

PROJECT MANUAL

RENOVATIONS TO

JOHN W. VAUGHAN M+S BUILDING (METER + STORES)

1810 LOCK HAVEN DRIVE | ROANOKE VA24019

AMERICAN ELECTRIC POWER

SPECTRUM DESIGN PROJECT NO.:
25020



PROJECT PHASE:
CONTRACT DOCUMENTS

DATE:
12.22.2025

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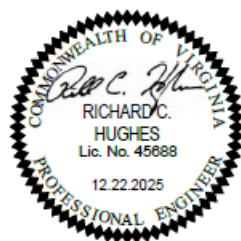
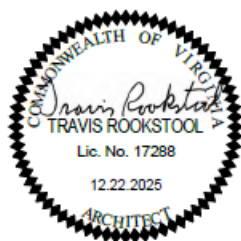
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SECTION 061050
MISCELLANEOUS CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Framing with dimension lumber.
2. Wood blocking and nailers.
3. Plywood backing panels.
4. Continuous soffit vents

1.2 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. SPIB: The Southern Pine Inspection Bureau.
3. WCLIB: West Coast Lumber Inspection Bureau.
4. WWPA: Western Wood Products Association.
5. NLGA: National Lumber Grades Authority.
6. RIS: Redwood Inspection Service.
7. WCLIB: West Coast Lumber Inspection Bureau.
8. WWPA: Western Wood Products Association.

1.3 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

- B. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:

1. Preservative-treated wood.
2. Fire-retardant-treated wood.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Deliver interior wood materials that are to be exposed to view only after building is enclosed and weatherproof, wet work other than painting is dry, and HVAC system is operating and maintaining temperature and humidity at occupancy levels.

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.
 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece .
 3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
 4. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWWA C2.
1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece .
- D. Application: Treat items indicated on Drawings, and the following:
1. Wood equipment support bases.
 2. Wood blocking at coping.

2.3 PRESERVATIVE TREATMENT BY PRESSURE PROCESS:

1. Lumber: AWPAC2 except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPAC31 with inorganic boron (SBX). Kiln dry after treatment to a maximum moisture content of 19 percent.
2. Plywood: AWPAC9. Kiln dry after treatment to a maximum moisture content of 18 percent.
3. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
4. For exposed items indicated to receive transparent finish, do not use chemical formulations that contain colorants or that bleed through or otherwise adversely affect finishes.
5. Do not use material that is warped or does not comply with requirements for untreated material.
6. Mark lumber with treatment quality mark of an inspection agency approved by ALSC's Board of Review.
 - a. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
7. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
 - a. For exposed plywood indicated to receive a stained or natural finish, mark back of each piece.

2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Comply with performance requirements in AWPAC20 (lumber) and AWPAC27 (plywood).
1. Use treatment that does not promote corrosion of metal fasteners.
 2. Use Exterior type for exterior locations and where indicated.
 3. Use Interior Type A, unless otherwise indicated.
- B. Identify fire-retardant-treated wood with appropriate classification marking of testing and inspecting agency acceptable to authorities having jurisdiction.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece .

- C. Application: Treat all miscellaneous carpentry, including the following, unless otherwise indicated:
 - 1. Concealed blocking.
 - 2. Roof construction.
 - 3. Plywood backing panels.

2.5 DIMENSION LUMBER FRAMING

- A. Maximum Moisture Content: 19 percent.
- B. Other Framing: No. 2 grade and any of the following species:
 - 1. Southern pine; SPIB.

2.6 Continuous Soffit Vents: Aluminum hat channel shape with perforations, 2 inches (51 mm) wide, and in lengths not less than 96 inches (2438 mm).

- 1. Net Free Area: 4 sq. in./linear ft. (280 sq. cm/m) .
- 2. Finish: Mill finish .

2.7 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
- B. For items of dimension lumber size, provide Standard, Stud, or No. 3 grade lumber with 19 percent maximum moisture content and any of the following species:
 - 1. Mixed southern pine; SPIB.
 - 2. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- C. For blocking not used for attachment of other construction Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.8 PLYWOOD BACKING PANELS

- A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.9 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M .
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A ; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

2.10 METAL FRAMING ANCHORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Cleveland Steel Specialty Co.
 2. Harlen Metal Products, Inc.
 3. KC Metals Products, Inc.
 4. Simpson Strong-Tie Co., Inc.
 5. Southeastern Metals Manufacturing Co., Inc.
 6. USP Structural Connectors.
- B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.
 1. Use for interior locations where stainless steel is not indicated.

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 to other construction; scribe and cope as needed for accurate fit.

Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

- B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
- D. Do not splice structural members between supports, unless otherwise indicated.
- E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
 - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- F. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 - 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal- thickness.
 - 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 - 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.
- G. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- H. Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- I. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. NES NER-272 for power-driven fasteners.
 - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- J. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive

finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.4 PROTECTION

- A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label

END OF SECTION

SECTION 064100
INTERIOR ARCHITECTURAL WOODWORK & PLASTICS

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Interior standing and running trim.
 - 2. Wood cabinetry.
 - 3. Custom wood trim not specified in other Sections.
 - 4. Shop finishing of woodwork.

1.2 DEFINITIONS

- A. Interior architectural woodwork includes wood furring, blocking, shims, and hanging strips for installing woodwork items unless concealed within other construction prior to woodwork installation.

1.3 REFERENCES

- A. Architectural Woodwork quality Standards, 7th Edition Version 1.0 1997, Architectural Woodwork Institute (AWI)

1.4 SUBMITTALS

- A. For Approval:
 - 1. Product data for each type of product and process specified and incorporated into items of architectural woodwork during fabrication, finishing, and installation.
 - 2. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
 - a) Show details full size.
 - b) Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.
 - c) Show locations and sizes of cutouts and holes for items installed in architectural woodwork.
 - d) Show veneer leaves with dimensions, grain direction, exposed face, and an identification number indicated for each leaf. Identification number shall indicate the flitch and the sequence within the flitch for each leaf.
- C. Samples for initial selection of the following in the form of manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.
 - 1. Shop-applied transparent finishes.
 - 2. Plastic laminates.

- D. Samples for verification of the following:
1. Lumber with or for stained and transparent finish, 50 sq. in., for each species and cut, finished on one side and one edge.
 2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.
 3. Wood-veneer-faced panel products, with or for transparent finish, 8 by 10 inches, for each species and cut. Include at least one face-veneer seam and finish one-half of face as specified.
 4. Step finish materials on sample to show and clearly define each coat.
 5. Provide separate samples of unfaced panel product used for core.
 6. Laminate-clad panel products, 8 by 10 inches, for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.
 7. Exposed hardware, one unit for each type and finish.
- E. For Information:
1. Product certificates signed by woodwork fabricator certifying that products comply with specified requirements.
 2. Qualification data for firms and persons specified in the *Quality Assurance* Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.
- B. Installer Qualifications: Arrange for interior architectural woodwork installation by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this Project.
- C. Single-Source Responsibility: Arrange for production of interior architectural woodwork with sequence-matched wood veneers by a single firm.
1. Include the veneering of wood doors in the single-firm production where veneer matching extends across wood doors.
- D. Single-Source Responsibility for Fabrication and Installation: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.
- E. Quality Standard: Except as otherwise indicated, comply with the following standard:
1. AWI Quality Standard: "Architectural Woodwork Quality Standards" of the Architectural Woodwork Institute for grades of interior architectural woodwork, construction, finishes, and other requirements.
 - a) Custom Grade

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
- B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in the *Project Conditions* Article of this Section.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.
- B. Environmental Limitations: Obtain and comply with woodwork fabricator's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork will be within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.
- C. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final shop drawings.

1.8 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

PART 2 PRODUCTS

2.1 MATERIALS

- A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the following products are part of interior woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:
 - 1. Medium-Density Fiberboard: ANSI A208.2.

2. Hardwood Plywood and Face Veneers: HPVA HP-1.
- B. Fiberboard: Medium-density fiberboard made without formaldehyde and complying with ANSI A208.2. Color to be selected from manufacturer's full range including charcoal gray.
 1. Product: Provide MDF equal Medite II by Medite Corp.
 - C. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
 1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
 - a) Wilsonart
 - D. Adhesive for Bonding Plastic Laminate: As recommended by laminate manufacturer for the intended use of the laminate assembly.
 - F. Wood materials:
 1. Exposed face and veneer lumber:
 - a) Graded in accordance with AWI for grade of work specified.
 - b) Maple or White Birch.
 - c) Plain Sawn
 - d) Of quality suitable for transparent finish in compliance with Custom Grade standards.
 - e) Book matched unless otherwise noted.
 2. Plywood:
 - a) Veneer core all hardwood.
 - b) Graded in accordance with AWI for grade of work specified.

2.2 HARDWARE AND ACCESSORY MATERIALS

- A. Hardware Schedule: Refer to schedule at end of this Section for cabinet hardware required for architectural cabinets.
- B. For concealed hardware, where finish is not indicated, provide manufacturer's standard finish that complies with product class requirements of BHMA A156.9.
- C. Exposed Hardware finish: unless otherwise noted, hardware finish shall be brushed stainless or brushed chrome.
- D. Reveals: Fry Reglet Reveal Molding WCTF125-217 (Wall Cover Field Trim) comprised of extruded aluminum alloy 6063T5 where indicated on drawings.
- E. Trims: Fry Reglet Trim Molding WCTOSC (Wall Cover Trim Outside Corner) comprised of extruded aluminum alloy 6063T5 where indicated on drawings.

2.3 INSTALLATION MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content, fire retardant treated as required by Code.
- B. Screws: Select material, type, size, and finish required for each use. Comply with ASME B18.6.1 for applicable requirements.
 - 1. For metal framing supports, provide screws as recommended by metal-framing manufacturer.
- C. Nails: Select material, type, size, and finish required for each use.
- D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors.

2.4 FABRICATION, GENERAL

- A. Interior Woodwork Grade: Provide interior woodwork complying with the referenced quality standard and of the following grade:
 - 1. Grade: Custom.
- B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.
- C. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
 - 1. Corners of cabinets and edges of solid-wood (lumber) members 3/4 inch thick or less: 1/16 inch.
 - 2. Edges of rails and similar members more than 3/4 inch thick: 1/8 inch.
 - 3. Corners of cabinets and edges of solid-wood (lumber) members and rails: 1/16 inch.
- D. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.
- E. Shop-cut openings, to maximum extent possible, to receive hardware, fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar

exposures, seal edges with a water-resistant coating.

F. Core Material:

1. Horizontal surfaces: All hardwood veneer core plywood
2. Vertical Surfaces: All hardwood veneer core plywood for MDF 40 at Contractor's option.
3. Doors: Provide solid bearing for hinges.

2.5 FINISH

A. Finish work in the factory in accordance with AWI Quality Standards - Section 1500 Systems.

1. Quality Standard: Custom Grade.

B. Stain and transparent finish to match color and sheen selected and approved for wood doors.

2.6 INTERIOR STANDING AND RUNNING TRIM FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 300.

1. Grade: Custom.

B. Backout or groove backs of flat trim members and kerf backs of other wide, flat members, except for members with ends exposed in finished work.

C. Assemble casings in plant except where limitations of access to place of installation require field assembly.

D. Assemble moldings in plant to maximum extent possible. Miter corners in plant and prepare for field assembly with bolted fittings designed to pull connections together.

E. Wood Species: Match species and cut indicated for other types of transparent-finished architectural woodwork located in same area of building, unless otherwise indicated.

1. Provide split species on trim that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

2.7 COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.

1. Grade: Custom.
2. High Pressure Decorative Laminate, "Premium" grade. Provide edge profile indicated.
3. Board Material:
 - a) Sinks: Provide Type II veneer core hardwood plywood or phenolic resin 45 psf density particle-board with 3/4" thickness built up to 1-1/4" with backer ply for "non-drip" edge profile.

- b) W/O Sinks: Provide 1-3/16" solid particleboard, 45 psf density (industrial grade).
- B. Laminate Cladding for Horizontal Surface: High pressure decorative laminate complying with NEMA LD 3 and as follows:
 - 1. Colors, Patterns, and Finishes: As indicated or, if not otherwise indicated, as selected from laminate manufacturer's standard products in full range of solid & matrix colors, matte finish.
 - 2. Grade: PF-42 (0.042" nominal thickness, roll-form material) at sink counters. GP-50 (0.050" nominal thickness) at counters without sinks.
 - 3. Edge Treatment: Same as laminate cladding on horizontal surface unless noted otherwise.

2.8 SHOP FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

- A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
 - 1. Grade: Provide finishes of same grades as items to be finished.
- B. General: The entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation.
 - 1. Shop Finishing: To the greatest extent possible, finish architectural woodwork at the fabrication shop. Defer only final touch up, cleaning, and polishing until after installation.
- C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
 - 1. Backpriming: Apply one coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of trim, cabinets, paneling, and ornamental work and the underside of countertops. Apply 2 coats to back of paneling. Concealed surfaces of plastic laminate-clad woodwork do not require backpriming when surfaced with plastic laminate or thermoset decorative overlay.
- D. Washcoat for Stained Finish: Apply a vinyl washcoat to woodwork made from closed-grain wood before staining and finishing.
- E. Open Finish for Open-Grain Woods: Do not apply filler to open-grain woods.
- F. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.
 - 1. Apply vinyl washcoat sealer after staining and before filling.
- G. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D 523.
 - 1. Grade: Custom.
 - 2. AWI Finish System TR-2: Catalyzed lacquer or TR-4 Conversion Varnish as used on interior doors. Refer to Division 8 Section *Flush Wood Doors*.

3. Staining: Match approved door finish
4. Sheen: Match approved door finish

PART 3 EXECUTION

3.1 PREPARATION

- A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.
- B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

- A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.
- B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 96 inches for plumb and level (including tops).
- C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.
- D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer, including those for adhesives used to install woodwork.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.
- F. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Do not use pieces less than 36 inches long, except where necessary. Stagger joints in adjacent and related members. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
 1. Install standing and running trim with no more than 1/8 inch in 96-inch variation from a straight line.
- G. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
 2. Maintain veneer sequence matching of cabinets with transparent finish.
- H. Tops: Anchor securely to base units and other support systems as indicated. Calk space between backsplash and wall with specified sealant.
1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
- I. Paneling: Anchor paneling to supporting substrate with concealed panel-hanger clips and by blind nailing on backup strips, splined-connection strips, and similar associated trim and framing. Do not face nail unless otherwise indicated.
1. Install flush paneling with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.
- J. Complete the finishing work specified in this Section to the extent not completed at shop or before installation of woodwork. Fill nail holes with matching filler where exposed. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats were applied in the shop.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semi-exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

- A. Provide final protection and maintain conditions in a manner acceptable to fabricator and Installer that ensures that woodwork is without damage or deterioration at the time of Substantial Completion.

3.5 CABINET HARDWARE AND ACCESSORY SCHEDULE

- A. Grommets for cable passage: HAFELE Catalog #429.93.322
- B. Metal Handles: Stanley, Ives. Satin anodized aluminum; 5/16Ø, "U" pull 1-5/16" proj. x 3-1/2" centers.
- C. Knuckle Hinges for flush overlay: Stanley 1592
- D. Magnetic Catches: HAFELE Catalog # 246.26/246.29, finish selected by Architect.

- E. Shelf Supports:
 - 1. Cabinet Shelves: HAFELE Catalog # 283.07.011
 - 2. Wall Mounted Shelves:
 - a) 16 gauge steel, with electroplated finish statuary bronze.
 - (1) Product number 80 by Knape & Vogt
 - (2) Product number 180 by Knape & Vogt
- F. Locks:
 - 1. Lever Type Cam Lock: Similar to HAFELE Catalog #235.04, operating in the G and H directions, suitable for a 1-3/8 inch door.
 - a) Flush screw mounted striking plate suitable to receive strike of cam lock.

END OF SECTION

SECTION 079200
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes joint sealants for the following applications:
1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints between metal panels.
 - e. Joints between different materials listed above.
 - f. Perimeter joints between materials listed above and frames of doors windows and louvers.
 - g. Control and expansion joints in ceilings and other overhead surfaces.
 - h. Other joints as indicated.
 2. Exterior joints in the following horizontal traffic surfaces:
 - a. Isolation and contraction joints in cast-in-place concrete slabs.
 - b. Joints between different materials listed above.
 - c. Other joints as indicated.
 3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
 - a. Control and expansion joints on exposed interior surfaces of exterior walls.
 - b. Perimeter joints of exterior openings where indicated.
 - c. Vertical joints on exposed surfaces of interior unit masonry concrete walls and partitions.
 - d. Other joints as indicated.
 4. Interior joints in the following horizontal traffic surfaces:
 - a. Isolation joints in cast-in-place concrete slabs.
 - b. Other joints as indicated.

1.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

- B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- C. Product Certificates: For each type of joint sealant and accessory, signed by product manufacturer.
- D. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.
- E. Qualification Data: For Installer.
- F. Field Test Report Log: For each elastomeric sealant application.
- G. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.
- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

1.5 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
 - 2. When joint substrates are wet.
 - 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 - 4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric 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's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 5 years from date of Substantial Completion.

- C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
 - 1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 - 2. Disintegration of joint substrates from natural causes exceeding design specifications.
 - 3. Mechanical damage caused by individuals, tools, or other outside agents.
 - 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.3 ELASTOMERIC JOINT SEALANTS

- A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- D. Single-Component Neutral- and Basic-Curing Silicone Sealant :
 - 1. Available Products:
 - a. Tremco; Spectrem 1 (Basic).

2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 100/50.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
 6. Stain-Test-Response Characteristics: Nonstaining to porous substrates per ASTM C 1248.
- E. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
1. Available Products:
 - a. Pecora Corporation; 898.
 - b. Tremco; Tremsil 600 White.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
 - a. Use O Joint Substrates: ceramic tile .
- F. Multicomponent Nonsag Urethane Sealant :
1. Available Products:
 - a. Pecora Corporation; Dynatrol II.
 - b. Tremco; Dymeric 511.
 - c. Tremco; Vulkem 922.
 2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 50.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.
- G. Multicomponent Nonsag Urethane Sealant :
1. Available Products:
 - a. Schnee-Morehead, Inc.; Permathane SM 7200.
 - b. Sika Corporation, Inc.; Sikaflex - 2c NS TG.
 - c. Sonneborn, Division of ChemRex Inc.; NP 2.
 - d. Tremco; Vulkem 227.
 - e. Tremco; Vulkem 322 DS.
 2. Type and Grade: M (multicomponent) and NS (nonsag).
 3. Class: 25.
 4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
 5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

- a. Use O Joint Substrates: aluminum coated with a high-performance coating brick.

H. Single-Component Nonsag Urethane Sealant :

1. Available Products:
 - a. Sika Corporation, Inc.; Sikaflex - 1a.
 - b. Sonneborn, Division of ChemRex Inc.; Ultra.
 - c. Sonneborn, Division of ChemRex Inc.; NP 1.
 - d. Tremco; Vulkem 116.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Uses Related to Exposure: T (traffic) and NT (nontraffic).
5. Uses Related to Joint Substrates: M, A, and, as applicable to joint substrates indicated, O.

2.4 LATEX JOINT SEALANTS

- A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

B. Available Products:

1. Bostik Findley; Chem-Calk 600.
2. Pecora Corporation; AC-20+.
3. Schnee-Morehead, Inc.; SM 8200.
4. Sonneborn, Division of ChemRex Inc.; Sonolac.
5. Tremco; Tremflex 834.

2.5 JOINT-SEALANT BACKING

- A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. 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:
- C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F . Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.
- D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

- a. Metal.
 - b. Glass.
 - c. Porcelain enamel.
 - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of sealant backings.
 - 2. Do not stretch, twist, puncture, or tear sealant backings.
 - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.

3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
 - b. Perform 1 test for each of joint length thereafter or 1 test per each floor per elevation.
2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab in Appendix X1 in ASTM C 1193.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.
4. Inspect tested joints and report on the following:
 - a. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
 - b. Whether sealants filled joint cavities and are free of voids.
 - c. Whether sealant dimensions and configurations comply with specified requirements.
5. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
6. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 081113
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 257 or UL 10C.
- C. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9. Label each individual glazed lite.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

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

1.7 COORDINATION

- A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
1. Amweld Building Products, LLC.
 2. Benchmark; a division of Therma-Tru Corporation.
 3. Ceco Door Products; an Assa Abloy Group company.
 4. Curries Company; an Assa Abloy Group company.
 5. Deansteel Manufacturing Company, Inc.
 6. Firedoor Corporation.
 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
 8. Habersham Metal Products Company.
 9. Karpen Steel Custom Doors & Frames.
 10. Kewanee Corporation (The).
 11. Mesker Door Inc.
 12. Pioneer Industries, Inc.
 13. Security Metal Products Corp.
 14. Steelcraft; an Ingersoll-Rand company.
 15. Windsor Republic Doors.

2.2 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. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

- G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
 - 1. Design: Flush panel.
 - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
 - a. Fire Door Core: As required to provide fire-protection ratings indicated.
 - b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
 - 1) Locations: Exterior doors.
 - 3. Vertical Edges for Single-Acting Doors: Beveled edge.
 - a. Beveled Edge: 1/8 inch in 2 inches.
 - 4. Vertical Edges for Double-Acting Doors: Round vertical edges with 2-1/8-inch radius.
 - 5. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
 - 6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).
- C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:
 - 1. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless).

- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as knocked down or face welded unless otherwise indicated.
 - 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
 - 1. Fabricate frames with mitered or coped corners.
 - 2. Fabricate frames as knocked down or face welded unless otherwise indicated.
 - 3. Fabricate knocked-down, drywall slip-on frames for in-place gypsum board partitions.
 - 4. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
 - 5. Frames for Wood Doors: 0.053-inch- thick steel sheet.
 - 6. Frames for Borrowed Lights: 0.053-inch- thick steel sheet, same as adjacent door frame.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
 - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
 - 3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
 - 4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.6 HOLLOW METAL PANELS

- A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.7 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

2.8 LOUVERS

- A. Provide louvers for interior doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch-thick, cold-rolled steel sheet set into 0.032-inch-thick steel frame.
 1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.

2.9 ACCESSORIES

- A. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch-wide steel.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

2.10 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:

1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 2. Glazed Lites: Factory cut openings in doors.
- D. 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. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 2. Sidelight 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.
 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 6. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Two anchors per jamb up to 60 inches high.
 - 2) Three anchors per jamb from 60 to 90 inches high.
 - 3) Four anchors per jamb from 90 to 120 inches high.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
 - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
 - 1) Three anchors per jamb up to 60 inches high.
 - 2) Four anchors per jamb from 60 to 90 inches high.
 - 3) Five anchors per jamb from 90 to 96 inches high.
 - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
 - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
 - c. Compression Type: Not less than two anchors in each jamb.
 - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
 7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
 - 1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8 .
 - 2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
 - 3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
- G. Stops and Moldings: Provide stops and moldings around glazed lites 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 type of glazing and type of installation indicated.

