluorescent Luminaires: Comply with UL 1598.
- H. HID Luminaires: Comply with UL 1598.
- I. Metal Parts: Free of burrs and sharp corners and edges.
- J. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- K. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Fabricate luminaires with concealed hinges

and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise

L. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
 - b. UV stabilized.
2. Glass: Annealed crystal glass unless otherwise indicated.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - f. CCT and CRI for all luminaires.

N. Provide fusing for high intensity discharge (HID/H.I.D.) luminaires.

O. Provide open Metal-Halide luminaires with open-rated sockets and open-rated lamps. Provide Metal-Halide luminaires with clear tempered glass lenses to protect persons from possible violent end of lamp life. This applies throughout the project though this may not be written into the Luminaire Schedule.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Provide same manufacturer and catalog number for ballasts of the same type. Refer to the drawings for input voltage requirements. If fusing requirements are indicated herein or on the Luminaire Schedule, fuse each ballast separately with a replaceable fuse external to the ballast.
2. Provide ballasts that are compatible with power line carrier systems, and that do not adversely impact such systems.
3. Provide luminaires shown on drawings with multi-level switching or similar special circuiting with multiple ballasts. Provide single ballasts wherever possible for other applications.
4. Provide outdoor ballasts (or ballasts indoors, but in unconditioned areas) that are cold weather low starting temperature type (-20 degrees Fahrenheit).
5. Comply with UL 935 and with ANSI C82.11.
6. Designed for type and quantity of lamps served.

7. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
 8. Sound Rating: Class A.
 9. Total Harmonic Distortion Rating: Less than 20 percent.
 10. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 11. Operating Frequency: 42 kHz or higher.
 12. Lamp Current Crest Factor: 1.7 or less.
 13. BF: 0.88 or higher.
 14. Power Factor: 0.95 or higher.
- B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.
- C. Electronic Programmed-Start Ballasts for T8, T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:
1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
 2. Automatic lamp starting after lamp replacement.
- D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
1. Ballast Manufacturer Certification: Indicated by label.
- E. Ballasts for Low-Temperature Environments:
1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.
- F. Ballasts for Dimmer-Controlled Luminaires: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
 2. Ballast Input Watts: Can be reduced to 20 percent of normal.
 3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
 4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated: Solid State Rapid Start Electronic Fluorescent Lamp Ballasts - Compact Fluorescent Lamps
1. Lamp end-of-life detection and shutdown circuit.
 2. Automatic lamp starting after lamp replacement.
 3. Sound Rating: Class A.
 4. Total Harmonic Distortion Rating: Less than 20 percent.
 5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
 6. Operating Frequency: 20 kHz or higher.
 7. Lamp Current Crest Factor: 1.7 or less.
 8. BF: 0.95 or higher unless otherwise indicated.
 9. Power Factor: 0.95 or higher.

10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.

2.6 FLUORESCENT LAMPS

- A. Lamps shall be manufactured by G.E., Osram Sylvania or Philips.
- B. T8 rapid-start lamps, CRI 82 (minimum), and average rated life 20,000 hours unless otherwise indicated. Refer to Luminaire Schedule for wattage and color temperature.
- C. T5 rapid-start lamps, CRI 85 (minimum), and average rated life 20,000 hours unless otherwise indicated. Refer to Luminaire Schedule for wattage and color temperature.
- D. T5HO rapid-start, high-output lamps, CRI 85 (minimum), and average rated life 20,000 hours unless otherwise indicated. Refer to Luminaire Schedule for wattage and color temperature.
- E. Compact Fluorescent Lamps, Twin-Tube/Dual Twin-Tube and Triple-Tube, CRI 80 (minimum), color temperature as indicated in Luminaire Schedule, average rated life of 10,000 hours at three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.

2.7 LIGHT EMITTING DIODE (LED) SYSTEMS

- A. Light Emitting Diode (LED) Systems
 1. LED Source
 - a. Provide factory installed LED modules that are specifically designed for, and matched and mated to, the respective luminaire in which they are used.
 - b. Provide LED modules that can easily be replaced in the field and are readily accessible for replacement.
 - c. Provide color temperature as indicated in Luminaire Schedule.
 2. LED Driver
 - a. Provide factory installed driver(s) for the LED source utilized that are specifically coordinated to the LED source and luminaire in which they are used.
 - b. Provide driver(s) having specific operating characteristics defined in the Luminaire Schedule.
 - c. Provide driver(s) that can easily be replaced in the field and are readily accessible for replacement.
 - d. Provide specification sheet for the specific driver as part of the Luminaire Submittal.

2.8 LUMINAIRE SUPPORT COMPONENTS

- A. Support fixtures in compliance with NEC.
- B. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- C. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- D. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.
- E. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- F. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- G. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- H. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.
- I. Provide additional supports as required in seismic areas.
- J. For gymnasiums, lab spaces and other open ceiling spaces where fixtures are suspended, provide an additional air craft cable support securely fastened to act as a safety chain providing a redundant support. Decorative pendants are exempt from this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Luminaires:
 - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
 - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.
- D. Lay-in Ceiling Luminaires Supports: Use grid as a support element.
 - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
 - 2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.