2.11 STEEL FINISHES

- A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
 - 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-protection-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 glazing 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 plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Field apply bituminous coating to backs of frames that are filled with grout or mortar.
- 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 powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
- 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
- 5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
- 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 7. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
- 8. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
- 9. 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, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
 - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Division 8 Section "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 o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection and prior to 1 year warranty date after substantial completion. 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.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION

SECTION 082113
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, and trim for openings. 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; location and extent of hardware blocking; and other pertinent data.

1. Indicate dimensions and locations of mortises and holes for hardware.
2. Indicate dimensions and locations of cutouts.
3. Indicate requirements for veneer matching.
4. Indicate doors to be factory finished and finish requirements.
5. Indicate fire-protection ratings for fire-rated doors.

C. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three samples showing typical range of color and grain to be expected in the finished work.
2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
 - a. Provide samples for each species of veneer and solid lumber required.
 - b. Finish veneer-faced door samples with same materials proposed for factory-finished doors.
3. Louver blade and frame sections, 6 inches long, for each material and finish specified.
4. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."
- 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.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
 - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
 - 2. Warranty Period for Solid-Core Interior Doors: Life of installation.

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. Buell Door Company Inc.
3. Chappell Door Co.
4. Eagle Plywood & Door Manufacturing, Inc.
5. Eggers Industries.
6. Graham.
7. Ideal Architectural Doors & Plywood.
8. Ipik Door Company.
9. Lambton Doors.
10. Marshfield Door Systems, Inc.
11. Oshkosh Architectural Door Company.
12. Vancouver Door Company.
13. VT Industries Inc.

2.2 DOOR CONSTRUCTION, GENERAL

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

1. Heavy Duty unless otherwise indicated.

B. Particleboard-Core Doors:

1. Particleboard: ANSI A208.1, Grade LD-2.
2. Blocking: Provide wood blocking in particleboard-core doors as follows:
 - a. 5-inch top-rail blocking, in doors indicated to have closers.
 - b. 5-inch bottom-rail blocking, in exterior doors and doors indicated to have kick, mop, or armor plates.
3. Provide doors with either glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

C. Structural-Composite-Lumber-Core Doors:

1. Structural Composite Lumber: WDMA I.S.10.
 - a. Screw Withdrawal, Face: 700 lbf.
 - b. Screw Withdrawal, Edge: 400 lbf.

D. Fire-Protection-Rated Doors: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

1. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
2. 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.

E. 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 and as follows:
 - a. 5-inch top-rail blocking.
 - b. 5-inch bottom-rail blocking, in doors indicated to have protection plates.
 - c. 5-inch midrail blocking, in doors indicated to have armor plates.
 - d. 4-1/2-by-10-inch lock blocks 5-inch midrail blocking, in doors indicated to have exit devices.
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 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors :

1. Grade: Premium, with Grade A faces.
2. Species to be select by Architect from following: Select white maple.
3. Cut: Plain sliced (flat sliced).
4. Match between Veneer Leaves: Bookmatch.
5. Assembly of Veneer Leaves on Door Faces: Runningmatch.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Transom Match: Continuous match.
8. Exposed Vertical and Top Edges: Same species as faces
9. Core: Either glued wood stave or structural composite lumber.
10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
11. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 LOUVERS AND LIGHT FRAMES

- A. Wood Louvers: Door manufacturer's standard solid-wood louvers unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
- B. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads as follows unless otherwise indicated.
 - 1. Wood Species: Same species as door faces.
 - 2. Profile: Manufacturer's standard shape.
 - 3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.
- C. 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.

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 requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
 - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Transom and Side Panels: Fabricate matching panels with same construction, exposed surfaces, and finish as specified for associated doors. Finish bottom edges of transoms and top edges of rabbeted doors same as door stiles.
 - 1. Fabricate door and transom panels with full-width, solid-lumber meeting rails. Provide factory-installed spring bolts for concealed attachment into jambs of metal door frames.
- D. Openings: Cut and trim openings through doors in factory.
 - 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 Division 8 Section "Glazing."
 - 3. Louvers: Factory install louvers in prepared openings.

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. Finish doors at factory.
- C. Transparent Finish:
 - 1. Grade: Premium.
 - 2. Finish: WDMA TR-6 catalyzed polyurethane.
 - 3. Staining: As selected by Architect from manufacturer's full range.
 - 4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
 - 5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
 - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, see Division 8 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
 - 1. Install fire-rated doors in corresponding fire-rated frames 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 at heads, jambs, and between pairs of doors. Provide 1/8 inch 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 from bottom of door to top of threshold unless otherwise indicated.

- a. Comply with NFPA 80 for fire-rated doors.
 - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
 - 3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
- 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.

3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083113
ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Access doors and frames for walls and ceilings.

1.2 SUBMITTALS

- A. Product Data: For each type of access door and frame indicated. Include construction details, fire ratings, materials, individual components and profiles, and finishes.
- B. Shop Drawings: Show fabrication and installation details of access doors and frames for each type of substrate. Include plans, elevations, sections, details, and attachments to other work.
- C. Access Door and Frame Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.
- D. Ceiling Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including access doors and frames, lighting fixtures, diffusers, grilles, speakers, sprinklers, and special trim are shown and coordinated with each other.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain access door(s) and frame(s) through one source from a single manufacturer.
- B. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 that are identical to access door and frame assemblies tested for fire-test-response characteristics per the following test method and that are listed and labeled by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
 - 1. NFPA 252 or UL 10B for vertical access doors and frames.
 - 2. ASTM E 119 or UL 263 for horizontal access doors and frames.
- C. Size Variations: Obtain Architect's acceptance of manufacturer's standard-size units, which may vary slightly from sizes indicated.

1.4 COORDINATION

- A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed plumbing, mechanical, or other concealed work, and indicate in the schedule specified in "Submittals" Article.

PART 2 - PRODUCTS

2.1 STEEL MATERIALS

- A. Steel Sheet: electrolytic zinc-coated, ASTM A 591/A 591M with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- B. Steel Finishes: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Surface Preparation for Steel Sheet: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 2. Factory-Primed Finish: Apply shop primer immediately after cleaning and pretreating.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Babcock-Davis; A Cierra Products Co.
 - 2. Bar-Co, Inc. Div.; Alfab, Inc.
 - 3. Dur-Red Products.
 - 4. J. L. Industries, Inc., as standard of quality use Model TM and FD for fire-rated.
 - 5. Nystrom, Inc.
- B. Flush Access Doors and Frames with Exposed Trim: Fabricated from steel sheet.
 - 1. Locations: Masonry wall surfaces.
 - 2. Door: Minimum 0.060-inch-thick sheet metal, set flush with exposed face flange of frame.
 - 3. Frame: Minimum 0.060-inch-thick sheet metal with 1-inch- or 1-1/4-inch- wide, manufacturer's standard, surface-mounted trim.
 - 4. Hinges: Spring-loaded, concealed-pin type or Continuous piano, manufacturer's standard.
 - 5. Lock: Cylinder.
- C. Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel sheet.
 - 1. Locations: Gypsum board wall and ceiling surfaces.
 - 2. Door: Minimum 0.060-inch-thick sheet metal, set flush with surrounding finish surfaces.
 - 3. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead flange.
 - 4. Hinges: Spring-loaded, concealed-pin type or Continuous piano, manufacturer's standard.
 - 5. Lock: Cylinder.

- D. Fire-Rated, Insulated, Flush Access Doors and Frames with Exposed Trim: Fabricated from metallic-coated steel sheet.
1. Locations: Masonry wall surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 5. Frame: Minimum 0.060-inch-thick sheet metal with 1-inch- or 1-1/4-inch- wide, manufacturer's standard, surface-mounted trim.
 6. Hinges: Spring-loaded, concealed-pin type or Continuous piano, manufacturer's standard.
 7. Automatic Closer: Spring type.
 8. Lock: Self-latching device with cylinder lock.
- E. Fire-Rated, Insulated, Flush Access Doors and Trimless Frames: Fabricated from metallic-coated steel sheet.
1. Locations: Gypsum board wall and ceiling surfaces.
 2. Fire-Resistance Rating: Not less than that of adjacent construction.
 3. Temperature Rise Rating: 250 deg F at the end of 30 minutes.
 4. Door: Flush panel with a core of mineral-fiber insulation enclosed in sheet metal with a minimum thickness of 0.036 inch.
 5. Frame: Minimum 0.060-inch-thick sheet metal with drywall bead flange.
 6. Hinges: Spring-loaded, concealed-pin type or Continuous piano, manufacturer's standard.
 7. Automatic Closer: Spring type.
 8. Lock: Self-latching device with cylinder lock.

2.3 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
 2. Provide mounting holes in frames for attachment of units to metal or wood framing.
 3. Provide mounting holes in frame for attachment of masonry anchors. Furnish adjustable metal masonry anchors.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
1. For cylinder lock, furnish two keys per lock and key all locks alike.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- C. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING AND CLEANING

- A. Adjust doors and hardware after installation for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 087100
DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components
3. Field verification, preparation and modification of existing doors and frames to receive new door hardware.

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
 - a. "Metal Doors and Frames"
 - b. "Flush Wood Doors"
 - c. "Stile and Rail Wood Doors"
 - d. "Interior Aluminum Doors and Frames"
 - e. "Aluminum-Framed Entrances and Storefronts"
 - f. "Stainless Steel Doors and Frames"
 - g. "Special Function Doors"
 - h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL, ULC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2019 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
 - a. Comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, "EXAMINATION" article, herein.
 - b. Review drawings and Sections from related trades to verify compatibility with specified hardware.
 - c. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
 - a. Wiring Diagrams: For power, signal, and control wiring and including:
 - 1) Details of interface of electrified door hardware and building safety and security systems.
 - 2) Schematic diagram of systems that interface with electrified door hardware.
 - 3) Point-to-point wiring.
 - 4) Risers.
3. Samples for Verification: If requested by Architect, submit production sample of requested door hardware unit in finish indicated and tagged with full description for coordination with schedule.

- a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.
- 4. Door Hardware Schedule:
 - a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
 - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
 - c. Indicate complete designations of each item required for each opening, include:
 - 1) Door Index: door number, heading number, and Architect's hardware set number.
 - 2) Quantity, type, style, function, size, and finish of each hardware item.
 - 3) Name and manufacturer of each item.
 - 4) Fastenings and other pertinent information.
 - 5) Location of each hardware set cross-referenced to indications on Drawings.
 - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
 - 7) Mounting locations for hardware.
 - 8) Door and frame sizes and materials.
 - 9) Degree of door swing and handing.
 - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
- 5. Key Schedule:
 - a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
 - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
 - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
 - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
 - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
 - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
 - 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
 - 2. Provide Product Data:
 - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
 - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
 - 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:

- a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
- b. Catalog pages for each product.
- c. Final approved hardware schedule edited to reflect conditions as installed.
- d. Final keying schedule
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

- 1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
- 2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
- 3. Architectural Hardware Consultant: 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 meets these requirements:
 - a. For door hardware: DHI certified AHC or DHC.
 - b. Can provide installation and technical data to Architect and other related subcontractors.
 - c. Can inspect and verify components are in working order upon completion of installation.
 - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
- 4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

- 1. Electrified Door Hardware
 - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
- 2. Accessibility Requirements:
 - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

- 1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
 - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2) Preliminary key system schematic diagram.
 - 3) Requirements for key control system.
 - 4) Requirements for access control.
 - 5) Address for delivery of keys.
- 2. Pre-installation Conference
 - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Inspect and discuss preparatory work performed by other trades.
 - c. Inspect and discuss electrical roughing-in for electrified door hardware.
 - d. Review sequence of operation for each type of electrified door hardware.
 - e. Review required testing, inspecting, and certifying procedures.
 - f. Review questions or concerns related to proper installation and adjustment of door hardware.
- 3. Electrified Hardware Coordination Conference:
 - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

1.06 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- D. Existing Openings: Where existing doors, frames and/or hardware are to remain, field verify existing functions, conditions and preparations and coordinate to suit opening conditions and to provide proper door operation.

1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
 - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
 - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
 - a. Mechanical Warranty
 - 1) Locks
 - a) 10 years
 - 2) Exit Devices
 - a) 10 years
 - 3) Closers
 - a) LCN 4000 Series: 30 years
 - b. Electrical Warranty
 - 1) Exit Devices
 - a) 3 years

1.08 MAINTENANCE

- A. Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.
- B. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance in section 01 25 00.
- B. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.
- C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Modification and Preparation of Existing Doors: Where existing door hardware is indicated to be removed and reinstalled.

1. Provide necessary fillers, Dutchmen, reinforcements, and fasteners, compatible with existing materials, as required for mounting new opening hardware and to cover existing door and frame preparations.
2. Use materials which match materials of adjacent modified areas.
3. When modifying existing fire-rated openings, provide materials permitted by NFPA 80 as required to maintain fire-rating.

C. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

D. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

2.03 HINGES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
 - a. Hager BB1191/1279 series
 - b. Best FBB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.

2. Provide five knuckle, ball bearing hinges.
3. Provide hinge weights and sizes as specified in hardware sets.
4. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 - a. Steel Hinges: Steel pins
 - b. Non-Ferrous Hinges: Stainless steel pins
 - c. Out-Swinging Exterior Doors: Non-removable pins
 - d. Out-Swinging Interior Lockable Doors: Non-removable pins
 - e. Interior Non-lockable Doors: Non-rising pins

2.04 CONTINUOUS HINGES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Select
 - b. ABH

B. Requirements:

1. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
2. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
3. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
4. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
5. On fire-rated doors, provide aluminum geared continuous hinges classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
6. Provide aluminum geared continuous hinges with electrified option scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware.
7. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 FLUSH BOLTS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. DCI

B. Requirements:

1. Provide automatic, constant latching, and manual flush bolts with forged bronze or stainless-steel face plates, extruded brass levers, and with wrought brass guides and strikes. Provide 12 inch (305 mm) steel or brass rods at doors up to 90 inches (2286 mm) in height. For doors over 90 inches (2286 mm) in height increase top rods by 6 inches (152 mm) for each additional 6 inches (152 mm) of door height. Provide dust-proof strikes at each bottom flush bolt.

2.06 CYLINDRICAL LOCKS – GRADE 2

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage ALX series
2. Acceptable Manufacturers and Products:
 - a. Best 7KC series
 - b. Sargent 7-Line

B. Requirements

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 2, and UL Listed for 3-hour fire doors with a minimum cycle life of 1 million.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide 3/4” latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide a minimum of 5 points of lever engagement between the cassette spindle and lever shank to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide modular lockset allowing lock functions to be created for 7 typical functions by inserting/installing parts into the exterior of a fully assembled chassis
9. Reconfigurable Chassis - Provide modular lockset that allows the function to be reconfigured by removing external components from the chassis
10. Lever Trim: Solid cast levers and wrought roses on both sides.
 - a. Lever Design: Rhodes (RHO)

2.07 DEADBOLTS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage B600/B700/B800 Series
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin DL3000 Series
 - b. Falcon D100 Series

B. Requirements:

1. Provide grade 1 deadbolt series conforming to ANSI/BHMA A156.
2. Cylinders: Refer to “KEYING” article, herein.

3. Provide deadbolts with standard 2-3/4 inches (70 mm) backset. Provide 2-3/8 inches (60 mm) where noted or if door or frame detail requires. Provide deadbolt with full 1-inch (25 mm) throw, constructed of steel alloy.
4. Provide manufacturer's standard strike.
5. Lock Status Indicator Trim: Where specified, provide escutcheon with lock status indicator window.
 - a. Escutcheon height 4.125 inches, width 2.54 inches. Projection 1.32 inches on thumbturn side and 1.28 inches on cylinder side.
 - b. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
 - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
 - d. Indicator window to provide 180-degree visibility.

2.08 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Von Duprin 98/35A series
2. Acceptable Manufacturers and Products:
 - a. Detex Advantex series
 - b. Sargent 19-43-GL-80 series

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide electrified options as scheduled.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

15. Provide exit devices with PA filler.
16. Accessibility: Require not more than 5 lb. to retract the latchbolt, per CBC 2022 11B-404.2.7 and 11B-309.4.
 - a. Mechanical method: Von Duprin AX feature, where touchpad directly retracts the latchbolt with 5 lb. or less of force. Provide testing lab certification confirming that the mechanical device is independent third-party tested to meet this 5 lb. requirement.
 - b. Electrical method: Von Duprin's RX-QEL feature, where lightly pressing the touchpad with 5 lb. or less of force closes an electric switch, activating quiet electric latch retraction.

2.09 POWER SUPPLIES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. Schlage/Von Duprin PS900 Series
2. Acceptable Manufacturers and Products:
 - a. Dynalock 5000 series
 - b. Security Door Controls 600 series

B. Requirements:

1. Provide power supplies approved by manufacturer of supplied electrified hardware.
2. Provide appropriate quantity of power supplies necessary for proper operation of electrified locking components as recommended by manufacturer of electrified locking components with consideration for each electrified component using power supply, location of power supply, and approved wiring diagrams. Locate power supplies as directed by Architect.
3. Provide regulated and filtered 24 VDC power supply, and UL class 2 listed.
4. Provide power supplies with the following features:
 - a. 12/24 VDC Output, field selectable.
 - b. Class 2 Rated power limited output.
 - c. Universal 120-240 VAC input.
 - d. Low voltage DC, regulated and filtered.
 - e. Polarized connector for distribution boards.
 - f. Fused primary input.
 - g. AC input and DC output monitoring circuit w/LED indicators.
 - h. Cover mounted AC Input indication.
 - i. Tested and certified to meet UL294.
 - j. NEMA 1 enclosure.
 - k. Hinged cover w/lock down screws.
 - l. High voltage protective cover.

2.10 CYLINDERS

A. Manufacturers:

1. Scheduled Manufacturer and Product:
 - a. Corbin Russwin small format interchangeable core CR8000

B. Requirements:

1. Provide cylinders for locking devices, whether called out in hardware sets or not.

2. Provide interchangeable cylinders/cores to match Owner's existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.11 KEYING

A. Scheduled System:

1. Existing factory registered system:
 - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Construction Keying:
 - a. Temporary Construction Cylinder Keying.
 - 1) Provide construction cores that permit voiding construction keys without cylinder removal, furnished in accordance with the following requirements.
 - a) Split Key or Lost Ball Construction Keying System.
 - b) 3 construction control keys, and extractor tools or keys as required to void construction keying.
 - c) 12 construction change (day) keys.
 - 2) Owner or Owner's Representative will void operation of temporary construction keys.
2. Permanent Keying:
 - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
 - 1) Master Keying system as directed by the Owner.
 - b. Forward biting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
 - c. Provide keys with the following features:
 - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
 - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
 - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
 - d. Identification:
 - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
 - 2) Identification stamping provisions must be approved by the Architect and Owner.
 - 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
 - 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
 - 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
 - e. Quantity: Furnish in the following quantities.
 - 1) Change (Day) Keys: 3 per cylinder/core.
 - 2) Permanent Control Keys: 3.
 - 3) Master Keys: 6.

2.12 KEY CONTROL SYSTEM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. HPC
2. Acceptable Manufacturers:
 - a. Lund
 - b. Barska

B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
 - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
 - b. Provide hinged-panel type cabinet for wall mounting.

2.13 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
 - a. LCN 4010/4110/4020 series
2. Acceptable Manufacturers and Products:
 - a. Corbin-Russwin DC8000 series
 - b. Sargent 281 series

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. Certify surface mounted mechanical closers to meet fifteen million (15,000,000) full load cycles. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter with 11/16-inch (17 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers. When closers are parallel arm mounted, provide closers which mount within 6-inch (152 mm) top rail without use of mounting plate so that closer is not visible through vision panel from pull side.
8. Pressure Relief Valve (PRV) Technology: Not permitted.

9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI/BHMA Standard A156.4 and ASTM B117, and has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.14 DOOR TRIM

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Burns

B. Requirements:

1. Provide push plates, push bars, pull plates, pulls, and hands-free reversible door pulls with diameter and length as scheduled.

2.15 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Burns
 - b. Trimco

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Provide protection plates with countersunk screw holes.
3. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
4. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.16 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
 - a. Glynn-Johnson
2. Acceptable Manufacturers:
 - a. Rixson

b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.17 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Ives
2. Acceptable Manufacturers:
 - a. Trimco
 - b. Burns

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button or thumbturn.
2. Where a wall stop cannot be used, provide an overhead stop.
3. Where wall or overhead stop cannot be used, provide floor stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.18 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
 - a. Zero International
2. Acceptable Manufacturers:
 - a. National Guard
 - b. Reese

- B. Seals and Gasketing: Provide continuous gasketing on exterior openings, to the head and jambs, forming a continuous seal between the door and the frame. Provide smoke, light, or sound gasketing on interior doors where indicated.
 - 1. Provide self-tapping fasteners for aluminum extruded gasketing being applied to hollow metal frames.
 - a. Provide non-corrosive fasteners for all exterior applications.
 - b. Provide security fasteners where indicated.
- C. Door Sweeps or Shoes: Where indicated, apply to the bottom of the door to close the gap between the door bottom and finished floor or saddle threshold.

2.19 SILENCERS

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Ives
 - 2. Acceptable Manufacturers:
 - a. Steelcraft
 - b. Trimco
- B. Requirements:
 - 1. Provide "push-in" type silencers for hollow metal or wood frames.
 - 2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
 - 3. Omit where gasketing is specified.

2.20 DOOR POSITION SWITCHES

- A. Manufacturers:
 - 1. Scheduled Manufacturer:
 - a. Schlage
 - 2. Acceptable Manufacturers:
 - a. GE-Interlogix
 - b. Sentrol
- B. Requirements:
 - 1. Provide recessed or surface mounted type door position switches as specified.
 - 2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.21 FINISHES

- A. Finish: Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Field verify existing doors and frames receiving new hardware and existing conditions receiving new openings. Verify that new hardware is compatible with existing door and frame preparation and existing conditions.
- C. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- D. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Where on-site modification of doors and frames is required:
 - 1. Carefully remove existing door hardware and components being reused. Clean, protect, tag, and store in accordance with storage and handling requirements specified herein.
 - 2. Field modify and prepare existing doors and frames for new hardware being installed.
 - 3. When modifications are exposed to view, use concealed fasteners, when possible.
 - 4. Prepare hardware locations and reinstall in accordance with installation requirements for new door hardware and with:
 - a. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
 - b. Wood Doors: DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."
 - c. Doors in rated assemblies: NFPA 80 for restrictions on on-site door hardware preparation.

3.03 INSTALLATION

- A. 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. Custom Steel Doors and Frames: HMMA 831.
 - 3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
 - 4. Installation Guide for Doors and Hardware: DHI TDH-007-20

- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.
- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
 - 1. Install construction cores to secure building and areas during construction period.
 - 2. Replace construction cores with permanent cores as indicated in keying section.
 - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
 - 1. Conduit, junction boxes and wire pulls.
 - 2. Connections to and from power supplies to electrified hardware.
 - 3. Connections to fire/smoke alarm system and smoke evacuation system.
 - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
 - 5. Connections to panel interface modules, controllers, and gateways.
 - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."
- Q. Stops: Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.04 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.
- C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.
- D. Hardware Sets:

Hardware Group No. 01

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ALX50BDC RHO		626	SCH
1	EA	CORBIN RUSSWIN REMOVEABLE CORE	CR8000			CR
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 02

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	CLASSROOM LOCK	ALX70BDC RHO		626	SCH
1	EA	CORBIN RUSSWIN REMOVEABLE CORE	CR8000			CR
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 03

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ALX50BDC RHO		626	SCH
1	EA	CORBIN RUSSWIN REMOVEABLE CORE	CR8000			CR
1	EA	OH STOP	100S		630	GLY
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 04

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PASSAGE	ALX10BDC RHO		626	SCH
1	EA	SURFACE CLOSER	4111		689	LCN
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 06

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	PRIVACY LOCK	ALX40 RHO		626	SCH
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 07

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PUSH PLATE	8200 4" X 16"		630	IVE
1	EA	PULL PLATE	8303 10" 4" X 16"		630	IVE
1	EA	SURFACE CLOSER	4011		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 08

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	35A-L-06-CYL		626	VON
1	EA	CORBIN RUSSWIN REMOVEABLE CORE	CR8000			CR
1	EA	SURFACE CLOSER	4111		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		630	IVE
3	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

Hardware Group No. 09

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	MANUAL FLUSH BOLT	MANUAL FLUSH BOLTS		626	IVE
1	EA	DUST PROOF STRIKE	DP2		626	IVE
1	EA	EXIT X BLANK OUTSIDE	ALX25 RHO		626	SCH
1	EA	ONE WAY DEADBOLT	B561BDC		626	SCH
1	EA	CORBIN RUSSWIN REMOVEABLE CORE	CR8000			CR
2	EA	OH STOP	100S		630	GLY
1	EA	SURFACE CLOSER	4011 ACTIVE LEAF		689	LCN
1	EA	MOUNTING PLATE	4020-18G		689	LCN
2	EA	SILENCER	SR64/SR65-TYPE AS REQ'D BY FRAME		GRY	IVE

LEVER INSTALLED ON PULL SIDE. NO LEVER TRIM ON PUSH SIDE OF ACTIVE LEAF.

DEADBOLD CYLINDER INSTALLED ON PULL SIDE OF ACTIVE LEAF.

LCN SPECIAL TEMPLATE ST-1544 FOR CONCEALED OVERHEAD STOP AND 4011 PULL SIDE MOUNTED CLOSER.

Hardware Group No. 10

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	CONT. HINGE	224XY		710	IVE
1	EA	CONT. HINGE	224XY EPT		710	IVE
1	EA	REMOVABLE MULLION	KR4954 STAB		695	VON
1	EA	PANIC HARDWARE	35A-EO		710	VON
1	EA	ELEC PANIC HARDWARE	QEL-35A-NL-OP-388-CON-CYL 24 VDC	 ⚡	710	VON
2	EA	MEDECO CORE & TAILPIECE	BY OWNER			MED
1	EA	90 DEG OFFSET PULL	8190EZHD 12"		695	IVE
2	EA	SURFACE CLOSER	4111 SCUSH TBWMS		695	LCN
1	SET	GASKETING & MEETING STILE SEALS	BY STOREFRONT SUPPLIER			
2	EA	DOOR SWEEP	39D		D	ZER
2	EA	DOOR CONTACT	679-05HM	 ⚡	BLK	SCE
1	EA	POWER SUPPLY	PS902 BBK 900-2RS KL900 120/240 VAC	 ⚡	LGR	SCE
	EA	PROVIDE FACTORY POINT TO POINT DIAGRAMS PROVIDE RISER DIAGRAM				

REUSE EXISTING POWER TRANSFER, CARD READER, MOTION SENSOR (FOR REQUEST TO EXIT) AND THRESHOLD.

DOORS NORMALLY CLOSED AND LOCKED.

ENTRY VIA VALID CREDENTIAL. PRESENTING CREDENTIAL TO READER RETRACTS EXIT DEVICE LATCHBOLT ON ACTIVE LEAF ALLOWING ENTRY.

FREE EGRESS AT ALL TIMES VIA EITHER LEAF.

UPON LOSS OF POWER, OPENING REMAINS LOCKED (FAIL SECURE).

COORDINATION REQUIRED FOR ELECTRICAL INSTALLATION AND ACCESS CONTROL CONFIGURATION.

END OF SECTION

SECTION 088000
GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass types:

- a. Glass 1 = 1/4" tempered clear (safety) glazing (interior UNO).
- b. Glass 2 = 1" IGU - low-e solar-controlling glass (exterior).
- c. Glass 3 = 1" IGU - Spandrel.
- d. Glass 4 = 1" IGU - low-e solar-controlling glass with decorative film (interior surface).
- e. Glass 5 = 1" IGU - low-e solar-controlling glass with Ceramic Frit.
- f. Glass 6 = 1" IGU with Security/Safety Film.

2. Field Applied Decorative and Security Glass Film.

1.2 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. IGU = Insulating Glass Units.
- C. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in low-e coating.
- E. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less

than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Design Wind Loads: As indicated.
 - b. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically and under wind action. For load duration of 60 seconds or less.
 - c. Maximum Lateral Deflection: For insulating glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - d. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.
 - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties based on manufacturer's published test data, as determined according to procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
 2. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- wide interspace.
 3. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F.
 4. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
 5. Solar Optical Properties: NFRC 300.

1.4 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated
- B. Samples: For the following products, in the form of 12-inch- square Samples for glass.
 1. Insulating glass for each designation indicated.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products comply with requirements.
- D. Warranties: Special warranties indicated in this Section.

1.5 QUALITY ASSURANCE

- A. Source Limitations for Tinted Glass: Obtain tinted, heat-absorbing, and light-reducing float glass from one primary-glass manufacturer for each tint color indicated.
- B. Source Limitations for Coated Glass: Obtain coated glass from one manufacturer for each type of coating and each type and class of float glass indicated.

- C. Source Limitations for Insulating Glass: Obtain insulating-glass units from one manufacturer using the same type of glass and other components for each type of unit indicated.
- D. Source Limitations for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.
- E. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
- F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: GANA'S "Glazing Manual"
 - 2. SIGMA Publications: SIGMA TM-3000, "Vertical Glazing Guidelines."
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the Insulating Glass Certification Council.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.
- B. For insulating-glass units that will be exposed to substantial altitude changes, comply with insulating-glass manufacturer's written recommendations for venting and sealing to avoid hermetic seal ruptures.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 - 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F.

1.8 WARRANTY

- A. General Warranty: Special warranties shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties under requirements of the Contract Documents.
- B. Manufacturer's Special Warranty on Coated-Glass Products: Written warranty, made out to Owner and signed by coated-glass manufacturer agreeing to furnish replacements for those coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of manufacture.

- C. Manufacturer's Special Warranty on Insulating Glass: Written warranty, made out to Owner and signed by insulating-glass manufacturer agreeing to furnish replacements for insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 - 1. Warranty Period: 10 years from date of manufacture.

PART 2 - PRODUCTS

2.1 PRODUCTS AND MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the products indicated in schedules at the end of Part 3.

2.2 HEAT-TREATED FLOAT GLASS

- A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent glass, flat); Quality q3 (glazing select); class, kind, and condition as indicated in schedules at the end of Part 3.

2.3 COATED FLOAT GLASS

- A. General: Provide coated glass complying with requirements indicated in this Article and in schedules at the end of Part 3. (Incorporated in insulating glass units indicated.)
 - 1. Provide Kind FT (fully tempered) products where coated safety glass is indicated.
- B. Sputter-Coated Float Glass: Float glass with metallic-oxide or metallic-nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), complying with requirements specified in schedules at the end of Part 3.

2.4 INSULATING GLASS

- A. Insulating-Glass Units: Preassembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements in this Article and in the Insulating-Glass Schedule at the end of Part 3.
- B. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated in the Insulating-Glass Schedule at the end of Part 3 are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
- C. Sealing System: Dual seal, with Manufacturer's standard primary and secondary sealants.
- D. Spacers: Manufacturer's standard spacer material and construction complying with the following requirements:
 - 1. Aluminum with mill or clear-anodized finish.
 - 2. Desiccant: Molecular sieve or silica gel, or blend of both.
 - 3. Corner Construction: Manufacturer's standard corner construction.

2.5 ELASTOMERIC GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect.
- B. Elastomeric Glazing Sealant Standard: Comply with ASTM C 920 and other requirements indicated for each liquid-applied, chemically curing sealant in the Glazing Sealant Schedule at the end of Part 3, including those referencing ASTM C 920 classifications for type, grade, class, and uses.

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; packaged on rolls with a release paper backing; and complying with ASTM C 1281 and AAMA 800 for products indicated below:
1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
 2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.
- B. Expanded Cellular Glazing Tape: Closed-cell, PVC foam tape; factory coated with adhesive on both surfaces; packaged on rolls with release liner protecting adhesive; and complying with AAMA 800 for the following types:
1. Type 1, for glazing applications in which tape acts as the primary sealant.
 2. Type 2, for glazing applications in which tape is used in combination with liquid sealant.

2.7 GLAZING GASKETS

- A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
1. Neoprene, ASTM C 864.
 2. EPDM, ASTM C 864.
 3. Silicone, ASTM C 1115.
 4. Thermoplastic polyolefin rubber, ASTM C 1115.
 5. Any material indicated above.
- B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. Neoprene.
 2. EPDM.
 3. Silicone.
 4. Thermoplastic polyolefin rubber.
 5. Any material indicated above.

2.8 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.9 FABRICATION OF GLASS AND OTHER GLAZING PRODUCTS

- A. Fabricate glass and 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 instructions of product manufacturer and referenced glazing standard, to comply with system performance requirements.
- B. Grind smooth and polish exposed glass edges.

2.10 CERAMIC FRIT

- A. Basis of design: Vitro EnergyGlaze Silkscreen.
- B. Style: 40% Dots – 1/8" [3mm] diameter dots with 1/4" [6mm] spacing.

2.11 SECURITY AND SAFETY GLAZING FILM

- A. Products:
 - 1. Security and Safety Glazing Film.
 - a. Manufacturer: Armored One
 - b. Product: Shooter/Attack/Bomb Resistant Security Film - Part #: Aotsf23
 - c. Thickness: 23 Mil
 - d. Transparency: Clear.

2.12 DECORATIVE GLASS FILM

- A. Applied sheet decorative window film for interior applications.
- B. Manufacturers include but are not limited to:
 - 1. LLumar Architectural Films; NRM-PS2 frosted window film (Basis of design).
 - 2. 3M Window Films.
 - 3. Other manufacturers, pending Architect's approval.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. 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/or impair performance and/or appearance (scratches, hairline cracks, etc.).
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. 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.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where the length plus width is larger than 50 inches as follows:
 - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. 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.

- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 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. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and 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. Do not remove release paper from tape until just before each glazing unit is installed.
- F. Apply heel bead of elastomeric sealant for insulating glass unit glazing at exterior exposure steel frames.
- G. 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.
- H. Apply cap bead of elastomeric sealant over exposed edge of tape at exterior exposures.

3.5 GASKET GLAZING (DRY)

- A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance 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. 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. Install gaskets so they protrude past face of glazing stops.

3.6 PROTECTION AND CLEANING

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing 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, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.
 - C. 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 build-up of dirt, scum, alkaline deposits, or stains; remove as recommended by glass manufacturer.
 - D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents, and vandalism, during construction period.
- 3.7 MONOLITHIC FLOAT-GLASS SCHEDULE – (AT ALL INTERIOR GLAZING EXCEPT RATED LOCATIONS AND WHERE NOTED OTHERWISE)
- A. Uncoated Clear Float Glass (**Glass 1**): Provide Type I (transparent glass, flat), Class 1 (clear) glass lites complying with the following:
 - 1. Uncoated Clear Fully Tempered Float Glass: Kind FT (fully tempered).
- 3.8 INSULATING-GLASS SCHEDULE
- A. Low-E Insulating Glass (**Glass 2 / 4 / 5 / 6**): For all exterior glazing unless noted otherwise (“vision glass”), provide low-emissivity solar-controlling insulating-glass units complying with the following:
 - 1. Products: Available products include the following:
 - a. 1” insulated tempered glass: ¼” + ½” airspace + ¼”
 - b. Vitro Solarcool Solargray + Solarban 60 clear
 - 2. Visible Light Transmittance (VLT): 14
 - 3. Visible Light Reflectance: Exterior 11%, Interior 29%
 - 4. NFRC U-value: Winter night-time .29.
 - 5. Solar Heat Gain Coefficient: .17
 - 6. Light To Solar Gain (LSG): 0.82
 - B. At Glass Type 4: Decorative (frosted) window film field-applied to interior (Surface 4).
 - C. At Glass Type 5: Ceramic Frit applied to Surface 3.
 - D. At Glass Type 6: Security and Safety film field-applied to interior (Surface 4).
- 3.9 INSULATED SPANDREL GLASS
- A. Insulated Spandrel Glass (**Glass 3**): Provide insulating spandrel glass units complying with the following:
 - 1. Products: Available products include the following:
 - a. 1” insulated tempered glass: ¼” + ½” airspace + ¼”
 - b. Vitro Solarcool Solargray + clear + Vitro Opaci-Coat-300
 - 2. Opaci-Coat-300 color to be selected by Architect.

3.10 GLAZING SEALANT SCHEDULE

- A. Medium-Modulus Neutral-Curing Silicone Glazing Sealant: Where glazing sealants are indicated, provide products complying with the following:
1. Products: Available products include the following:
 - a. 791 or 795; Dow Corning.
 - b. HiFlex 393; NUCO Industries, Inc.
 - c. PSI-631; Polymeric Systems, Inc.
 - d. SM5731 Poly-Glaze or SM5733 Poly-Glaze; Schnee-Morehead, Inc.
 - e. Spectrem 2 or Tremsil 600; Tremco.
 2. Type and Grade: S (single component) and NS (nonsag).
 3. Class: 25.
 4. Use Related to Exposure: NT (nontraffic).
 5. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - a. Use O Glazing Substrates: Coated glass, aluminum coated with a high-performance coating, and galvanized steel.

3.11 WINDOW FILM INSTALLATION

A. Examination

1. Examine glazing surfaces to receive security and safety glazing film application. Report conditions detrimental to application of film in writing to Architect. Do not apply film to substrates until approved.

B. Preparation

1. Clean glass substrates in accordance with provider's instructions. Test substrate after cleaning for adhesion when recommended.

C. Installation

1. Install in accordance with manufacturer's written instructions.
2. Install with no gaps or overlaps.
3. If seamed, make seams non-overlapping.
4. Do not remove release liner from film until just before each piece of film is cut and ready for installation.
5. Custom cut to the glass with neat, square corners and edges to within 1/8-inch of the window frame.
6. Remove air bubbles, blisters, and other defects. Be careful to remove "fingers" to eliminate any contamination or excess water pockets. It is crucial to remove as much water as possible during installation.
7. Once the film is installed and borders dried for at least several hours, all edges must be sealed to prevent edge delamination and possible metal corrosion. Edge Sealing must be as follows: Use neutral-cure (non-acidic) weatherable silicone sealant.

D. Field quality control

1. After installation, view film from a distance of 10 feet against a bright uniform sky or background. Film shall appear uniform in appearance with no visible streaks, wrinkles, banding, thin spots or pinholes.
2. If installed film does not meet these criteria, remove and replace with new film.

E. Cleaning and Protection

1. Remove excess mounting solution at finished seams, perimeter edges, and adjacent surfaces.
2. Use cleaning methods recommended by film manufacturer. Note: Special cleaning instructions for cleaning exterior films should be provided to building maintenance following film installation.
3. Replace films that cannot be cleaned.
4. Protect installed products until completion of project.
5. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

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.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks, firestop tracks post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

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, the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. 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 E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft.
- D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- E. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C645 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with ASTM A653/A653M, G40 or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: ASTM C645
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. ClarkDietrich.
 - c. MBA Building Supplies.
 - d. MarinoWARE.
 - e. SCAFCO Steel Stud Company.
 - f. Steel Construction Systems.

2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection
 3. Depth: As indicated on Drawings
 4. See "Embossed, High-Strength Steel Studs and Tracks" Article in the Evaluations for information about embossed, high-strength steel studs and tracks.
- C. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. CEMCO; California Expanded Metal Products Co.
 - b. MBA Building Supplies.
 - c. MarinoWARE.
 - d. Phillips Manufacturing Co.
 - e. SCAFCO Steel Stud Company.
 - f. Steel Construction Systems.
- D. Slip-Type Head Joints: Where indicated, provide 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 2-inch minimum vertical movement.
 2. Single Long-Leg Track System: ASTM C645 top track with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
 3. Double-Track System: ASTM C645 top outer tracks, inside track with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. 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.
- F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Steel Thickness: As indicated on Drawings

2. Retain "Cold-Rolled Channel Bridging" Paragraph below for channel bridging for fixture attachment or lateral bracing. Indicate locations and details of installation on Drawings.
- G. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings
 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.
- H. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Minimum Base-Steel Thickness: As indicated on Drawings
 2. Depth: As indicated on Drawings
- I. Resilient Furring Channels: 1/2-inch-deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.
- J. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
1. Depth: As indicated on Drawings
 2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-steel thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 AC193 AC58 or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor, torque-controlled, adhesive anchor, or adhesive anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.

- d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless steel bolts, ASTM F593, and nuts, ASTM F594.
- 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings
- E. Retain "Carrying Channels (Main Runners)" Paragraph below for conventional ceiling suspension framing; delete if only grid suspension ceilings are required.
- F. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: As indicated on Drawings
- G. Furring Channels (Furring Members):
 - 1. Cold-Rolled Channels: 0.0538-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
 - 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: 0.0329 inch
 - b. Depth: As indicated on Drawings
 - c. See "Embossed, High-Strength Steel Studs and Tracks" Article in the Evaluations for information about embossed, high-strength steel studs and tracks.
 - 3. Embossed, High-Strength Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: .0190 inch
 - b. Depth: As indicated on Drawings
 - 4. Hat-Shaped, Rigid Furring Channels: ASTM C645, 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.0329 inch
 - 5. Resilient Furring Channels: 1/2-inch-deep members designed to reduce sound transmission.
 - a. Configuration: Asymmetrical or hat shaped.
- H. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 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 D226/D226M, 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 thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 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.
 - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- 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 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.
- 6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Z-Shaped Furring Members:
 - 1. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
 - 2. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Hangers: 48 inches o.c.
 - 2. Carrying Channels (Main Runners): 48 inches o.c.
 - 3. Furring Channels (Furring Members): 24 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support

- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION

SECTION 092900
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes metal stud wall framing; metal channel ceiling framing; gypsum board and joint treatment; gypsum sheathing; and acoustic insulation.

1.2 REFERENCES

- A. ASTM C36 - Gypsum Wallboard.
- B. ASTM C475 - Joint Compound and Joint Tape for Finishing Gypsum Board.
- C. ASTM C645 - Non-Load Bearing (Axial) Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
- D. ASTM C754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
- E. ASTM C840 - Application and Finishing of Gypsum Board.
- F. ASTM E119 - Test Methods for Fire Tests of Building Construction and Materials.
- G. GA-216 (Gypsum Association) - Recommended Specifications for the Application and Finishing of Gypsum Board.
- H. GA-600 (Gypsum Association) - Fire Resistance Design Manual.
- I. UL (Underwriters Laboratories, Inc.) - Fire Resistance Directory.

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to applicable code for fire rated assemblies as follows:
 - 1. Fire Rated Partitions: Listed assembly by UL Numbers as indicated on partition types.
 - 2. Fire Rated Ceiling and Soffits: Listed assembly by UL as indicated.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate special details associated with fireproofing, and acoustic seals.
- B. Product Data: Submit data on metal framing, gypsum board, joint tape; acoustic accessories and all trim pieces.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM C840, ASTM C1280, GA-214, GA-216 and GA-600.

1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this section with minimum five years documented experience.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Manufacturers:
 - 1. National Gypsum Co.
 - 2. G-P Gypsum Corp.
 - 3. Celotex Building Products.
 - 4. United States Gypsum Co.
 - 5. No Substitutions.

2.2 COMPONENTS

- A. Studs: ASTM C645; nominal 25-guage; 0.0179" minimum thickness of base metal for interior assemblies except 20-guage 0.0328" minimum thickness for reinforcement at door frames and ceramic wall tile assemblies.
- B. Depth of Section: As indicated on the drawings.
- C. Runners: Match studs; provide type recommended by stud manufacturer for floor and ceiling support of studs. Top track connection to structural steel frame shall be by deep leg tracks, metal angle clips or zee sections as required for spray-on fireproofing of steel members.
- D. Coating: All members shall be galvanized per ASTM A525 and ASTM A591.
- E. Furring, Framing, and Accessories: ASTM C645, GA-216 and GA-600.
- F. Fasteners: ASTM C514, ASTM C1002 and GA-216 as recommended by board manufacturer.
- G. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- H. Adhesive: ASTM C557, GA-216 and as recommended by board manufacturer

I. Gypsum Board Materials:

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:
 - i. American Gypsum Co.
 - ii. G-P Gypsum.
 - iii. National Gypsum Company.
 - iv. USG Corporation.
2. Standard Gypsum Board: ASTM C36; 5/8 inch thick, maximum available length in place; ends square cut, tapered edges
3. Fire Rated Gypsum Board: ASTM C36; fire resistive type, UL; 5/8 inch thick, maximum available length in place; ends square cut, tapered edges.
4. Moisture Resistant Gypsum Board: ASTM C630; 5/8 inch thick, maximum available length in place; ends square cut, tapered edges, and damp areas such as bathrooms, toilets (above wainscots).
5. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
 - a. Thickness: 1/2 inch.
 - b. Long Edges: Tapered.
6. Fiberglass-Mat Faced Gypsum Backing Board (TBB- at tiled surfaces): ASTM C1178:
 - a. Thickness: 1/2 inch at non fire-rated walls and 5/8" Type X at fire-rated walls
 - b. Width: 4 feet
 - c. Length: 8 feet
 - d. Weight: 2.0 lb/sq. ft.
 - e. Edges: Square.
 - f. Surfacing: Coated fiberglass mat on face, back, and long edges.
 - g. Mold Resistance (ASTM D3273): 10, in a test as manufactured.
 - h. Microbial Resistance (ASTM D6329, EPA 12-week protocol): Will not support microbial growth.
 - i. Permeance (ASTM E96): Not more than 1.0 perms when tiled.
 - j. Acceptable Products:
 - i. DensShield Tile Backer, Georgia-Pacific Gypsum.
 - ii. Approved Equal.