3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
- E. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
 2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
 4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- G. Install surface and recessed ceiling luminaires on grid and tile ceilings to agree with module of ceiling either displacing a tile, or unit on center of tile, or centered on grid lines.
- H. Install flush mounted luminaires properly to eliminate light leakage between luminaire frame and finished surface.
- I. Do not locate splice or tap within an arm, stem, or chain. Provide wiring continuous from splice in outlet box of the building wiring system to lamp socket, or to ballasts terminals in fluorescent luminaires.
- J. Provide Type AC/MC Cable or wiring in minimum 1/2" diameter flexible metal conduit (with full parity sized green insulated equipment ground wire) for "drops" from building wiring system junction boxes to suspended ceiling mounted luminaires. Limit the length of these "drops" to 72". Install "drops" to luminaires in gypsum board, and similar inaccessible ceiling systems, from identified accessible junction boxes.
- K. Connect luminaires utilized for emergency egress lighting ahead of switching and other controls. The only exceptions to this are photocell-only controls for outdoor emergency egress luminaires.
- L. Provide luminaires and luminaire outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Owner's representative and review by ceiling installer. Anchor luminaires installed in, or on, suspended ceiling systems in strict compliance with NEC, including advance coordination with the ceiling installer. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box luminaire stud.
- M. Fasten electrical luminaires and brackets securely to structural supports. Install luminaires level and plumb.
- N. Where special mounting conditions are encountered, such as mounting to rounded columns or similar special circumstances, provide special factory fabricated mounting means (i.e., brackets designed to conform with curvature of rounded columns, or to conform with similar special surfaces).
- O. Provide stems and chains for luminaires as designated by the Owner's representative where deemed necessary by the owner's representative to achieve a functional and neat installation.

Contact owner's representative to determine pendant, stem, and chain lengths if mounting height is not indicated.

- P. Provide plaster frames, or gypsum board frames, or similar kits for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.
- Q. Wear clean white cotton gloves when handling the luminaires reflective and diffusing surfaces. Clean surfaces including dust, finger prints, paint, etc with a clean dry cheesecloth after interior work has been completed. Remove plastic shipping bags from luminaires only after work in the respective area is complete.
- R. Where applicable, verify that measured illuminance values comply with respective isolux (or equivalent) plot diagram values.
- S. Provide full assembly for luminaires that are shipped with any loose components, regardless of who furnishes the luminaires.

3.2 LIGHTING STANDARDS AND POST LIGHTS

- A. Utilize belt slings or rope (not chain or cable) to protect finishes of poles and standards when raising and setting finished poles and standards.
- B. Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling where applicable.
- C. Fasten electrical poles, luminaires and brackets securely to structural supports.
- D. Provide concrete base for each luminaire standard pole. Provide base that is reinforced, and, unless indicated deeper on drawings, of the depth recommended by the manufacturer. Provide galvanized steel washers, nuts and anchor bolts, in diameters, lengths and classes as directed by pole manufacturer.
- E. After ensuring that the poles are plumb, neatly fill the entire space between top of concrete bases and bottom of pole bases with grout. Provide poles with matching factory base covers ("skirts"). This applies even if not specifically indicated on Luminaire Schedule.
- F. Separately-fuse luminaires within the pole-base handholes.

3.3 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 STARTUP SERVICE

- A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.
 - 1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 26 51 00.00

Submittal Form - 265100.00 – Luminaires

Provide and complete this sheet and submit as a cover sheet for submittals requested within this section.

Electrical Contractor: _____ Electrical Supplier: _____

Electrical Contractor Rep: _____ Electrical Supplier Rep: _____

Electric Contractor Ph. Number: _____ Electric Supplier Ph. Number: _____

Electric Contractor Rep email: _____ Electric Supplier Rep email: _____

Explanation responses to questions below must indicate specific luminaire type comment refers to.

	Yes	No
Luminaire product data sheets are formatted with the manufacturer's representatives' header on each sheet, and include submittals for third party components?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Luminaire submittal table has been filled out completely and is attached with this form, including identification of third party components in Comments area?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturers listed as basis of design or listed equivalent manufacturer?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturer's qualifications meet or exceed those required under quality assurance section within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Submitted luminaires, lamps (sources), ballasts (drivers), and associated components meet all requirements listed within this specification?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Manufacturer's warranty meets or exceeds warranty period specified within this spec.?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Are applicable emergency lighting related components UL924 listed?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Are all system components referenced in other sections by the same manufacturer, coordinated with this system and included in this submittal (such as occupancy sensors)?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		
Are all lighting related specification sections, including those with lighting control devices or systems, being submitted concurrently with this submittal?	<input type="checkbox"/>	<input type="checkbox"/>
If No, Explain _____		