2.3 ACCESSORIES

- A. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board.
- B. Corner Beads: Metal.

- C. Edge Trim: GA-216; Type LC, L, LK, U exposed reveal bead. Shape as required.
- D. Joint Materials: ASTM C475; GA-201 and GA-216; reinforcing tape, joint compound, adhesive, and water.
- E. Fasteners: ASTM C1002, Type S12 and GA-216 as recommended by accessory manufacturer.
- F. Drywall Suspension System: For ceilings provide Direct Suspension as manufactured by U. S. Gypsum Company or approved equal. Install per manufacturer's directions.
- G. Preformed Drywall Trims:
 - 1. Reveals: Gordon Series 400 #412-518 Pittcon Model SWR-0630-063, where indicated on drawings.
- H. Screws: ASTM C1002, with corrosion resistant treatment (at tiled areas)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that site conditions are ready to receive work and opening dimensions are as instructed by the manufacturer.

3.2 INSTALLATION

- A. Metal Stud Installation:
 - 1. Install studs in accordance with ASTM C754, GA-216 and GA-600.
 - 2. Metal Stud Spacing: 16 inches on center.
 - 3. Extend stud framing to bottom of roof deck or structure. Attach ceiling runner securely to framing in accordance with details indicated. Maintain clearance under structural building members to avoid deflection transfer to studs. Provide extended leg ceiling runners.
 - 4. Door Opening Framing: Install double studs at door frame jambs. Install stud tracks on each side of opening, at frame head height, and between studs and adjacent studs.
 - 5. Blocking: Screw wood blocking to studs. Bolt or screw steel channels to studs. Install blocking for support of plumbing fixtures, toilet partitions, wall cabinets, toilet accessories, hardware, etc.
- B. Ceiling Framing Installation:
 - 1. Install in accordance with ASTM C754.

2. Coordinate location of hangers with other work.
 3. Install ceiling framing independent of walls, columns, and above ceiling work.
 4. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.
 5. Laterally brace entire suspension system.
- C. Acoustic Accessories Installation:
1. Install acoustic sealant within partitions.
- D. Gypsum Board Installation:
1. Install gypsum board in accordance with GA-216 and GA-600.
 2. Erect single layer gypsum board in most economical direction, with ends and edges occurring over firm bearing. Extend board 4 inches above ceiling or to roof deck, whichever is lower.
 3. Erect exterior gypsum sheathing in accordance with ASTM C1280, horizontally, with edges butted and ends occurring over firm bearing.
 4. Use screws when fastening gypsum board to metal furring or framing.
 5. Double Layer Applications for Rated Partitions: Place first layer perpendicular to framing members. Use fire rated gypsum backing board for fire rated partitions and ceilings.
 6. Place second layer perpendicular to first layer. Offset joints of second layer from joints of first layer.
 7. Treat cut edges and holes in moisture resistant gypsum board with sealant.
 8. Place control joints consistent with lines of building spaces as indicated or as directed.
 9. Place corner beads at external corners. Use longest practical length. Place edge trim where gypsum board abuts dissimilar materials.
 10. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C840.
 - a. Install sound attenuation blankets (where required) prior to gypsum board unless readily installed after board has been installed.
 - b. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.

- c. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.
- d. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.
- e. Do not install imperfect, damaged or damp boards.
- f. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.
- g. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide ¼ inch to ½ inch space and trim edge with “L” or “LC” edge trim. Seal joints with acoustical sealant.

12. Install reveal moldings where board abuts dissimilar materials.

E. Joint Treatment:

- 1. Finish in accordance with GA-214 Level (1) above ceilings only, behind ceramic tile or (2 and 3) above ceilings only, (4) storage and utility areas, (5) all public, classroom, and office areas.
- 2. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
- 3. Feather coats on to adjoining surfaces so that camber is per finish level (i.e., 1/32 inch for level (4) and no camber for level (5)).
- 4. Taping, filling, and sanding is not required at surfaces behind adhesive applied ceramic tile.

END OF SECTION

SECTION 093000 TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes ceramic tile, porcelain tile, glass mosaics, metal and glass composite tile, natural stone pebbles and stacked pebbles for floor and wall applications; using thin-set application method; thresholds at door openings; and tiling accessories.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A108.1 - Installation of Ceramic Tile, A collection.
 - 2. ANSI A108.10 - Specifications for Installation of Grout in Tilework.
 - 3. ANSI A108.5 - Specifications for Ceramic Tile Installed with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
 - 4. ANSI A118.1 - Standard Specification for Dry-Set Portland Cement Mortar.
 - 5. ANSI A118.3 - Chemical-Resistant, Water-Cleanable, Tile-Setting and -Grouting Epoxy and Water-Cleanable Tile-Setting Epoxy Adhesive.
 - 6. ANSI A118.4 - Latex-Portland Cement Mortar.
 - 7. ANSI A118.6 - Ceramic Tile Grouts.
 - 8. ANSI A137.1 - Ceramic Tile.
- B. Tile Council of America:
 - 1. TCA - Handbook for Ceramic Tile Installation. Use recommendations from latest addition

1.3 DEFINITIONS

- A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.
- B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).
- C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 SUBMITTALS

- A. Product Data: For each type of tile, mortar, grout, and other products specified.
- B. Tile Samples for Verification: One each item listed below, prepared on Samples of size and construction indicated. Where products involve normal color and texture variations, include Sample sets showing the full range of variations expected.

- C. Grout Samples for Initial Selection: Manufacturer's color charts consisting of actual selections of grout showing the full range of colors available for each type of grout indicated.
- D. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source.
- C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source of producer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements of ANSI A137.1 for labeling sealed tile packages.
- B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.8 EXTRA MATERIALS

- A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 2 percent of amount installed, for each type, composition, color, pattern, and size indicated. Provide letter of transmittal for new package and labeled extra stock. Not to be used for punch list items.

PART 2 PRODUCTS

2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
 - 2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.
- C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:
 - 1. Provide full range of manufacturer's colors, textures, and patterns.

2.2 CERAMIC/ PORCELAIN TILE/ GLASS/ METAL/ NATURAL STONE

- A. Manufacturers:
 - 1. Dal-Tile International, www.daltile.com* (Standard of Design CT-1, CT-2, CT-3)
 - 2. Substitutions: Permitted if reviewed and approved by architect a minimum of ten (10) days prior to bid date.
 - * Contact Jay McCray: 540.563.4881, mail to: jay.mccray@daltile.com

2.3 COMPONENTS

- A. **CT-1:** Ceramic Wall Tile – Daltile Color Wheel Linear 4x16, Matte Arctic White
- B. **CT-2:** Ceramic Floor Tile – Daltile Unity 12x24 Grigio P402 Matte. Install 1/3 Offset
- C. **CT-1:** Ceramic Base Tile – Daltile Unity 12x24 Grigio P402 Matte.

2.4 ACCESSORIES

- A. Mortar Materials:
 - 1. Mortar Bond Coat Materials:
 - a. Dry-Set Portland Cement type: ANSI A118.1.
 - b. At large format tiles: Provide a non-sag mortar with high polymer content

- B. Grout Materials:
 - 1. Standard Grout: Sand-Portland Cement type as Dry-Set type as specified in ANSI A118.6
 - a. Color: As selected from manufacturer's full range
 - 2. Epoxy Grout: two-component 100%-solids waterproof epoxy grout and mortar. Non-sagging and non-slumping, non-yellowing, water-cleanable as recommended by TCNA. All walls with tile @ janitor's closet to receive epoxy grout.
 - a. Color: White
- C. Thresholds: Granite type (Absolute Black), black color, honed finish, door frame width x 1/2" size by full width of wall or frame opening, beveled both sides, radiused edges from bevel to vertical face. Meet ADA requirements for maximum threshold heights. Use where thresholds are required in resinous flooring
- D. Trim Units:
 - 1. Provide Satin Anodized Clear Aluminum trim units @ Porcelain Tile and Satin Stainless Steel @ Ceramic Tile:
 - 2. Size: To accommodate tile sizes and thicknesses specified except at external corridor corners where 1" x 1" Corner-guards the full height of the tile are to be used. 1" x 1" corner guards are to be used at gypsum boards corners where noted in the drawings.
 - 3. Shapes: As follows, selected from manufacturer's standard shapes:
 - a. External Corners: 1" x 1" Clear Satin Anodized Aluminum Corner Guards—full height of wall tile—Corridors
 - b. Internal Corners: Field-butt square corners.
 - c. Wainscot Cap: Continuous Schluter strip at top of all tile wainscots.
 - d. Provide Satin Anodized Clear Aluminum trim units- Shape to be selected from manufacturer's full range
 - e. Base & Wainscot Cap: Continuous Schluter strip at top of all tile wainscots except CT-1.

2.5 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturer's written instructions to accommodate tile(s) specified.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
 - 1. Verify that substrates for setting tile are firm; dry; clean; free from oil; waxy films, and curing compounds unless otherwise indicated; and within flatness tolerances required by referenced ANSI A 108.5 series of tile installation standards for installations indicated.
 - 2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile have been completed before installing tile.
 - 3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.
- B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.
- B. Use trowellable leveling and patching compounds per tile-setting material manufacturers written instructions to fill cracks, holes, and depressions.
- C. Remove protrusions, bumps, and ridges by sanding or grinding.

3.3 INSTALLATION, GENERAL

- A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.
- B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA Installation methods indicated in ceramic tile installation schedules.
- C. Extend tile work into recesses and behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim,

finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

- E. Jointing Pattern:
 - 1. Lay Ceramic tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Provide uniform joint widths, unless otherwise indicated.
 - 2. Lay Porcelain Tile in running bond or stacked bond as noted on drawings.
- F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, in locations in accordance with manufacturer's recommendations during installation of setting materials and tile. Do not saw-cut joints after installing tiles.
- G. Grout tile to comply with the requirements of the following tile installation standards:
 - 1. For ceramic tile grouts (sand-portland cement, dry-set), comply with ANSI A108.10.
 - 2. For chemical-resistant epoxy grouts, comply with ANSI A108.3.
- H. Where cove base is specified, do not install base until Floor installation is complete.

3.4 ACCESSORIES INSTALLATION

- A. Place thresholds at all exposed resinous floor edges and locations indicated.

3.5 WALL TILE INSTALLATION

- A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.
- B. Joint Widths: Install tile on walls with the following joints widths:
 - 1. Glazed Wall Tile: 1/16 inch.
 - 2. Porcelain Tile: Nominal 3/16" joint at large format and 1/16" at 2" x 2" unless otherwise indicated on drawings.

3.6 CLEANING AND PROTECTING

- A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

- C. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, un-bonded, and otherwise defective tile work.
- D. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensure tile is without damage or deterioration at the time of Substantial Completion.
 - 1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
 - 2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.
- E. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.
- E. Grout tile joints. Use standard grout at all wall tile.
- F. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- G. Over interior concrete and masonry install in accordance with TCA Handbook Method W202, thin-set with dry-set cement bond coat.

3.7 CLEANING

- A. Division 1 - Execution Requirements: Final cleaning.
- B. Clean tile and grout surfaces.

3.8 PROTECTION OF INSTALLED CONSTRUCTION

- A. Division 1 - Execution Requirements: Protecting installed construction.

END OF SECTION

SECTION 095113
ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. CAC: Ceiling Attenuation Class.
- B. LR: Light Reflectance coefficient.
- C. NRC: Noise Reduction Coefficient.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. 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.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers access panels, and special moldings.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot.
- C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on samples of size indicated below.
 - 1. Acoustical Panel: Set of 6-inch square samples of each type, color, pattern, and texture.
 - 2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch long samples for each type, finish and color.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each acoustical panel ceiling.
- G. Research/Evaluation Reports: For each acoustical panel ceiling and components and anchor and fastener type.
- H. Maintenance Data: For finishes to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

1.5 DELIVERY STORAGE AND HANDLING

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

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panels ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for project when occupied for its intended use.

1.7 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 - 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2.0 percent of quantity installed.

PART 2 PRODUCTS

2.1 ACOUSTICAL PANELS, GENERAL

- A. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designed by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
 - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface per ASTM E795.
- B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
 - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.
- C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G21.

2.2 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – ACP-1

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.; Ultima Tegular
- B. Classification: Provide panels complying with ASTM E 1264 for type, form and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. Edge/Joint Detail: Tegular edge.
- E. Thickness: 5/8 inch.
- F. Modular Size: 24 by 48 inches (ACP-1)
- G. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.3 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – ACP-2

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.; Ultima Tegular W/ Humigard PPlus

- B. Classification: Provide panels complying with ASTM E 1264 for type, form and pattern as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: CE (perforated, small holes and lightly textured).
- C. Color: White.
- D. LR: Not less than 0.85.
- E. NRC: Not less than 0.55.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square edge.
- H. Thickness: 5/8 inch.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.4 ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – ACP-3 (Locker Room Showers/ Wet Locations)

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.; Fine Fissured, to be used as standard of quality. Item Number 1728. Prelude 15/16" Grid.
 - 2. Chicago Metallic Corporation
 - 3. Tectum Inc.
 - 4. USG Interiors, Inc.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form and pattern as follows:
 - 1. Type and Form: Type XX, other types: described as high-density, ceramic and mineral base panels with scrubbable finish, resistant to heat, moisture, and corrosive fumes.
 - 2. Pattern: EG (lightly textured and smooth)
 - 3. Color: White.
- C. LR: Not less than 0.85 1.00.
- D. Sound Attenuation (per ASTM E1414): 46 db
- E. Edge/Joint Detail: Square.
- F. Thickness: 5/8 inch.
- G. Modular Size: 24 by 24 inches.
- H. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.
- B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.
 - 1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C635, Table 1, "Direct Hung", unless otherwise indicated. Comply with seismic design requirements.
 - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
 - a. Type: Post-installed expansion anchors.
 - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
 - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
 - d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
- D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Select wire diameter so its stress at 3 times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.
- E. Hold-Down Clips: Where indicated and at all Vestibules and at Kitchen areas, provide manufacturer's standard hold-down clips spaced 24 inches on center on all cross tees.

2.6 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. BPB USA
 - 3. Chicago Metallic Corporation

4. Ecophon CertainTeed, Inc.
 5. USG Interiors, Inc.
- B. 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 according to ASTM A 653/A 653M, not less than G30 coating designation, with prefinished 15/16 inch wide or 9/16 inch (dependent on type) metal caps on flanges.
1. Structural Classification: Intermediate-duty system.
 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 3. Face Design: Flat, flush.
 4. Cap Material: Steel cold-rolled sheet.
 5. Cap Finish: Painted white and to match color of acoustical unit.

2.7 METAL EDGE MOLDINGS AND TRIM

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Armstrong World Industries, Inc.
 2. Chicago Metallic Corporation
 3. Fry Reglet Corporation
 4. Gordon, Inc.
 5. USG Interiors, Inc.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners, unless otherwise indicated.
 2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
 3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
- C. Acoustic Ceiling Clouds (Band & Choir): At areas to receive acoustic "cloud" ceilings, provide 5-13/16" High Armstrong Axiom Trim at perimeter.

2.8 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:
1. Acoustical Sealant for Concealed Joints:
 - a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.
 - b. Pecora Corporation; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
- B. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying; nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant

recommended for sealing interior concealed joints to reduce airborne sound transmission.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C636 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook".
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
 - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
 - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 - 4. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 - 5. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 - 6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.

7. Do not attach hangers to steel deck tabs.
 8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
 10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- D. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- E. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
 2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
 3. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension systems surfaces and panel faces flush with bottom face of runners.
 4. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
 5. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions, unless otherwise indicated.

3.4 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096513
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Resilient base.
 - 2. Resilient molding accessories.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.
- C. Product Schedule: For resilient and aluminum products.

1.3 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: 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 II, not less than 0.22 W/sq. cm.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

- C. Install resilient products after other finishing operations, including painting, have been completed.

1.6 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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Armstrong World Industries, Inc.
 - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - c. Flexco, Inc.
 - d. Johnsonite.
 - e. Mondo Rubber International, Inc.
 - f. Roppe Corporation, USA.
 - g. VPI, LLC; Floor Products Division.
- B. Resilient Base Standard: ASTM F 1861.
 - 1. Material Requirement: Type TS (rubber, vulcanized thermoset) or Type TP (rubber, thermoplastic).
 - 2. Manufacturing Method: Group I (solid, homogeneous).
 - 3. Style: Cove (base with toe) unless noted otherwise and straight (flat or toeless) at all carpet areas.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Corners: Manufactured at Outside Corners and Job-formed at Inside Corners.
- G. Finish: As selected by Architect from manufacturer's full range.
- H. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 RESILIENT MOLDING ACCESSORY

A. Resilient Molding Accessory:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
 - a. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
 - b. Flexco, Inc.
 - c. Johnsonite.
 - d. Roppe Corporation, USA.
 - e. VPI, LLC; Floor Products Division.

B. Description: Carpet edge for glue-down applications, Nosing for carpet on stairs, Reducer strip for resilient floor covering and transition strips.

C. Material: Rubber

D. Profile and Dimensions: As required between dissimilar floor surfaces and materials.

E. Colors and Patterns: As selected by Architect from full range of industry colors.

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 manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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 and remove bumps and ridges to produce a uniform and smooth substrate.

- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
 - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable 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. Job-Formed Corners:
 - 1. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 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 carpet and resilient floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.

- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION

SECTION 096519
RESILIENT FLOOR TILE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl composition floor tile (VCT).
 - 2. Slip-Resistant VCT (SR-VCT)
 - 3. PVC/Cork Composite Floor Tile (SAGA- S-1, S-2).
 - 4. Static Dissipative Tile (SDT)

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- 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.
 - 2. Provide shop drawings with each color number clearly designated. Contractor is not released to begin installation until shop drawings have been reviewed and approved.
- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
- D. Product Schedule: For floor tile. Use same designations indicated on Drawings.
- E. Qualification Data: For qualified installer.
- F. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.
- B. Fire-Test-Response Characteristics: 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 II, not less than 0.22 W/sq. cm.

1.4 DELIVERY STORAGE AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by

manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.5 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. Unit Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F. Close spaces to traffic during floor tile installation.
- C. Close spaces to traffic for 48 hours after floor tile installation.
- D. Install floor tile after other finishing operations, including painting, have been completed.

1.6 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. Floor Tile (VCT): Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
 - 2. Floor Tile (SR-VCT): Furnish 1 box of each type, color, pattern of floor tile installed.
 - 3. Floor Tile (SAGA): Furnish 1 box each of each type, color, pattern of floor tile installed.
 - 4. Floor Tile (SDT): Furnish 1 box each of each type, color, pattern of floor tile installed.

PART 2 PRODUCTS

2.1 VINYL COMPOSITION FLOOR TILE (VCT-1)

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Mannington Mills, Inc.
 - 3. Tarkett, Inc. (used as quality standard).
- B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.
- C. Wearing Surface: Smooth.

- D. Thickness: 0.125 inch.
- E. Size: 12 by 12 inches.
- F. Colors and Patterns: As selected by Architect from full range of industry colors including premium.

2.2 LUXURY VINYL TILE (LVT-1):

- A. Products: Subject to compliance with requirements, provide one of the following:
 - 1. Interface, Natural Woodgrains, Washed Wheat.Note: Owner Furnished, Contractor Installed

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 manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to 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 curling 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 manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
 4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
 - a. Perform 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. in 24 hours.
 - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install floor tiles until they are same temperature as space where they are to be installed.
 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
 1. Lay tiles square with room axis or in patterns indicated on drawings.
- 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 with grain direction alternating in adjacent tiles (basket-weave pattern).
- 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 to 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, non-staining 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.
- I. Follow manufacturer's recommendations and electrical requirements when installing static dissipative tile (SDT).

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
 - 1. Remove adhesive and other blemishes from exposed surfaces.
 - 2. Sweep and vacuum surfaces thoroughly.
 - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from marks, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish (VCT): Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
 - 1. Apply three coats.
- E. Floor Protection Coat (S): Protecscot®; apply per manufacturer's recommendations.
- F. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 096813
CARPET TILE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes carpet tile and installation.
 - 1. Carpet Tile.
 - 2. Walk Off Carpet Tiles

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.
- B. Shop Drawings: Show the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Pile direction.
 - 8. Type, color, and location of insets and borders.
 - 9. Type, color, and location of edge, transition, and other accessory strips.
 - 10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
 - 1. Carpet Tile: Full-size Sample.
 - 2. Exposed Edge Stripping and Accessory: 12-inch- long Samples.
- D. Product Schedule: Use same room and product designations indicated on Drawings and in schedules.
- E. Maintenance Data: For carpet tile to include in maintenance manuals include the following:
 - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.
- B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with CRI 104, Section 5, "Storage and Handling."

1.5 PROJECT CONDITIONS

- A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."
- B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.6 WARRANTY

- A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
 - 1. Warranty Period: **10** years from date of Substantial Completion.
 - 2. Limited Commercial Lifetime Warranty

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

PART 2 - PRODUCTS

2.1 CARPET TILE – SEE FINISH LEGEND SHEET A104

- A. Note: Carpet is Owner Furnished, Contractor Installed

2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer. (Gypsum-based products are not acceptable.)
- B. Adhesives: Water-resistant, mildew-resistant, non-staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
 - 1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
 - 2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.
- C. 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 carpet tile manufacturer.

- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)."
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. 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.
- D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- F. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
 - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
 - 2. Remove yarns that protrude from carpet tile surface.
 - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 15, "Protection of Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION

SECTION 098433
ACOUSTICAL WALL TREATMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Custom fabricated acoustical wall panels, shapes and sizes as indicated on the drawings.

1.2 REFERENCES

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

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements:
 - 1. Surface Burning Characteristics (ASTM E84):
 - a. Flamespread: 25, maximum.
 - b. Smoke Developed: 450, maximum.
 - c. This rating applies to all acoustical wall treatment unless specifically excluded in the product specification section 2.02.
 - 2. Acoustical Test Report: Provide acoustical test reports from a qualified testing agency indicating acoustical wall panels meet (0.70, 0.90, 0.95) NRC per ASTM C-423.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Regulatory Requirements and Approvals

1.6 DELIVERY, STORAGE & HANDLING

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

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 45%, respectively.

1.8 WARRANTY

- A. Special Warranty for Acoustic Room Components: Manufacturer's written warranty indicating manufacturer's intent to repair or replace panels that fail in materials or workmanship. Failures are defined to include, but are not limited to, the following:
 - 1. Fracturing or breaking of unit components which results from normal wear and tear and normal use other than vandalism.
 - 2. Warping of components not resulting from leaks, flooding, or other uncontrolled moisture or humidity.
 - 3. Failure of unit to perform acoustically in accordance with manufacturer's published data.
 - 4. Sound-Absorbing and Sound-Diffusing Panels Warranty Period: 5 years.

PART 2 PRODUCTS

2.1 ACOUSTICAL CEILING AND WALL PANELS **[AWT-1]**

- A. Provide products from the following Manufacturer, or approved equal:
 - 1. Sound Seal, Inc. (Basis of Design)
 - 2. Armstrong World Industries
 - 3. ASI Architectural
- B. Basis of Design: Paintable Acoustic Wall/ Ceiling Panel
 - 1. Product: Sound Quality S-2000 Chroma Panel
 - 2. Manufacturer: Sound Seal, Inc.
50 Almgren Dr.
Agawam, MA. USA
 - 3. Contact: David Ingersoll
Ph. (804) 698-9697
Email: dingersoll@kwcompany.com
 - 4. Facing Material: Signature White Paint-ready fiber veil

5. Panel Thickness: nominal 1" thick – see architectural Finish Legend
 6. Noise Reduction Coefficient: NRC 0.95, 1.00
 7. Panel Width: 48 inches
 8. Panel Length: As indicated on drawings, up to 10 feet long
- C. Fire-rating: The fully assembled product, as installed, shall meet Class A fire protection. Test results for flame spread and smoke developed shall be provided upon request. Individual component level fire test data is not sufficient to meet Class A fire protection requirements and shall not be accepted.

2.2 CONSTRUCTION

- A. The acoustical wall panel products shall be supplied in 48-inch wide panels with lengths as indicated. All edges will be fully wrapped with mounting as indicated.

2.3 MOUNTING

- A. Back-Mounting Accessories: Manufacturers standard accessories for securely mounting panels, of type and size indicated and complying with the following requirements:
1. Mechanically Mounted Edge-Reinforced Panels: metal Z clips designed to support weight of panels, mechanically attached to wall substrate according to manufacturer's standard pattern and adhesively bonded to back of panel, with base support brackets where recommended by manufacturer for additional support of panels.

2.4 ACOUSTICAL PERFORMANCE

- A. Sound Absorption: Per ASTM C – 423
Sound Absorption Coefficient per Octave Band Center Frequency (Hz)

	125	250	500	1000	2000	4000	NRC
1-inch	.80	.90	.83	.99	1.03	1.11	.95
2-inch	.30	.85	1.09	1.05	.99	1.01	1.00

2.5 FLAMMABILITY RATING

- A. All components shall have a Class A Flammability rating per ASTM E-84. Surface Burning Characteristics of Building Materials, with Flame Spread of 25 or less and Smoke Developed of 450 or less.

PART 3 EXECUTION

3.1 EXAMINATION

- a. Examine fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- b. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- a. Install units in locations indicated. Unless otherwise indicated, install units with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- b. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

- a. Variation from Plumb and Level: Plus or minus **1/16 inch** in 48 inches, noncumulative.
- b. Variation of Joint Width: Not more than **1/16-inch** variation from reveal line in 48 inches, noncumulative.

3.4 CLEANING

- a. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.
- b. Remove surplus material, rubbish, and debris resulting from panel installation, on completion of the work, and leave areas of installation in a neat and clean condition.

END OF SECTION

SECTION 099000
PAINTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and field application of paints, stains, varnishes, and other coatings.
- B. Work includes, but is not limited to:
 - 1. Painting and finishing of interior and exterior exposed items and surfaces including surface preparation and priming. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified under other sections.
 - 2. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.
 - 3. Where items or surfaces are not specifically mentioned, paint the same as similar adjacent materials or areas. If color or finish is not designated, Architect will select these from standard colors or finishes available.
 - 4. Paint exposed surfaces whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted or to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from standard colors or finishes available.
 - 5. Painting includes field painting exposed-to-view bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment except as specified in Divisions 21-25 and/or 26.
 - 6. All existing painted items/ rooms to receive new paint in this project.

1.2 REFERENCES

- A. ASTM D16 - Terminology Relating to Paint, Varnish, Lacquer, and Related Products.
- B. ASTM D823-95 Standard Practices for Producing Films of Uniform Thickness of Paint, Varnish, and Related Products.
- C. ASTM D5150-92 (1997) e1 Standard Test Method for Hiding Power of Architectural Paints Applied by Roller.

- D. ASTM D3276-96 Standard Guide for Painting Inspectors- (metal substrates).

1.3 DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.4 SUBMITTALS

- A. Product Data: Submit data on all finishing products. Submit manufacturer's technical information including paint label analysis and application instructions for each material proposed for use.
- B. Samples: Provide a listing of material and application for each coat of each finish sample. Submit samples for Architect's review of color and texture only. Submit two paper chip samples, illustrating range of colors and textures available for each surface finishing product scheduled.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of painted and coated surfaces.

1.6 QUALIFICATIONS

- A. Applicator: Company specializing in performing the work of this section with minimum five years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F (7 degrees C) and a maximum of 90 degrees F (32 degrees C), in ventilated area, and as required by manufacturer's instructions.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Do not apply exterior coatings during rain, fog, mist, or snow when relative humidity is outside the humidity ranges, or moisture content of surfaces exceed those required by the paint product manufacturer.
- C. Minimum Application Temperature for Varnish: 65 degrees F for interior or exterior, unless required otherwise by manufacturer's instructions.

- D. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 degrees F.
- E. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.
- F. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 PRODUCTS

2.1 PAINTS AND COATINGS

- A. Provide materials as manufactured by Sherwin-Williams, PPG, Duron, Tnemec, or Benjamin Moore.
- B. The quality of paint shall be equal to Sherwin Williams or Tnemec product numbers as specified in the schedule below.

2.2 SCHEDULE

- A. Exterior Ferrous Metal:
 - 1. First Coat: SW-KEM Kromik Universal Metal Primer, B5ONZ6
 - 2. Second Coat: SW-Silicone Alkyd enamel, B-56 Series
 - 3. Third Coat: SW-Silicone Alkyd enamel, B-56 Series
- B. Exterior Galvanized Metal:
 - 1. First Coat: Tnemec Series 27 F.C. Typoxy Polyamide Epoxy at 3-5 mils. (Coordinate with metal fabrication items required to receive first coat applied in shop.)
 - 2. Second Coat: Tnemec Series 75 Endura – Shield Aliphatic Acrylic Urethane – Satin, 3-4 mils.
 - 3. Field touch up of welds to be primed w/Tnemec Series 90-97 Tnemec-Zinc 2.5-3.5 mils thick prior to receiving first and second coat.
- C. Exposed Exterior Steel (AESS): (Use at all exposed ornamental steel including columns, trellises, railings, etcetera, and at all areas labeled “HIPAC” on the drawings).
 - 1. Primer by Steel Fabricator: Tnemec Series 90-97 Tnemec-Zinc 2.5-3.5 mils.

2. First Coat: Tnemec Series 27 F.C. Typoxy Polyamide Epoxy at 3-5 mils. (Coordinate with metal fabrication item required to receive first coat applied in shop.)
 3. Second Coat: Tnemec Series 75 Endura – Shield Aliphatic Acrylic Urethane – Satin, 3-4 mils.
 4. Field touch up of welds to be primed w/Tnemec Series 90-97 Tnemec-Zinc 2.5-3.5 mils thick prior to receiving first and second coat.
- D. Interior Plaster and Drywall (Walls):
1. Prime Coat (New Walls): SW ProMar 200 Zero VOC Latex Primer, B28W2600, at 1.0 mils dry, per coat.
 2. Prime Coat (Existing Walls): SW Multipurpose Primer B51W00453
 3. Intermediate Coat: ProMar 200 (Zero VOC) Semi-Gloss B31-2600.
 4. Top Coat: ProMar 200 (Zero VOC) Semi-Gloss B31-2600.
- E. Interior Drywall (Ceilings and Soffits):
1. Prime Coat: ProMar 200 Zero VOC Latex Primer, B28W2600.
 2. Intermediate Coat: ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series.
 3. Top Coat: ProMar 200 Zero VOC Interior Latex Flat, B30-2600 Series.
- F. Interior Concrete Masonry, Brick, and Concrete:
1. First Coat: Series: 130 Envirofill high performance block filler.
 2. Second Coat: SW-DTM Acrylic semi gloss, B66W200 Series
 3. Third Coat: SW-DTM Acrylic semi gloss, B66W200 series
- G. Interior Ferrous Metal: (Other than AESS) Gloss Finish (Water Base)
1. 1st Coat: S-W Pro-Cryl® Universal W/B Primer, B66-310 series (2-4 mils dry)
 2. 2nd Coat: S-W Water-based Industrial Enamel, B53-300 Series
 3. 3rd Coat: S-W Water-based Industrial Enamel, B53-300 Series
- H. Exposed Interior Steel: (AESS) (Use at all exposed steel including columns, trusses, etcetera, and at all areas labeled “HIPAC” on the drawings)
1. Primer by Steel Fabricator: Tnemec Series 90-97 Tnemec-Zinc 2.5-3.5 mils.

2. First Coat: Tnemec Series 27 F.C. Typoxy Polyamide Epoxy at 3-5 mils. (Coordinate with metal fabrication item required to receive first coat applied in shop.)
 3. Second Coat: Tnemec Series 75 Endura – Shield Aliphatic Acrylic Urethane – Satin, 3-4 mils.
 4. Field touch up of welds to be primed w/Tnemec Series 90-97 Tnemec-Zinc 2.5-3.5 mils thick prior to receiving first and second coat.
- I. Interior Wood:
1. Opaque Finish: 2 coats low luster alkyd enamel over primer and enamel undercoat.
 2. Transparent Finish: Stain Finish: 1 coat A48-200 oil stain; 2 coats A67 polyurethane varnish.
- J. Interior Concrete Masonry and Brick: Generally, group toilets, locker rooms, and kitchen.
1. High Performance Finish- Semi-Gloss
 2. Prime Coat (New Walls): SW PrepRite Block Filler, B25W25, at 8.0 mils dry, per coat.
 3. Prime Coat (Existing Walls): SW Multipurpose Primer B51W00453
 4. Intermediate Coat: SW High-Performance Epoxy Series B67-200 at 2.0 to 4.0 Mils dry, per coat.
 5. Top Coat: SW High-Performance Epoxy Series B67-200 at 2.0 to 4.0 Mils dry, per coat.
- K. Ferrous Metal with Latex Dry Fog Flat Finish: One finish coat over primed exposed steel roof construction. (Note: Coordinate with masking and painting accent color exposed ductwork as indicated.)
1. Prime Coat: (Acrylic or recommended VOC compliant metal primer.) 2.0 mils DFT.
 Duron: (As recommended)
 ICI 1280 Spray-master Pro Uni-Grip-WB Aqua-acrylic Dryfall Flat
 S-W: B66 W1 DTM Acrylic Primer/Finish
 2. Top Coat: All exposed metal structure as scheduled. Acrylic Dry Fog 3.0 mils DFT.
 Duron: Dura Clad Interior Latex Dry Fog Flat 95-108 (4/03/00)

ICI 1280 Spray-master Pro Uni-Grip-WB Aqua-acrylic Dryfall Flat

Moore: M53 Sweep-Up Spray Latex Flat (3/30/00)

L. Hollow Metal Doors and Frames

1. System Type: High Performance Finish- Semi-Gloss
2. Prime Coat: SW Pro Industrial Pro-Cryl Universal Metal Primer B66-310 Series (Use manufacturer's recommendation at existing doors and Frames.
3. Intermediate Coat: SW Pro Industrial Acrylic Coating B66-600 (Zero VOC)
4. Top Coat: SW Pro Industrial Acrylic Coating B66-600 (Zero VOC)

M. Concrete Floor Sealer

1. System Type: Water-based epoxy floor coating.
2. Surface Prep: Clean, dry, sound.
3. Two Coats: SW Armorseal 8100.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.
- B. Test shop applied primer for compatibility with subsequent cover materials.
- C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below 8%.

3.2 PREPARATION

- A. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- B. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove or repair existing coatings that exhibit surface defects.

- C. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish: Remove foreign particles to permit adhesion of finishing materials.
- D. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
- E. Galvanized Surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.
- F. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish: Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter. Remove oil and grease with a solution of tri-sodium phosphate; rinse well and allow to dry. Remove stains caused by weathering of corroding metals with a solution of sodium metasilicate after thoroughly wetting with water. Allow to dry.
- G. Plaster Surfaces: Fill hairline cracks, small holes, and imperfections with latex patching plaster.
- H. Uncoated Steel and Iron Surfaces: Remove grease, mill scale, weld splatter, dirt, and rust. Where heavy coatings of scale are evident, remove by wire brushing or sandblasting; clean by washing with solvent. Apply a treatment of phosphoric acid solution, ensuring weld joints, bolts, and nuts are similarly cleaned. Spot prime paint after repairs.
- I. Interior Wood Items Scheduled to Receive Transparent Finish: Wipe off dust and grit prior to sealing. Sand lightly between coats and protect from dust while drying.
- J. Metal Doors Scheduled for Painting: All hollow metal frames shall receive one field prime coat, front and back, before erection (color to be medium gray); after erection, touch-up all abrasive marks; this prime coat is in addition to factory prime coat and to the two coats of finish painting specified under Paragraph 2.2. Protect from dust while drying.
- K. Apply a bead of sealant where hollow metal door frames abut adjacent wall surfaces.

3.3 APPLICATION

- A. Spray painting will be permitted wherever practical; however, excess thinning will not be permitted and complete surface coverage shall be equal to that of first class brush work. Do not spray paint concrete block unless it is immediately back-rolled.
- B. Do all touch-up and clean-up at the completion of this work to leave all surfaces in a finished condition.

- C. Where exposed, painting contractor shall paint all ducts, piping, conduit and mechanical and electrical equipment without factory finish, including those in mechanical and electrical rooms.
- D. Visible surfaces on interior of ducts behind louvers, diffusers, registers and grilles shall be primed and then painted with one coat of flat black metal enamel.
- E. Belt guards and other protective guards on equipment shall be painted with two coats of safety yellow metal enamel.
- F. Insulated pipes and ducts with paper or canvas jacket shall be painted with one coat of paint equal to Sherwin Williams SW-Preprite 200 Latex Wall Primary, and insulated surfaces with aluminum foil jacket shall be painted with one coat of Zinc Chromate Primer prior to two coats of finish paint. Armaflex type insulation on exposed pipes shall be painted with two coats of latex base paint equal to SW-PROMAR 200 Latex flat wall paint tinted to match background color.
- G. Mechanical equipment surfaces with asphalt or bitumen coating shall be sealed with an approved asphalt sealer and painted with two coats of SW-KemKromik universal/metal primer, B5ONZ6.
- H. The Architect shall have the right to select in addition to scheduled colors, deep, accent colors for one or more walls, bulkheads, columns, or other features in any of the spaces on the project, up to 2500 sq ft of area.
- I. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- J. Apply each coat to uniform appearance. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.
- K. Sand wood and metal surfaces lightly between coats to achieve required finish.
- L. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior applying next coat.
- M. Paint front and back sides of access panels, and removable or hinged covers.
- N. Protect work of other trades, whether being coated or not, against damage from coating.

3.4 CLEANING

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

3.5 SCHEDULE - COLORS

- A. Color schemes will be prepared by the Architect after receipt of approved manufacturer's color samples. See Architectural Finish Schedule and Finish Plans for the number of paint colors used.

- B. Samples of work receiving natural or stained finish shall be submitted for Architect's review and selection.

END OF SECTION

SECTION 101600
METAL TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes new metal toilet compartments, and urinal screens.

1.2 REFERENCES

- A. ASTM A424 - Standard Specification for Steel Sheet for Porcelain Enameling.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall and floor supports, and door swings.
- B. Product Data: Submit manufacturer's detailed technical data for materials, colors, fabrication, and installation, including catalog cuts of anchors, hardware, fastenings and accessories.
- C. Manufacturer's Installation Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- D. Samples of all hardware proposed for use on this project.

1.4 COORDINATION

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

PART 2 PRODUCTS

2.1 METAL TOILET COMPARTMENTS

- A. Manufacturers:
 - 1. ASI Global Partitions (Basis of Design).
- B. Product Description: Floor mounted.

2.2 COMPONENTS

- A. General: Exposed surfaces which exhibit pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections on finished units are not acceptable.

- B. Stainless Steel Sheet: ASTM A167, Type 304:
 - 1. Pilasters (overhead braced): 20-gauge.
 - 2. Panels: 18-gauge.
 - 3. Doors: 12-gauge.
- C. Core Material for Metal Partitions: Manufacturer's standard sound-deadening honey comb of impregnated Kraft paper.
- D. Concealed Anchorage Reinforcement: Minimum 12-gauge galvanized steel sheet.
- E. Concealed Tapping Reinforcement: Minimum 14-gauge galvanized steel sheet.
- F. Pilaster Shoes: ASTM A 167, Type 304 stainless steel, not less than 3" high, 20-gauge, finished to match partition.
- G. Stirrup Brackets: Manufacturer's standard design for attaching panels to walls and pilasters, type 304 .
- H. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories of type 304 satin finish stainless steel.
- I. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, chromium-plated steel, or brass finished to match hardware, with theft-resistant type heads and nuts. For concealed anchors, use hot-dip galvanized, cadmium-plated, or other rust-resistant protective-coated steel.

2.3 FABRICATION

- A. General: Furnish standard doors, panels, screens, and pilasters fabricated for partition system, unless otherwise indicated. Furnish units with cut-outs, drilled holes, and internal reinforcement to receive partition-mounted hardware, accessories and grab bars, as indicated.
- B. Door Dimensions: Unless otherwise indicated, furnish 24" wide in-swinging doors for ordinary toilet stalls and 32" wide (clear opening) out-swinging doors at stalls equipped for use by handicapped .
- C. Metal Toilet Partitions: Pressure laminate seamless face sheets to core material and seal edges with continuous interlocking strip or with lapped and formed edges. Weld edges and corners, with exposed welds ground smooth.
- D. Hardware: Furnish hardware for each compartment in partition system, as follows:
 - 1. Hinges: Manufacturer's standard type, adjustable to hold door open at any angle up to 90°.
 - 2. Latch and Keeper: Manufacturer's standard surface-mounted latch unit, designed for emergency access, with combination rubber-faced door strike and keeper. (ADA compliant at accessible stalls).
 - 3. Coat Hook: Manufacturer's standard.
 - 4. Door Pull: Manufacturer's standard.

2.4 FACTORY FINISHING

- A. Stainless Steel # 4 finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements are as indicated on shop drawings.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.2 INSTALLATION

- A. General: Comply with manufacturer's recommended procedures and installation sequence. Install partitions rigid, straight, plumb, and level. Provide clearances of not more than $\frac{1}{2}$ " between pilasters and panels, and not more than 1" between panels and walls. Secure panels to walls with not less than two stirrup brackets attached near top and bottom of panel. Secure panels to pilasters with not less than two stirrup brackets located to align with stirrup brackets at wall. Secure panels in position with manufacturer's recommended anchoring devices.
- B. Mount accessories to partition units in accordance with manufacturer's instructions.

3.3 ERECTION TOLERANCES

- A. Maximum Variation From True Position: $\frac{1}{4}$ inch.
- B. Maximum Variation From Plumb: $\frac{1}{8}$ inch.

3.4 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding $\frac{3}{16}$ inch.
- B. Adjust hinges to position doors in partially opened position when unlatched. Return out swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 102600
DIGITALLY PRINTED WALL PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes vinyl wall protection for interior walls.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics. Submit sufficient information to determine compliance with the drawings and specifications.
- B. Shop Drawings: Show location and extent of each wall protection type, indicate pattern placement, seams and termination points.
- C. Samples: For each type of wall protection and for each color, pattern, texture, and finish specified, full width by 36-inch- (914 mm-) long in size.
 - 1. Wall protection sample: From same production run to be used for the Work with specified finish applied. Show complete pattern repeat. Mark top and face of fabric.
- D. Lighting: Do not install wall protection until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive material.
- E. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall protection manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 DIGITALLY PRINTED FLEXIBLE WALL PROTECTION **[WPP-1]**

- A. Fire-Test-Response Characteristics: As determined by testing identical wall protection applied with identical adhesive to substrate according to test methods indicated below by a qualified testing agency.
 - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency.
 - a. Flame-Spread Index: 5 or less.
 - b. Smoke-Developed Index: 40 or less.

- B. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Wolf Gordon
 - 2. Inpro Architectural Products
 - 3. Construction Specialties
- C. Basis of Design: RAMPART wall protection by Wolf Gordon or approved equal meeting the performance specification herein.
- D. Description: Provide mildew-resistant product in rolls from same production run and complying with the following:
 - 1. FC CCC-W-408D Type III, Heavy Duty products
- E. Total Weight: 35 oz per linear yard
- F. Width: 52 inches
- G. Bolt Size: 27 linear yards
- H. Packaging: Ship rolled goods
- I. Backing: Dense Cotton or Dense Polyester/Cotton
- J. Stain-Resistance Coating: Surcoat stain- and abrasion-resistant treatment
- K. Surface Abrasion: Passes ASTM D4977 – Level 3
- L. Surface Indentation: Passes ASTM D5430 – Level 2
- M. Permeability Rating: 1
- N. Low Emitting VOCs: Passes Cal 01350 standard
- O. Color, Textures, Patterns: Custom Graphic provided by owner/architect
- P. Other Characteristics: Ability to wrap both inside and outside corners
- Q. Location: At select locations, see architectural drawings.

2.2 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, clay-based vinyl wallcovering adhesive, for use with specific wall protection and substrate application indicated and as recommended in writing by wall protection manufacturer.
- B. Primer/Sealer: Acrylic or latex wallcovering primer/sealer complying with requirements in Interior Painting and recommended in writing by primer/sealer manufacturer and wall protection manufacturer for intended substrate.
- C. Other Accessories: Non (does not require vertical trim pieces at the seams)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Examine wall protection to ensure that the material, color, and quality are satisfactory and as ordered. Check that the quantity and dimensions match the required specification, prior to cutting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instruction for surface preparation.
- B. Clean substrates of substances that could impair bond of wall protection material, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coating, cracks, and defects. The finished surface should be at least Level 4 as per the Gypsum Association guidelines, although Level 5 is preferred.
 - 1. Moisture Content: Maximum of 4 percent on new plaster, concrete and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with Primer recommended in writing by primer/ sealer manufacturer.
 - 3. Gypsum Board: Prime with primer as recommended in writing by primer/ sealer manufacturer and wall protection manufacturer.
- D. Check painted surfaces for pigment bleeding, moisture resilience, and adhesion. Sand gloss, semi-gloss, or eggshell finish with fine sandpaper.
- E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- F. Acclimate wall protection in the installation area for at least six days prior to and after installing at 70° -90°F, with relative humidity at 50% or less.

3.3 WALL PROTECTION INSTALLATION

- A. Comply with wall protection manufacturer's written instructions applicable to products and applications indicated.
- B. Cut wall protection material into full width strips in roll number sequence. Change the roll numbers at partition breaks and corners.
 - 1. Install strips in same order as cut from roll.
- C. For even-texture or random-match patterns, reverse hang every other strip.
- D. Digital print wallcoverings are intended to be installed with a straight hang/straight match.
- E. For digitally printed murals, line up the design at eye level, allowing any drift in alignment to run off toward the ceiling and floor.
- F. To ensure alignment of the design when positioning the second panel, double cutting yields better results.
- G. Install wall protection without lifted or curled edges and without visible shrinkage.
- H. Match pattern per manufacturers direction above the finish floor.
- I. If railroading is required (horizontal application) install seams vertical and plumb at least 8 inches (203 mm) from outside corners and 8 inches (203 mm) from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not recommended.
- J. Trim edges and seams for color uniformity, pattern match, and tight closure.
- K. Fully bond wall protection to substrate. Remove air bubbles, wrinkles, blisters, and other defects

3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommend in writing by wall protection manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixtures trims, and similar items.

END OF SECTION

SECTION 104413
FIRE EXTINGUISHER CABINETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fire protection cabinets for the following:
 - a. Portable fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.
 1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
- B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
- C. Samples for Initial Selection: For each type of fire protection cabinet indicated.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
- B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

- B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:
 - 1. Sheet: ASTM B 209
 - 2. Extruded Shapes: ASTM B 221
- C. Stainless-Steel Sheet: ASTM A 666, Type 304.
- D. Acrylic Bubble: One piece.

2.2 FIRE PROTECTION CABINET

- A. Cabinet Type: Suitable for fire extinguisher.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire End & Croker Corporation.
 - b. J. L. Industries, Inc., a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division, Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
 - e. Potter Roemer LLC; Series 1772 (*Basis of Design*).
- B. Cabinet Construction: Nonrated.
- C. Cabinet Material: Aluminum sheet.
- D. Semirecessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend). Provide where walls are of insufficient depth for recessed cabinets but are of sufficient depth to accommodate semirecessed cabinet installation.
 - 1. Rolled-Edge Trim: 2-1/2-inch (64-mm) backbend depth.
- E. Cabinet Trim Material: Aluminum sheet.
- F. Door Material: Aluminum sheet.
- G. Door Style: Vertical Duo.
- H. Door Glazing: Clear Acrylic.
- I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
 - 1. Provide recessed door pull and friction latch.
 - 2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.
- J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
 - a. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
 - 1) Location: Applied to cabinet door.
 - 2) Application Process: Silk-screened.
 - 3) Lettering Color: White.
 - 4) Orientation: Vertical.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:
 - a. Interior of cabinet.
2. Aluminum: Clear anodic.

2.3 FABRICATION

- A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
 1. Weld joints and grind smooth.
 2. Provide factory-drilled mounting holes.
 3. Prepare doors and frames to receive locks.
 4. Install door locks at factory.
- B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
 1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
 2. Miter and weld perimeter door frames.
- C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.
- C. Finish fire protection cabinets after assembly.

- D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.6 STEEL FINISHES

- A. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

- 1. Color and Gloss: As selected by Architect from manufacturer's full range.

2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

- A. General: Install fire protection cabinets in locations and at mounting heights indicated.
 - 1. Fire Protection Cabinets: 48 inches (1219 mm) above finished floor to top of cabinet.
- B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
 - 1. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.4 ADJUSTING AND CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.
- C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.
- D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.
- E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 104416
FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher.
- B. Warranty: Sample of special warranty.

1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
 - 1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:

- a. Failure of hydrostatic test according to NFPA 10.
 - b. Faulty operation of valves or release levers.
- 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fire End & Croker Corporation.
 - b. J. L. Industries, Inc.; a division of Activar Construction Products Group.
 - c. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
 - d. Larsen's Manufacturing Company.
 - e. Potter Roemer LLC.
 - 2. Valves: Manufacturer's standard.
 - 3. Handles and Levers: Manufacturer's standard.
 - 4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.
- B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:60-B:C, 10-lb (4.5-kg) nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

2.2 MOUNTING BRACKETS

- A. Provide brackets for extinguishers not located in cabinets. Provide manufacturer's standard brackets designed to prevent accidental dislodgement of extinguisher, of sizes required for type and capacity of extinguisher indicated, in manufacturer's standard plated finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 - 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers in locations indicated and in compliance with requirements of authorities having jurisdiction.

END OF SECTION

SECTION 210000
BASIC FIRE PROTECTION REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Basic Fire Protection Requirements applicable to all Division 21 Sections.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacture for components being replaced.

1.3 MANUFACTURER INSTALLATION INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting and finishing to Architect/Engineer in quantities specified for product data.
- B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.4 MANUFACTURER CERTIFICATES

- A. When specified in individual specification sections, submit certification by manufacturer to Architect/Engineer in quantities specified for product data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect/Engineer.

1.5 REGULATORY REQUIREMENTS

- A. Conform to:
 - 1. The Virginia Uniform Statewide Building Code (VUSBC) including referenced codes and standards.
 - 2. Industry Standards, Codes and Specifications:
 - a. ANSI: American National Standards Institute.
 - b. ASME: American Society of Mechanical Engineers.
 - c. ASTM: American Society for Testing and Materials.
 - d. AWS: American Welding Society.

- e. AWWA: American Water Works Association.
- f. ICC: International Code Council, Inc.
- g. MSS: Manufacturers Standardization Society of the Valve & Fittings Industry, Inc.
- h. NBS: National Bureau of Standards.
- i. NFPA: National Fire Protection Association.
- j. UL: Underwriters Laboratories, Inc.
- k. USASI: United States of America Standards Institute.

B. Obtain permits and request inspections from authority having jurisdiction.

1.6 PROJECT/SITE CONDITIONS

- A. Install work in locations shown on drawings, unless prevented by project conditions. The drawings show the general arrangement of all piping, ductwork, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to the requirements shown on all of the drawings. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange the work accordingly, providing such fittings, valves, offsets, transitions and other accessories as may be required to meet such conditions.
- B. Prepare drawings showing proposed re-arrangement of work to meet project conditions, including changes to work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.
- C. Install all Sprinkler piping within depths of structure and above ceiling.

1.7 PAINTING

- A. Refer to Division 9 - Product and execution requirements for painting specified by this section.
- B. Plumbing equipment, related piping, and materials do not require painting except as indicated below:
 - 1. Painting is not required for equipment having a factory applied finish except touch-up with matching finish where factory finish is damaged.
 - 2. Piping (except insulated and jacketed piping), fabricated supports, and any unfinished or unprotected materials located outdoors shall be painted with a suitable primer and compatible finish paint. Color shall be as directed by Architect/Engineer.
- C. Protection of work: Painting shall be done with care to protect work and work of other trades. All damage caused by the painting operations shall be corrected, repaired and cleaned as required. Hardware, special control items, gages, thermometers, nameplates, instrument glass and other similar items shall be removed or properly protected during the painting operation to ensure that these items are not covered or splattered with paint.

1.8 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a minimum period of one (1) year from date of acceptance and Contractor shall make good, without additional cost to the Owner, any defects which may appear within that period. Manufacturer's warranties extending beyond one year shall be processed and turned over to the Owner.

1.9 CLOSEOUT PROCEDURES: OPERATION AND MAINTENANCE MANUALS

- A. Comply with requirements of Division 1 Sections and the following requirements.
- B. One complete hard copy set and one digital set of Operation and Maintenance Manuals shall be provided to the Owner a minimum of two weeks prior to the pre-final inspection.
- C. Submit data on 8-1/2 x 11-inch text pages, bound in three ring binders with durable plastic or cloth covers. Provide two hard copies and one digital copy in "pdf" format.
- D. Prepare binder cover with printed title "Operation and Maintenance Manuals", title or project, and subject matter of binder when multiple binders are required.
- E. Provide with Index and Page Numbers.
- F. Provide with Certificate of Substantial Completion.
- G. Provide with a summary sheet of warranties with the dates noted and a copy of all warranties.
- H. Provide with a list of all subcontractors and supplies with name, addresses and phone numbers.
- I. Internally subdivide the binder contents with permanent page dividers, logically organized, with minimum content as described below.
- J. Contents:
 - 1. Name of manufacturer.
 - 2. Name, address and telephone number of nearest manufacturer's representative.
 - 3. Copy of latest approved submittal including all review comments.
 - 4. Manufacturer's installation, operation and maintenance instructions including lubrication data.
 - 5. Parts numbers for all replaceable items.
 - 6. Serial numbers of all principal items of equipment.
 - 7. Control diagrams and sequence of operation, including complete start-up operation and shut down procedures.
 - 8. Manufacturer's written warranties that extend beyond the Contractor's one year warranty.

- K. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect/Engineer and Commissioning Authority will comment on whether general scope and content of manual are acceptable. Revise content of all document sets as required prior to final submittal.
- L. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect/Engineer and Commissioning Authority will return copy with comments.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Dimensions: The Contractor shall verify that items to be furnished fit the space available. He shall make field measurements to ascertain space requirements, including those for connections and maintenance, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications. Should he conclude that there is insufficient space for installation of specified materials, he shall immediately notify the Architect/Engineer of the conflict and shall stop affected work until he receives instructions as to how to proceed from the Architect/Engineer.
- B. When substitution of equipment or materials requires changes or revisions to the arrangement, layout or design of any system, drawings showing these changes or revisions shall be submitted for review, along with other required submittal data. The costs of all such changes and revisions shall be borne by the Contractor.
- C. Similar items shall be provided by a single manufacturer.

2.2 EQUIPMENT ACCESSORIES

- A. Equipment or Connections Different from those Shown: Where equipment requiring different arrangements of connections from those shown is proposed by the Contractor, and is acceptable to the Architect/Engineer, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the intent of the drawings and specifications. The Contractor shall make all incidental changes in piping, ductwork, supports, insulation, heaters, controls and other associated facilities. He shall provide all additional equipment required for proper operation of the system, including all required changes in affected trades. The Contractor shall be responsible for the proper location of rough-in and connections. All such changes shall be made at no increase in cost to the Owner.
- B. Supports: The Contractor shall support plumb, rigid and true to line all work and equipment furnished. The Contractor shall study thoroughly all general, structural and plumbing drawings, shop drawings and catalog data to determine how

equipment, fixtures, piping, etc., are to be supported, mounted or suspended and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support whether or not shown on the drawings. When directed, the Contractor shall submit drawings showing supports for review by the Architect/Engineer.

2.3 ACCESS DOORS

- A. General: Access doors shall be provided for all concealed valves, controls, dampers, damper operators and any other equipment or material requiring inspection or maintenance. Access doors shall be furnished for floors, walls, and ceilings, or adequate size so that the concealed items will be readily accessible for servicing or for removal and replacement if necessary.
- B. Access Doors: Provide access doors in accordance with requirements of Division 8 Sections.
- C. Construction: Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware. Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth; 16 gage frames and 14 gage flush panel doors, 175-degree swing with concealed spring hinges; flush screwdriver-operated cam locks; factory applied rust inhibitive prime coat paint finish.

PART 3 EXECUTION

3.1 COORDINATION

- A. Offsets, transitions and changes in direction in pipes shall be made as required to maintain proper head room, clearances and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all fittings, drains, etc., as required to affect these offsets, transitions and changes in direction.
- B. Drawings by the Contractor: When directed by the Architect/Engineer, the Contractor shall submit for review drawings clearly showing certain portions of the fire protection and its relation to the work of other trades before commencing shop fabrication or erection at the project site.

3.2 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project site identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling. Protect stored equipment and materials from damage. Comply with manufacturer's rigging and moving instructions for unloading equipment and moving into final location.

3.3 DEMOLITION

- A. Fire Protection work necessary for demolition and renovation in the existing building shall be provided under this section.

END OF SECTION

SECTION 210517
SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.2 SPECIAL REQUIREMENTS FOR THIS PROJECT

- A. The use of PVC or other types of plastic sleeves are not allowed.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, anticorrosion coated, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

- A. Description: Manufactured, Dura-coated or Duco-coated cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Description:

1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
2. Designed to form a hydrostatic seal of 20 psig minimum.
3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size.
4. Pressure Plates: Carbon steel.
5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- B. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
 3. Using grout or silicone sealant, seal space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.
 2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Use silicone sealant to seal around the outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space

between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use grout silicone sealant to 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. Piping Smaller Than NPS 6: Cast-iron pipe sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger:
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - 5. Interior Partitions:
 - a. Piping Smaller Than NPS 6: Steel pipe sleeves.
 - b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION

SECTION 210518
ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel cast brass or split-plate steel with polished, chrome-plated finish.

END OF SECTION

SECTION 210523
GENERAL-DUTY VALVES FOR FIRE PROTECTION PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Trim and drain valves.

1.2 DEFINITIONS

- A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- B. NRS: Nonrising stem.
- C. OS&Y: Outside screw and yoke.
- D. SBR: Styrene-butadiene rubber.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

- D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.
- B. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B1.20.1 for threads for threaded-end valves.
 - 3. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.
- D. NFPA Compliance: Comply with NFPA 24 for valves.
- E. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Actuator Types:
 - 1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
 - 2. Handwheel: For other than quarter-turn trim and drain valves.
 - 3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

- A. Description:
 - 1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
 - 2. Minimum Pressure Rating: 175 psig.
 - 3. Body Design: Two piece.
 - 4. Body Material: Forged brass or bronze.
 - 5. Port Size: Full or standard.
 - 6. Seats: PTFE.
 - 7. Stem: Bronze or stainless steel.
 - 8. Ball: Chrome-plated brass.
 - 9. Actuator: Worm gear or traveling nut.
 - 10. Supervisory Switch: Internal or external.
 - 11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
 - 12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Stainless steel.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Lug or wafer Grooved-end connections.

2.5 CHECK VALVES

A. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 TRIM AND DRAIN VALVES

A. Description:

1. Pressure Rating: 175 psig.
2. Body Design: Two piece.
3. Body Material: Forged brass or bronze.
4. Port size: Full.
5. Seats: PTFE.
6. Stem: Bronze or stainless steel.
7. Ball: Chrome-plated brass.
8. Actuator: Handlever.
9. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
10. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:

1. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Brass or bronze.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:

1. Description:
 - a. Pressure Rating: 175 psig.
 - b. Body Material: Bronze with integral seat and screw-in bonnet.
 - c. Ends: Threaded.
 - d. Stem: Bronze.
 - e. Disc Holder and Nut: Bronze.
 - f. Disc Seat: Nitrile.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

- A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
 - 1. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.
- B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection.
- D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the pipe center.
- F. Install valves in position to allow full stem movement.
- G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.
- H. Install check valve in each water-supply connection.

END OF SECTION

SECTION 210529
HANGERS AND SUPPORTS FOR FIRE SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Fastener systems.
5. Equipment supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Comply with NFPA 13.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: Factory-fabricated components, NFPA approved, UL listed, or FM approved for fire-suppression piping support.
2. Galvanized Metallic Coatings: Pregalvanized or hot-dip galvanized.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with NFPA-approved, UL-listed, or FM-approved carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
3. Channels: Continuous slotted carbon-steel channel with intumed lips.
4. Channel Width: Selected for applicable load criteria.
5. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
7. Metallic Coating: No coating.
8. Paint Coating: Green epoxy, acrylic, or urethane.

2.5 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: NFPA-approved, UL-listed, or FM-approved, insert-wedge-type anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Indoor Applications: Zinc-coated or Stainless steel.

2.6 EQUIPMENT SUPPORTS

- A. Description: NFPA-approved, UL-listed, or FM-approved, welded, shop- or field-fabricated equipment support, made from structural-carbon-steel shapes.

2.7 MATERIALS

- A. Aluminum: ASTM B 221.
- B. Carbon Steel: ASTM A 1011/A 1011M.
- C. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A 240/A 240M.
- E. Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout, suitable for interior and exterior applications.
 1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with installation requirements of approvals and listings. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal strut systems.
- D. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual. Install in accordance with approvals and listings.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. Install in accordance with approvals and listings.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with NFPA requirements for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Horizontal-Piping Hangers and Supports: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 4. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 5. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 6. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 7. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.

8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Comply with NFPA requirements.
- I. Building Attachments: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. C-Clamps (MSS Type 23): For structural shapes.
 3. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- J. Saddles and Shields: Comply with NFPA requirements. Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- K. Comply with NFPA requirements for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- L. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION

SECTION 210553
IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.2 SPECIAL INSPECTIONS FOR THIS PROJECT

- A. Do not label piping that is exposed to view in open ceilings. Coordinate with architects for final paint color where piping is exposed to view in public areas.
- B. All valve, Equipment and pipe shall be identified.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.
- C. Valve Schedules: Valve numbering scheme.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger

lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- B. Letter Color: 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. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction according to ASME A13.1.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: Size letters according to ASME A13.1 for piping.

D. Pipe-Label Colors:

1. Background Color: Safety Red.
2. Letter Color: White.

2.4 STENCILS

A. Stencils for Piping:

1. Lettering Size: Size letters according to ASME A13.1 for piping.
2. Stencil Material: Fiberboard or metal.
3. Stencil Paint: Safety Red, exterior, gloss, alkyd enamel. Paint may be in pressurized spray-can form.
4. Identification Paint: White, exterior, alkyd enamel. Paint may be in pressurized spray-can form.

2.5 VALVE TAGS

A. Description: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain beaded chain or S-hook.
3. Valve-Tag Color: Safety Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Description: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 GENERAL INSTALLATION REQUIREMENTS

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

3.3 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

- A. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations and on both sides of through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit a view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes including pipes where flow is allowed in both directions.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in fire-suppression piping systems. List tagged valves in a valve-tag schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
 1. Valve-Tag Size and Shape:
 - a. Wet-Pipe Sprinkler System: 1-1/2 inches, round.

3.6 WARNING-TAG INSTALLATION

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

END OF SECTION

SECTION 211313
WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinklers.
4. Control panels.
5. Pressure gages.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For wet-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

- C. Delegated-Design Submittal: For wet-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and professional engineer.

- B. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, including hydraulic calculations if applicable. Submittal to the authority having jurisdiction: The A/E shall review and attach his approval to the fire sprinkler submittal, then send one complete copy of the "approved" submittal to the authority having jurisdiction for review. The contractor shall revise and resubmit, through the A/E for approval, to the authority having jurisdiction as required for acceptance. Calculations are required.

- C. Fire-hydrant flow test report.
- D. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wet-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
 - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
 - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding Qualifications: Qualify procedures and operators according to 2010 ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
 - 1. NFPA 13.
- B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- C. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design wet-pipe sprinkler systems.

1. Sprinkler system design shall be approved by authorities having jurisdiction.
 - a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
 - b. Sprinkler Occupancy Hazard Classifications:
 - 1) Building Service Areas: Ordinary Hazard, Group 1.
 - 2) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
 - 3) General Storage Areas: Ordinary Hazard, Group 1.
 - 4) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
 - 5) Office and Public Areas: Light Hazard.
2. Minimum Density for Automatic-Sprinkler Piping Design:
 - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
 - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
3. Maximum Protection Area per Sprinkler: According to UL listing.
4. Maximum Protection Area per Sprinkler:
 - a. Office Spaces: 225 sq. ft..
 - b. Storage Areas: 130 sq. ft..
 - c. Mechanical Equipment Rooms: 130 sq. ft..
 - d. Electrical Equipment Rooms: 130 sq. ft..
 - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

- A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.
- C. Uncoated-Steel Couplings: ASTM A 865/A 865M, threaded.
- D. Malleable- or Ductile-Iron Unions: UL 860.
- E. Cast-Iron Flanges: ASME 16.1, Class 125.
- F. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
 1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
 - a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
 - b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.
 2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.
- G. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Grooved-Joint, Steel-Pipe Appurtenances:

1. Pressure Rating: 175-psig minimum.
2. Painted Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
3. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Standard: UL 193.
2. Design: For horizontal or vertical installation.
3. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
4. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
6. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175-psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-tee and -cross fittings.
5. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.

6. Size: Dimensions to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded or grooved.

C. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
2. Pressure Rating: 175-psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.
2. Pressure Rating: 250-psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

F. Flexible Sprinkler Hose Fittings:

1. Standard: UL 1474.
2. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
3. Pressure Rating: 175-psig minimum.
4. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

- A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
- B. Pressure Rating for Automatic Sprinklers: 175-psig minimum.
- C. Automatic Sprinklers with Heat-Responsive Element:
 - 1. Early-Suppression, Fast-Response Applications: UL 1767.
 - 2. Nonresidential Applications: UL 199.
 - 3. 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 Finishes: bronze.
- E. 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.
 - 2. Sidewall Mounting: Chrome-plated steel, one piece, flat.
- F. Sprinkler Guards:
 - 1. Standard: UL 199.
 - 2. Type: Wire cage with fastening device for attaching to sprinkler.

2.6 CONTROL PANELS

- A. Description: Single-area, two-area, or single-area cross-zoned control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.
 - 1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
 - 2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
 - 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Manual Control Stations: Electric operation, metal enclosure, labeled "MANUAL CONTROL STATION," with operating instructions and cover held closed by breakable strut to prevent accidental opening.
- C. Panels Components:
 - 1. Power supply.
 - 2. Battery charger.
 - 3. Standby batteries.

4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

2.7 PRESSURE GAGES

- A. Standard: UL 393.
- B. Dial Size: 3-1/2- to 4-1/2-inch diameter.
- C. Pressure Gage Range: 0- to 250-psig minimum.
- D. Label: Include "WATER" label on dial face.
- E. Sprinklers.

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 PIPING INSTALLATION

- A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.
 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
 2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.
- B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.
- C. Install seismic restraints on piping. Comply with NFPA 13 requirements for seismic-restraint device materials and installation.
- D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

- E. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.
- I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- K. Install alarm devices in piping systems.
- L. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13. In seismic-rated areas, refer to
- M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they are not subject to freezing.
- N. Fill sprinkler system piping with water.
- O. Install electric heating cables and pipe insulation on sprinkler piping in areas subject to freezing. Comply with requirements for heating cables in Section 210533 "Heat Tracing for Fire-Suppression Piping" and for piping insulation in Section 210700 "Fire-Suppression Systems Insulation."
- P. 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."
- Q. 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."
- R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.
- I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
 - 1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.
- K. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.
- L. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- M. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
- N. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- O. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

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

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.
- B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.
- C. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 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."

3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

3.8 PIPING SCHEDULE

- A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

- B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.
- C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight, black-steel pipe with plain ends; uncoated, plain-end-pipe fittings; and twist-locked joints.
 - 3. Standard-weight, black-steel pipe with cut- or rolled grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 4. Standard-weight, black-steel pipe with plain ends; steel welding fittings; and welded joints.
- D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4 , shall be one of the following:
 - 1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
 - 2. Standard-weight or, black-steel pipe with cut- or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
 - 3. Standard-weight or black-steel pipe with plain ends; steel welding fittings; and welded joints.

3.9 SPRINKLER SCHEDULE

- A. Use sprinkler types in subparagraphs below for the following applications:
 - 1. Rooms without Ceilings: Upright sprinklers.
 - 2. Rooms with Suspended Ceilings and Cloud Ceilings: Recessed pendant sprinklers.
 - 3. Wall Mounting: Sidewall sprinklers (Provide heat deflectors where/when necessary).
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
 - 1. Flush Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 2. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
 - 3. Upright Pendent and Sidewall Sprinklers: Rough bronze in unfinished spaces not exposed to view and rough bronze in areas without ceilings.

END OF SECTION

SECTION 220000
BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes Basic Plumbing Requirements applicable to all Division 22 Sections.

1.2 PRODUCTS

- A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacture for components being replaced.

1.3 REGULATORY REQUIREMENTS

- A. Conform to:
 - 1. The Virginia Uniform Statewide Building Code including referenced codes and standards.
 - 2. Industry Standards, Codes and Specifications:
 - a. ANSI: American National Standards Institute.
 - b. ASME: American Society of Mechanical Engineers.
 - c. ASTM: American Society for Testing and Materials.
 - d. AWS: American Welding Society.
 - e. AWWA: American Water Works Association.
 - f. CISPI: Cast Iron Soil Pipe Institute.
 - g. ICC: International Code Council, Inc.
 - h. MSS: Manufacturers Standardization Society of the Valve & Fittings Industry, Inc.
 - i. NAIMA: North American Insulation Manufacturers Association.
 - j. NBS: National Bureau of Standards.
 - k. NFPA: National Fire Protection Association.
 - l. UL: Underwriters Laboratories, Inc.
 - m. USASI: United States of America Standards Institute.
- B. Obtain permits and request inspections from authority having jurisdiction.

1.4 PROJECT/SITE CONDITIONS

- A. Install work in locations shown on drawings, unless prevented by project conditions. The drawings show the general arrangement of all piping, equipment and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The work shall conform to

the requirements shown on all of the drawings. Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, offsets, transitions and other accessories as may be required to meet such conditions.

- B. Prepare drawings showing proposed re-arrangement of work to meet project conditions, including changes to work specified in other Sections. Obtain permission of Architect/Engineer before proceeding.

1.5 PAINTING

- A. Refer to Division 9 - Paints and Coatings: Product and execution requirements for painting specified by this section.
- B. Plumbing equipment, related piping, and materials do not require painting except as indicated below:
 - 1. Painting is not required for equipment having a factory applied finish except touch-up with matching finish where factory finish is damaged.
 - 2. Piping (except insulated and jacketed piping), fabricated supports, and any unfinished or unprotected materials located outdoors shall be painted with a suitable primer and compatible finish paint. Color shall be as directed by Architect/Engineer.
- C. Protection of work: Painting shall be done with care to protect work and work of other trades. All damage caused by the painting operations shall be corrected, repaired and cleaned as required. Hardware, special control items, gages, thermometers, nameplates, instrument glass and other similar items shall be removed or properly protected during the painting operation to ensure that these items are not covered or splattered with paint.

1.6 WARRANTY

- A. All materials and workmanship shall be warranted to be free from defects for a period of one (1) year from date of acceptance and Contractor shall make good, without additional cost to the Owner, any defects which may appear within that period. Manufacturer's warranties extending beyond one year shall be processed and turned over to the Owner.

1.7 CLOSEOUT PROCEDURES: OPERATION AND MAINTENANCE MANUALS

- A. Submit data on 8-1/2 x 11 inch text pages, bound in three ring binders with durable plastic or cloth covers.
- B. Prepare binder cover with printed title "Operation and Maintenance Instructions", title or project, and subject matter of binder when multiple binders are required.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized, with minimum content as described below.

- D. Contents:
 - 1. Name of manufacturer.
 - 2. Name, address and telephone number of nearest manufacturer's representative.
 - 3. Copy of latest approved submittal including all review comments.
 - 4. Manufacturer's installation, operation and maintenance instructions including lubrication data.
 - 5. Parts numbers for all replaceable items.
 - 6. Manufacturer's written warranties that extend beyond the Contractor's one year warranty.
- E. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect/Engineer will comment on whether general scope and content of manual are acceptable. Revise content of all document sets as required prior to final submittal.
- F. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect/Engineer will return copy with comments.

PART 2 PRODUCTS

2.1 EQUIPMENT AND MATERIALS

- A. Dimensions: The Contractor shall verify that items to be furnished fit the space available. He shall make field measurements to ascertain space requirements, including those for connections and maintenance, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications. Should he conclude that there is insufficient space for installation of specified materials, he shall immediately notify the Architect/Engineer of the conflict and shall stop affected work until he receives instructions as to how to proceed from the Architect/Engineer.
- B. When substitution of equipment or materials requires changes or revisions to the arrangement, layout or design of any system, drawings showing these changes or revisions shall be submitted for review, along with other required submittal data. The costs of all such changes and revisions shall be borne by the Contractor.
- C. Similar items shall be provided by a single manufacturer.

2.2 EQUIPMENT ACCESSORIES

- A. The Contractor shall furnish and install all equipment, accessories, connections and incidental items necessary to fully complete the work ready for use, occupancy and operation by the Owner.
- B. Equipment or Connections Different from those Shown: Where equipment requiring different arrangement of connections from those shown is proposed by

the Contractor, and is acceptable to the Architect/Engineer, it shall be the responsibility of the Contractor to install the equipment to operate properly and in harmony with the intent of the drawings and specifications. The Contractor shall make all incidental changes in piping, supports, insulation, heaters, controls and other associated facilities. The contractor shall provide all additional equipment required for proper operation of the system, including all required changes in affected trades. The Contractor shall be responsible for the proper location of rough-in and connections. All such changes shall be made at no increase in cost to the Owner.

- C. Supports: The Contractor shall support plumb, rigid and true to line all work and equipment furnished. The Contractor shall study thoroughly all general, structural and plumbing drawings, shop drawings and catalog data to determine how equipment, fixtures, piping, etc., are to be supported, mounted or suspended and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support whether or not shown on the drawings. When directed, the Contractor shall submit drawings showing supports for review by the Architect/Engineer.
- D. Concrete Equipment Bases (Housekeeping Pads): Refer to Section 220529 Hangers and Supports for Plumbing Piping and Equipment.

2.3 ACCESS DOORS

- A. General: Access doors shall be provided for all concealed valves, controls, water hammer arrestors and any other equipment or material requiring inspection or maintenance. Access doors shall be furnished for floors, walls, and ceilings, or adequate size so that the concealed items will be readily accessible for servicing or for removal and replacement if necessary.
- B. Construction: Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware. Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth; 16 gage frames and 14 gage flush panel doors, 175 degree swing with concealed spring hinges; flush screwdriver-operated cam locks; factory applied rust inhibitive prime coat paint finish.

PART 3 EXECUTION

3.1 INSTALLATION OF EQUIPMENT

- A. All equipment and materials specified in this Division shall be installed in accordance with the manufacturer's instructions including, but not limited to, the following:
 - 1. Storage, handling, rigging, and installation shall be accomplished using means and methods recommended by the manufacturer.
 - 2. Location and orientation of equipment shall provide the indicated operation and performance and shall also provide the recommended unobstructed clearances around equipment for maintenance and repair.

3. Provide accessories and incidental materials recommended by the manufacturer.

3.2 COORDINATION

- A. Offsets, transitions and changes in direction in pipes and ducts shall be made as required to maintain proper head room, clearances and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all fittings, traps, drains, air vents, sanitary vents, etc., as required to affect these offsets, transitions and changes in direction.
- B. Drawings by the Contractor: When directed by the Architect/Engineer, the Contractor shall submit for review drawings clearly showing certain portions of the plumbing work and its relation to the work of other trades before commencing shop fabrication or erection at the project site.

3.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to project site identified with names, model numbers, types, grades, compliance labels, and other information needed for distinct identification; adequately packaged and protected to prevent damage during shipment, storage and handling. Protect stored equipment and materials from damage. Comply with manufacturer's rigging and moving instructions for unloading equipment and moving into final location.

3.4 INSTALLATION OF ACCESS DOORS

- A. Install access doors at all concealed valves, controls, dampers, damper operators, other equipment or materials requiring inspection or maintenance, where indicated and where required by Code, in accordance with manufacturer's written instructions and in compliance with industry practices.
- B. Coordinate with other work, including substrate construction work, as necessary to interface installation of access doors with other work.
- C. Locate each access door accurately in relation to the item requiring access.
- D. Provide adequate temporary support or attachment to framing or formwork such that units will not be dislocated during construction of substrates.
- E. Set frames accurately in position and securely attach to supports with face panels plumb and level in relation to adjacent finish surfaces.
- F. Adjust hardware and panels after installation for proper operation.
- G. Replace panels and frames which are warped or damaged.

3.5 DEMOLITION

- A. Plumbing work necessary for demolition and renovation in the existing building shall be provided under this section.

- B. Existing underground utilities serving the remaining existing building shall remain in service, with relocations and reconnections as necessary for coordination with the new work.
- C. Work necessary to be performed in, or otherwise affecting the use or comfort of the remaining existing building, shall be coordinated with the occupants' schedule.

END OF SECTION

SECTION 220517
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves without waterstop.
 - 2. Grout.
 - 3. Silicone sealants.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

2.2 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Packaging: Premixed and factory packaged.

2.3 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant.
 - 1. Standard: ASTM C920, Type S, Grade NS, Class 25, Use NT.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

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

END OF SECTION

SECTION 220518
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip 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 insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping and Relocated Existing Piping:
 - a. Chrome-Plated Piping: One-piece cast brass or split-casting brass with polished, chrome-plated finish.
 - b. Insulated Piping: One-piece steel with finish.
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with finish.
 - 2. Escutcheons for Existing Piping to Remain:
 - a. Chrome-Plated Piping: Split-casting, stamped steel with or hinge with polished, chrome-plated finish. Install where required.

END OF SECTION

SECTION 220523.12
BALL VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze ball valves.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges on steel valves.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for cast copper solder-joint connections.
 - 6. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
 - 7. ASME B16.34 for flanged and threaded end connections
 - 8. ASME B31.9 for building services piping valves.
- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

F. Valve Actuator Type:

1. Hand Lever: For quarter-turn valves smaller than NPS 4.

G. Valves in Insulated Piping:

1. Provide 2-inch extended neck stems.
2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
3. Memory stops that are fully adjustable after insulation is applied.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, Two Piece with Full Port, and Bronze or Brass Trim, Threaded Ends:

1. Standard: MSS SP-110; MSS SP-145.
2. CWP Rating: 600 psig.
3. Body Design: Two piece.
4. Body Material: Bronze.
5. Ends: Threaded.
6. Seats: PTFE.
7. Stem: Bronze or brass.
8. Ball: Chrome-plated brass.
9. Port: Full.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.
- H. Adjust or replace valve packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves exhibiting leakage.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3.4 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze ball valves, two piece with Full port, and bronze or brass trim. Provide with threaded solder or -joint ends.
 - 2. Bronze ball valves, two piece with Full port, and bronze trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.

END OF SECTION

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to "2015 ASME Boiler and Pressure Vessel Code, Section IX."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 3. Design seismic-restraint hangers and supports for piping and equipment.

2.2 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel .

2.3 TRAPEZE PIPE HANGERS

- ### A.
- Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FASTENER SYSTEMS

- ### A.
- Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Indoor Applications: Zinc-coated steel.
 2. Outdoor Applications: Stainless steel.

2.5 MATERIALS

- ### A.
- Aluminum: ASTM B 221.
- ### B.
- Carbon Steel: ASTM A 1011/A 1011M.
- ### C.
- Structural Steel: ASTM A 36/A 36M carbon-steel plates, shapes, and bars; black and galvanized.
- ### D.
- Stainless Steel: ASTM A 240/A 240M.
- ### E.
- Grout: ASTM C 1107/C 1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb .

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- E. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- F. Install lateral bracing with pipe hangers and supports to prevent swaying.
- G. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.

- H. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- J. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - 5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work.

3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A 780/A 780M.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.
- F. Use and corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 2. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
 - 3. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

4. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 8. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 9. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 10. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 11. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 12. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 13. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 14. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
- J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- K. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 2. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- M. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

- N. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Equipment labels.
 2. Warning signs and labels.
 3. Pipe labels.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
1. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 2. Letter and Background Color: As indicated for specific application under Part 3.
 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of 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.
 5. Fasteners: Stainless steel rivets or self-tapping screws.
 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.

- C. Maximum Temperature: Able to withstand temperatures of 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 of 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. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on main distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping .

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E.

3.4 INSTALLATION OF PIPE LABELS

- A. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- B. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Within 3 ft. of each valve and control device.
 - 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 3. Within 3 ft. of equipment items and other points of origination and termination.
 - 4. Spaced at maximum intervals of 25 ft. along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- C. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- D. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- E. Pipe-Label Color Schedule:

1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
3. Sanitary Waste and Storm Drain / Rain Leader Piping: White letters on a black background.

END OF SECTION

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic cold-water piping.
 - 2. Domestic hot-water piping.
 - 3. Supplies and drains for handicap-accessible lavatories and sinks.

1.2 ACTION SUBMITTALS

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

1.3 INFORMATIONAL SUBMITTALS

1.4 QUALITY ASSURANCE

- A. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.5 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," & "Indoor Piping Insulation Schedule," for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.

2.3 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
 - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 - 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136, Types I, II, III, IV, and VII.
 - 5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Piping Enclosures, :

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with the contract documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.3 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 - 4. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 - 5. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 - 6. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 - 7. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.4 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.5 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099000 "Painting."
- B. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- C. Do not field paint aluminum or stainless steel jackets.

3.6 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Cold Water:
 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
 - a. Glass Fiber: 1 inch thick.
 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
 - a. Glass Fiber: 1 inch thick.
- B. Floor Drains, Traps, and Horizontal & Vertical Exposed Storm / Rain Leader Piping:
 1. All Pipe Sizes: Insulation shall be one of the following:
 - a. Glass Fiber.

3.7 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Exposed:
 1. PVC, white: 20 mils thick.

END OF SECTION

SECTION 221119
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Strainers for domestic water piping.
3. Drain valves.
4. Water-hammer arresters.
5. Trap-seal primer device.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Chrome plated.

2.4 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Drain: Factory-installed, hose-end drain valve.

2.5 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.6 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Metal Bellow, Piston.
3. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.7 TRAP-SEAL DEVICE

A. Drainage-Type, Trap-Seal Device:

1. Standard: ASSE 1070, ANSI/ASME A112.6.3, Trap sealer.
2. Size: NPS 1-1/4 minimum.
3. Material: Elastomeric.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ADJUSTING

- A. Adjust each pressure vacuum breaker in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

END OF SECTION

SECTION 221316
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hubless, cast-iron soil pipe and fittings.

1.2 ACTION SUBMITTALS

- A. Product data.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - 2. ASTM A888 or CISPI 301.
- B. Hubless-Piping Couplings:
 - 1. Standards: ASTM C1277 and ASTM C1540.

2.3 PVC PIPE AND FITTINGS

- A. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- B. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- C. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

- D. Adhesive Primer: ASTM F656.
- E. Solvent Cement: ASTM D2564.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- B. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- D. Install piping at indicated slopes.
- E. Install piping free of sags and bends.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- I. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- J. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:

1. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 2. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- K. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- L. Install underground piping in accordance with ASTM D2321.
- M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- N. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- P. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Joint Restraints and Sway Bracing:
1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.

3.3 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
1. Install transition couplings at joints of piping with small differences in ODs.
 2. In Waste Drainage Piping: Unshielded Shielded, nonpressure transition couplings.

3.4 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers for cast-iron soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- B. Install hangers for piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling.
- D. Support vertical runs of cast-iron soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support vertical runs of and piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.7 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed and Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.8 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller are to be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.
- C. Aboveground, vent piping NPS 4 and smaller is to be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Unshielded Shielded, nonpressure transition couplings.
- D. Underground, soil, waste, and vent piping NPS 4 and smaller are to be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; cast-iron hubless-piping couplings; and coupled joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 3. Dissimilar Pipe-Material Couplings: Unshielded Shielded, non-pressure transition couplings.
 - 4. Match with existing below slab piping materials below slab/grade.

END OF SECTION

SECTION 221319
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cleanouts.
2. Miscellaneous sanitary drainage piping specialties.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 CLEANOUTS

A. Cast-Iron Exposed Cleanouts :

1. Standard: ASME A112.36.2M.
2. Size: Same as connected drainage piping.
3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Adjustable housing Threaded, adjustable housing.
4. Body or Ferrule: Cast iron.
5. Closure: Cast-iron plug.
6. Adjustable Housing Material: Cast iron with threads.
7. Frame and Cover Material and Finish: Rough bronze.

8. Frame and Cover Shape: Square.
9. Top-Loading Classification: Heavy Duty.
10. Riser: ASTM A74, Extra-Heavy Class, cast-iron drainage pipe fitting and riser to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure Plug:
 - a. Cast iron.
 - b. Countersunk or raised head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
5. Wall Access, Cover Plate: Round, deep, chrome-plated bronze cover plate with screw.
6. Wall Access, Frame and Cover: Square, nickel-bronze, copper-alloy, or stainless steel wall-installation frame and cover.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.
 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub 2 inches above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- G. Install wood-blocking reinforcement for wall-mounting-type specialties.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221319.13
SANITARY DRAINS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor drains.

1.2 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 DRAIN ASSEMBLIES

- A. Sanitary drains shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary piping specialty components.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains: FD-1
 - 1. Pattern: Floor drain.
 - 2. Body Material: Gray iron.
 - 3. Seepage Flange: Not required.
 - 4. Anchor Flange: Not required.
 - 5. Clamping Device: Not required.
 - 6. Outlet: Bottom.
 - 7. Coating on Interior and Exposed Exterior Surfaces:
 - 8. Top or Strainer Material: Gray iron.
 - 9. Top of Body and Strainer Finish: Nickel bronze.
 - 10. Top Shape: Round.
 - 11. Trap Material: Cast iron .
 - 12. Trap Pattern: W / Deep seal Trap Guard Insert. Standard P-trap.
 - 13. Trap Features: Cleanout.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.
 - 3. Install floor-drain flashing collar or flange, so no leakage occurs between drain and adjoining flooring.
 - a. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221414
STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hubless, cast-iron soil pipe and fittings.
 - 2. PVC pipe and fittings.

1.2 ACTION SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Provide materials bearing label, stamp, or other markings of specified testing agency.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage 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 Construction Manager and Owner no fewer than seven days in advance of proposed interruption of storm drainage service.
 - 2. Do not proceed with interruption of storm drainage service without Owner's written permission.

1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark and NSF certification mark.
 - 2. Standards: ASTM A888 and CISPI 301.
- B. Heavy-Duty, Hubless-Piping Couplings:
 - 1. Standard: ASTM C1277 or ASTM C1540.
 - 2. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.
 - 3. Description: Two-piece ASTM A48/A48M, cast-iron housing; stainless steel bolts and nuts; and ASTM C564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS

- A. PVC Pipe:
 - 1. NSF Marking: Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
 - 2. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- B. PVC Socket Fittings:
 - 1. Standard: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
 - 2. NSF Marking: Comply with NSF 14 for plastic piping components. Include marking with "NSF-dwv" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.
- C. Adhesive Primer: ASTM F656.
- D. Solvent Cement: ASTM D2564.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1173.
 - b. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564 rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
- B. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- C. Install piping in concealed locations.
 1. Piping installed in equipment rooms, service areas, and where indicated may be exposed.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.

- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
 - 1. Do not change direction of flow more than 90 degrees.
 - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of drainage piping in direction of flow is prohibited.
- K. Install piping at the following minimum slopes unless otherwise indicated.
 - 1. Horizontal Storm Drainage Piping: 1/4 inch per foot downward in direction of flow to match existing.
- L. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Ch IV, "Installation of Cast Iron Soil Pipe and Fittings."
- M. Install underground PVC piping in accordance with ASTM D2321.
- N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- O. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeve and Sleeve Seals for Plumbing Piping."
- P. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeve and Sleeve Seals for Plumbing Piping."
- Q. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

2. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendices.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.

3.5 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

B. Install hangers for cast-iron storm, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

C. Support horizontal piping and tubing within 12 inches of each fitting[, valve,] and coupling.

D. Support vertical cast-iron to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping and fittings.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

A. Identify exposed storm drainage piping.

- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Test storm drainage piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 3. Test Procedure:
 - a. Test storm drainage piping on completion of roughing-in.
 - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water.
 - c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
 - d. Inspect joints for leaks.
 - 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.

3.10 PROTECTION

- A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day and when work stops.
- C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.11 PIPING SCHEDULE

- A. Aboveground storm drainage piping NPS 6 and smaller is to be of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty, hubless-piping couplings; and coupled joints.
- B. Underground storm drainage piping NPS 6 or smaller shall be of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
 - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

END OF SECTION

SECTION 224213.13
COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall-mounted water closets.
2. Flushometer valves.
3. Toilet seats.
4. Supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
5. Comply with ASME A112.6.1M for water-closet supports.
6. Comply with ICC A117.1 for ADA-compliant water closets.
7. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 WALL-MOUNTED WATER CLOSETS

A. Water Closets - Wall Mounted, Top Spud:

1. Bowl:
 - a. Material: Vitreous china.
 - b. Type: Siphon jet.
 - c. Style: Flushometer valve.
 - d. Mounting Height: Standard and ADA compliant.
 - e. Rim Contour: Elongated.
 - f. Water Consumption: 1.6 gal. per flush.
 - g. Spud Size and Location: NPS 1-1/2; top.
 - h. Color: White.

2.3 FLUSH VALVES

A. Automatic Valves: Hard-wired - Diaphragm type:

1. Minimum Pressure Rating: 125 psig.
2. Features: Include integral check stop and backflow-prevention device.
3. Material: Brass body with corrosion-resistant components.
4. Style: Exposed.
5. Flushometer-Valve Finish: Chrome-plated.
6. Finish: Chrome-plated.
7. Consumption: 1.6 gal. per flush.
8. Minimum Inlet: NPS 1.
9. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats:

1. Material: Plastic.
2. Type: Commercial (Heavy duty).
3. Shape: Elongated rim, open front.
4. Hinge: Self-sustaining, check.
5. Hinge Material: Noncorroding metal.
6. Seat Cover: Not required.
7. Color: White.

2.5 SUPPORTS

A. Water-Closet Carrier:

1. Description: Waste-fitting assembly, as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Use carrier supports with waste-fitting assembly and seal.
2. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
3. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet. (Install in this manner for future flush valve replacement combinations/possibilities.)
4. Install actuators in locations easily reachable for people with disabilities.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221119 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

END OF SECTION

SECTION 224213.16
COMMERCIAL URINALS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall-hung urinals.
2. Urinal flushometer valves.
3. Supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 WALL-HUNG URINALS

A. Urinals - Wall Hung, Bottom Outlet, Washout:

1. Fixture:
 - a. Standards: ASME A112.19.2/CSA B45.1 and SME A112.19.5/CSA B45.15.
 - b. Material: Vitreous china.
 - c. Drain: Integral trap.
 - d. Strainer: Manufacturer's standard strainer.
 - e. Inlet Spud Size and Location: NPS 3/4; top.
 - f. Outlet Size and Location: NPS 1-1/2; back.
 - g. Color: White.
 - h. Water Consumption: 0.5 gpf.
2. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap:
 - 1) Size: NPS 1-1/2.
3. Support: urinal carrier with hanger and bearing plates.
4. Urinal Mounting Height: Standard Handicapped/elderly according to ICC A117.1.

2.2 URINAL FLUSHOMETER VALVES

A. Hard-Wired, Solenoid-Actuator, Diaphragm Flushometer Valves:

1. Standard: ASSE 1037/ASME 112.1037/CSA B125.37.
2. Minimum Pressure Rating: 125 psig.
3. Features: Include integral check stop and backflow-prevention device.

4. Material: Brass body with corrosion-resistant components.
5. Exposed Flushometer-Valve Finish: Chrome plated.
6. Panel Finish: Chrome plated or stainless steel.
7. Style: Exposed .
8. Actuator: Solenoid complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
9. Trip Mechanism: Hard-wired electronic sensor complying with UL 1951; listed and labeled as defined in NFPA 70, by a qualified testing agency; and marked for intended location and application.
10. Consumption: 0.5 gal. per flush.
11. Minimum Inlet: NPS 3/4.
12. Minimum Outlet: NPS 3/4.

2.3 SUPPORTS

A. Urinal Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Urinal Installation:

1. Install urinals level and plumb according to rough-in drawings.
2. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
3. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use carriers without waste fitting for urinals with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.

C. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.

D. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

E. Joint Sealing:

1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to urinal color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.2 PIPING CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221119 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.3 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.

END OF SECTION

SECTION 224216.13
COMMERCIAL LAVATORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vitreous-china, Counter-mounted lavatories.
2. Automatically operated lavatory faucets.
3. Supply fittings.
4. Waste fittings.
5. Lavatory supports.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

A. Lavatory - Round, Vitreous China, Counter Mounted:

1. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: Counter drop-in.
 - c. Nominal Size: Oval, 19 by 19 inches Approx.
 - d. Faucet-Hole Punching: One hole.
 - e. Faucet-Hole Location: Top.
 - f. Color: White.
 - g. Mounting Material: Countertop.
2. Support: Countertop.
3. Lavatory Mounting Height: Handicap in accordance with ICC A117.1.

2.2 AUTOMATICALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. Lavatory Faucets - Automatic Type: Hard-wired Electronic Sensor Operated, Mixing, :

1. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. General: Coordinate faucet inlets with supplies and fixture hole punching; coordinate outlet with spout and fixture receptor.
4. Body Type: Single hole.
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: Chrome.
7. Maximum Flow Rate: 0.5 gpm.
8. Mounting Type: Deck, concealed.
9. Spout: Rigid type.
10. Spout Outlet: Aerator.
11. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping. Provide loose keys.
- E. Operation: Sensor.
- F. Risers:
 1. NPS 3/8.
 2. ASME A112.18.6/CSA B125.6, braided- or corrugated-stainless steel, flexible hose riser.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.
- C. Trap:
 1. Size: NPS 1-1/2 by NPS 1-1/4 .
 2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

2.5 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install accessible lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- D. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.2 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221119 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ELECTRICAL CONNECTIONS

- A. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

1. Nameplate to be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
2. Nameplate to be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224216.16
COMMERCIAL SINKS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Kitchen/utility sinks.
2. Manually operated sink faucets.
3. Supply fittings.
4. Waste fittings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 KITCHEN/UTILITY SINKS

A. Kitchen/Utility Sinks - Stainless Steel, Counter Mounted: (Above / Below):

1. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Stainless steel, Non / self-rimming, sound-deadened unit with ledge back.
 - c. Number of Compartments: One.
 - d. Material: 18 gauge, Type 304 stainless steel.
 - e. Compartment:
 - 1) Drain: Grid with NPS 1-1/2 tailpiece and twist drain.
 - 2) Drain Location: Centered in compartment.
 - f. Each Compartment:
 - 1) Drains: Grid with NPS 1-1/2 tailpiece and twist drain.
 - 2) Drain Location: Centered in compartment.
 - 3) Depth: Standard.
2. Faucet(s):
 - a. Mounting: On ledge / on countertop.
3. Supply Fittings:
 - a. Standard: ASME A112.18.1/CSA B125.1.
 - b. Supplies: Chrome-plated brass compression stop with inlet connection matching water-supply piping type and size.
 - 1) Operation: Loose keys.

- 2) Risers: NPS 1/2, chrome-plated, rigid-copper pipe ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.
4. Waste Fittings:
 - a. Standard: ASME A112.18.2/CSA B125.2.
 - b. Trap(s):
 - 1) Size: NPS 1-1/2.
 - 2) Material:
 - a) Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall; and chrome-plated brass or steel wall flange.
 - c. Continuous Waste:
 - 1) Size: NPS 1-1/2.
 - 2) Material: Chrome-plated, 17-gauge brass tube.
5. Mounting: On counter with sealant.

2.2 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: One-handle mixing.
 1. Standard: ASME A112.18.1/CSA B125.1.
 2. General: Coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and sink receptor.
 3. Body Type: Centerset.
 4. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
 5. Finish: Polished chrome plated.
 6. Maximum Flow Rate: 1.0 to 1.28 gpm.
 7. Mounting Type: Deck, exposed.
 8. Valve Handle: Lever.
 9. Spout Type: Swing Swivel gooseneck.
 10. Vacuum Breaker: Required for hose outlet.
 11. Spout Outlet: Aerator Hose thread in accordance with ASME B1.20.7 Plain end Spray.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.

- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless steel wall flange.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.
- E. Operation: Loose keys.
- F. Risers:
 - 1. NPS 1/2.
 - 2. ASME A112.18.6/CSA B125.6, braided or corrugated stainless steel flexible hose.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 1-1/2.
 - 2. Material:
 - a. Chrome-plated, two-piece, cast-brass trap and ground-joint swivel elbow with 17-gauge brass tube to wall ; and chrome-plated brass or steel wall flange.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523.12 "Ball Valves for Plumbing Piping".
 - 2. Install stops in locations where they can be easily reached for operation.
- C. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- D. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

- E. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.2 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221119 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.3 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.

3.4 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 250111
BAS: START-UP, VERIFICATION AND COMMISSIONING

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 01 12, BAS: Training
- B. SECTION 25 05 01, BAS: General Requirements
- C. SECTION 25 05 02, BAS: Submittals and Review Process
- D. SECTION 25 05 03, BAS: Project Record Documents
- E. SECTION 25 10 01, BAS: Networks
- F. SECTION 25 10 02, BAS: Computer Systems, MMI
- G. SECTION 25 30 01, BAS: Field Controllers
- H. SECTION 25 35 13, BAS: Actuators and Operators
- I. SECTION 25 35 16, BAS: Sensors and Transmitters
- J. SECTION 25 35 19, BAS: Control Valves

1.2 DEFINITIONS

- A. Acronyms and definitions: refer to Section 25 05 01 - BAS: General Requirements.
- B. CDL - Control Description Logic.
- C. CxA – Commissioning Agent / Authority
- D. AE – Architect / Engineer (Consultant)
- E. AEL: ratio between the total test period less any system downtime accumulated within that period and test period.
- F. Downtime: results whenever BAS is unable to fulfill required functions due to malfunction of equipment defined under responsibility of BAS contractor. Downtime is measured by duration, in time, between time that Contractor is notified of failure and time system is restored to proper operating condition. Downtime not to include following:
- G. Outage of main power supply in excess of back-up power sources, provided that:

1. Automatic initiation of back-up was accomplished.
- H. Automatic shut-down and re-start of components was as specified.
- I. Failure of communications link, provided that:
 1. Controller automatically and correctly operated in stand-alone mode.
 2. Failure was not due to failure of any specified BAS equipment.
- J. Functional failure resulting from individual sensor inputs or output devices, provided that:
 1. System recorded said fault.
 2. Equipment defaulted to fail-safe mode.
 3. AEL of total of all input sensors and output devices is at least 99 % during test period.

1.3 DESIGN REQUIREMENTS

- A. Confirm with AE and Owner's Representative that Design Criteria and Design Intent are still applicable.
- B. Commissioning personnel to be fully aware of and qualified to interpret Design Criteria and Design Intent.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- A. Submittals in accordance with Section [25 05 01 BAS General Requirements].
- B. Final Report:
 1. Include measurements, final settings and certified test results.
 2. Bear signature of commissioning technician and supervisor
 3. Report format to be approved by AE and owner's representative before commissioning is started.
 4. Revise "as-built" documentation, commissioning reports to reflect changes, adjustments and modifications to BAS as set during commissioning and submit to AE and owner's representative in accordance with Section [25 05 01 BAS General Requirements].
 5. Recommend additional changes and/or modifications deemed advisable in order to improve performance, environmental conditions or energy consumption.

1.5 CLOSEOUT SUBMITTALS

- A. Provide documentation, O&M Manuals, and training of O&M personnel for review of AE, CxA and owner's representative before interim acceptance in accordance with Section [25 05 01 BAS General Requirements].

1.6 COMMISSIONING

- A. Supporting commissioning in accordance with Section [25 05 01 BAS General Requirements].
- B. In addition to Division 25 commissioning, the BAS contractor is to perform commissioning for lighting as described in Division 25 and the referenced section(s) of Division 26 by Division 25.
- C. Carry out commissioning under direction of AE, CxA, and owner's representative.
- D. Inform, and obtain approval from, AE, CxA and owner's representative in writing at least [14] days prior to commissioning or each test. Indicate:
 - 1. Location and part of system to be tested or commissioned.
 - 2. Testing/commissioning procedures, anticipated results.
 - 3. Names of testing/commissioning personnel.
- E. Correct deficiencies; re-test in presence of CxA until satisfactory performance is obtained.
- F. Acceptance of tests will not relieve Contractor from responsibility for ensuring that complete systems meet every requirement of Contract.
- G. Load system with project software.
- H. Perform tests as required.

1.7 COMPLETION OF COMMISSIONING

- A. Commissioning to be considered as satisfactorily completed when objectives of commissioning have been achieved and reviewed by AE, CxA and owner's representative.

1.8 ISSUANCE OF FINAL CERTIFICATE OF COMPLETION

- A. Final Certificate of Completion will not be issued until receipt of written approval indicating successful completion of specified commissioning activities including receipt of commissioning documentation.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Provide sufficient instrumentation to verify and commission the installed system. Provide two-way radios.

- B. Instrumentation accuracy tolerances: higher order of magnitude than equipment or system being tested.
- C. Independent testing laboratory to certify test equipment as accurate to within approved tolerances no more than [2] months prior to tests.
- D. Locations to be approved, readily accessible and readable.
- E. Application: to conform to normal industry standards.

PART 3 - EXECUTION

3.1 PROCEDURES

- A. Test each system independently and then in unison with other related systems.
- B. Commission each system using procedures prescribed by the CxA.
- C. Commission integrated systems using procedures prescribed by CxA.
- D. Debug system software.
- E. Optimize operation and performance of systems by fine-tuning PID values and modifying CDLs as required.
- F. Test full scale emergency evacuation and life safety procedures including operation and integrity of smoke management systems under normal and emergency power conditions as applicable.

3.2 FIELD QUALITY CONTROL

- A. Pre-Installation Testing.
 - 1. General: consists of field tests of equipment just prior to installation.
 - 2. Testing may be on site or at Contractor's premises as approved by AE, CxA, and owner's representative.
 - 3. Configure major components to be tested in same architecture as designed system. Include 2 sets of Building Controller's including MCU's, LCU's, and TCU's.
 - 4. Equip each Building Controller with sensor and controlled device of each type (AI, AO, DI, DO).
 - 5. Additional instruments to include:
 - 6. DP transmitters.
 - 7. VAV supply duct SP transmitters.
 - 8. DP switches used for dirty filter indication and fan status.
 - 9. In addition to test equipment, provide inclined manometer, digital micro-manometer, milli-amp meter, source of adequate air pressure to operate any

- pneumatic device used, to hold steady at any setting and with direct output to milli-amp meter at source.
10. After setting, test zero and span in [10] % increments through entire range while both increasing and decreasing pressure.
 11. [DDC Representative] to mark instruments tracking within [0.5]% in both directions as "approved for installation".
 12. Transmitters above [0.5]% error will be rejected.
 13. DP switches to open and close within 2% of setpoint.
- B. Completion Testing.
1. General: test after installation of each part of system and after completion of mechanical and electrical hook-ups, to verify correct installation and functioning.
 2. Include following activities:
- C. Test and calibrate field hardware including stand-alone capability of each controller.
- D. Verify each A-to-D convertor.
- E. Test and calibrate each AI using calibrated digital instruments.
- F. Test each DI to ensure proper settings and switching contacts.
- G. Test each DO to ensure proper operation and lag time.
- H. Test each AO to ensure proper operation of controlled devices. Verify tight closure and signals.
- I. Test operating software.
- J. Test application software and provide samples of logs and commands.
- K. Verify each CDL including energy optimization programs.
- L. Debug software.
- M. Blow out flow measuring and static pressure stations with high pressure air.
- N. Provide point-to-point verification list in table format including point identifier, point identifier expansion, point type and address, low and high limits and engineering units. Indicate name and date signoff as well as any repairs or modifications by startup / commissioning technician. This document will be used in final startup testing.
- O. Final Start up Testing: Upon satisfactory completion of tests, provide contractor-led functional test of entire system under direction of [DDC Representative] and provide:
1. [2] Technical personnel capable of re-calibrating field hardware and modifying software.
 2. Detailed daily schedule showing items to be tested and personnel available.
 3. [DDC Representative's] acceptance signature to be on executive and applications programs.

4. Commissioning to commence during final start-up testing.
 5. O&M personnel to assist in commissioning procedures as part of training.
 6. Commissioning to be supervised by qualified supervisory personnel including [DDC Representative] and owner's representative if requested.
 7. Commission systems considered as life safety systems before affected parts of the facility are occupied.
 8. Operate systems as long as necessary to commission entire project.
 9. Monitor progress and keep detailed records of activities and results.
- P. Final Operational Testing: to demonstrate that BAS functions in accordance with contract requirements.
1. Prior to beginning of [30] day test demonstrate that operating parameters (setpoints, alarm limits, operating control software, sequences of operation, trends, graphics and CDL's) have been implemented to ensure proper operation and operator notification in event of off-normal operation.
- Q. Repetitive alarm conditions to be resolved to minimize reporting of nuisance conditions.
1. Test to last at least [30] consecutive 24 hour days.
 2. Tests to include:
- R. Demonstration of correct operation of monitored and controlled points.
- S. Operation and capabilities of sequences, reports, special control algorithms, diagnostics, software.
1. System will be accepted when:
- T. BAS equipment operates to meet overall performance requirements. Downtime as defined in this Section must not exceed allowable time calculated for this site.
- U. Requirements of Contract have been met.
1. In event of failure to attain specified AEL during test period, extend test period on day-to-day basis until specified AEL is attained for test period.
 2. Correct defects when they occur and before resuming tests.
 3. Seasonal testing may be required at different periods based on weather conditions. Contractor is required to support seasonal testing and CxA demonstration when required during the defined BAS warranty period.
- V. DDC Representative, CxA and Owner's representative to verify reported results.

3.3 ADJUSTING

- A. Final adjusting: upon completion of commissioning set and lock devices in final position and permanently mark settings. Document final settings and setpoints in O&Ms, asbuilts, and sequences of operation.

3.4 DEMONSTRATION

- A. Demonstrate to CxA and owner's representative operation of systems per CxA-provided test scripts including sequence of operations in regular and emergency modes, under normal and emergency conditions, failure scenarios, start-up, shut-down interlocks and lock-outs in accordance with Section [01 79 00 - Demonstration and Training].

END OF SECTION

SECTION 250112
BAS: TRAINING

PART 1 - GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- A. Submittals in accordance with Section 013300 - Submittal Procedures, supplemented and modified by requirements of this Section.
- B. Submit training proposal complete with hour-by-hour schedule including brief overview of content of each segment to Owners Representative 30-days prior to the anticipated commencement date of training.
 - 1. List name of trainer, and type of visual and audio aids to be used.
 - 2. Show co-ordinated interface with other BAS mechanical and electrical training programs.
- C. Submit reports within one week after completion of Phase 1 & Phase 2 training program that training has been satisfactorily completed.

1.2 QUALITY ASSURANCE

- A. Provide competent instructors thoroughly familiar with aspects of BAS installed in facility.
- B. Representative reserves right to approve instructors.

1.3 INSTRUCTIONS

- A. Provide instruction to designated personnel in adjustment, operation, maintenance and pertinent safety requirements of BAS installed.
- B. Training to be project-specific and relevant to the BAS system described herein.

1.4 TIME FOR TRAINING

- A. Number of days of instruction to be as specified in this section (1 day = 8 hours including two 15 minute breaks and excluding lunch time).

1.5 TRAINING MATERIALS

- A. Provide equipment, visual and audio aids, and materials for classroom training.

- B. Supply manual for each trainee, describing in detail data included in each training program.
 - 1. Review contents of manual in detail to explain aspects of operation and maintenance (O&M).

1.6 TRAINING PROGRAM

- A. To be in 2 phases over 2-month period.
- B. Phase 1: 2 day program to begin before 30 day test period at time mutually agreeable to Contractor, Owners Representative.
 - 1. Train O&M personnel in functional operations and procedures to be employed for system operation.
 - 2. Supplement with on-the-job training during 30 day test period.
 - a. Include overview of system architecture, communications, operation of computer and peripherals, report generation.
 - b. Include detailed training on operator interface functions for control of mechanical systems, CDL's for each system, and elementary preventive maintenance.
- C. Phase 2: 5-day program to begin 2-weeks after acceptance for operators, equipment maintenance personnel and programmers. Provide multiple instructors on pre-arranged schedule. Include at least following:
 - 1. Operator training: provide operating personnel, maintenance personnel and programmers with condensed version of Phase 1 training.
 - 2. Equipment maintenance training: provide personnel with 2-days training within 5-day period in maintenance of BAS equipment, including general equipment layout, trouble shooting and preventive maintenance of BAS components, maintenance and calibration of sensors and controls.
 - 3. Programmers: provide personnel with 2-days training within 5-day period in following subjects in approximate percentages of total course shown:
 - a. Software and architecture: 10%
 - b. Application programs: 15%
 - c. Controller programming: 50%
 - d. Trouble shooting and debugging: 10%
 - e. Colour graphic generation: 15%

1.7 ADDITIONAL TRAINING

- A. List courses offered by name, duration and approximate cost per person per week. Note courses recommended for training supervisory personnel.

1.8 MONITORING OF TRAINING

- A. Owners Representative to monitor training program and may modify schedule and content.

PART 2 - PRODUCTS

2.1 NOT USED

- A. Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- A. Not Used.

END OF SECTION

SECTION 250501
BAS: GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 01 11, BAS: Start-up, Verification and Commissioning
- B. SECTION 25 01 12, BAS: Training
- C. SECTION 25 05 02, BAS: Submittals and Review Process
- D. SECTION 25 05 03, BAS: Project Record Documents
- E. SECTION 25 10 01, BAS: Networks
- F. SECTION 25 10 02, BAS: Computer Systems, MMI
- G. SECTION 25 30 01, BAS: Field Controllers
- H. Scope Of Work
- I. This project requires the installation of a new Integrated Automation System (IAS) constructed using BACnet Field Level Devices. The IAS shall utilize single or multiple Network Control Units (NCUs) based on point counts and available resources utilizing a web interface to all controlled devices.
- J. The Contractor will be required to perform the following:
 - 1. Furnish and install a new Integrated System with BACnet fully programmable and application specific DDC controllers for the equipment identified in the IAS drawings including:
 - a. Rooftop Packaged Heat Pump Units (RTUs)
 - b. Ductless Split System Heat Pump Units (IUs)
 - c. Fan Coil Units (FCUs)
 - d. Electric Duct Heaters (EDHs)
 - e. Exhaust Fans (EFs)
 - f. Variable Air Volume Terminal Units (VAVs)
 - g. Sensors
 - h. Integration of AHUs / RTUs, VFDs,
 - i. Integration of Fire Alarm System, Generators, ATSS, Fuel Systems, Lighting Systems, Domestic Water Pumping Systems
 - j. Integration of new BACnet DDC controllers with Network Controller(s)
- K. Contractor to confirm actual location and capacity of Network Controllers.

- L. Provide Graphical User Interface Development for all of the devices identified above and illustrated within the IAS drawings.
- M. Graphical User Interface development must comply with owner program requirements and standards where applicable
- N. Refer to Section 25 15 00.
- O. Furnish and install all items listed below in Section 1.2 GENERAL IAS INSTALLATION SCOPE OF WORK.
- P. It is the contractor's responsibility to review all of the design documents and specifications and report any discrepancies to the owner.

1.2 GENERAL IAS INSTALLATION SCOPE OF WORK

- A. Contractor shall install a new IAS by furnishing and installing system to provide an open protocol, enterprise based, direct digital control, Integrated Automation System.
- B. The new IAS components shall utilize network controllers, BACnet protocol, BTL certified devices, enterprise connectivity, electronic sensing, microprocessor-based digital control, and electronic actuation of dampers and valves to perform control sequences and functions specified.
- C. The IAS will consist of monitoring and control of systems identified within the IAS drawings, which include integration of HVAC and other systems as outlined.
- D. The installation of Network Controllers and DDC control system devices for the HVAC equipment as illustrated on the IAS drawings and detailed in these specifications.
- E. This includes all hardware, electrical installation, configuration, programming and commissioning coordination for the DDC system.
- F. Contractor shall implement an open system that will allow products from various suppliers to be integrated into a unified system in order to provide flexibility for expansion, maintenance, and service of the system.
- G. The Owner shall be the named license holder of all software associated with any and all incremental work on the project.
- H. Provide an Integrated System supplied by a company regularly engaged in the manufacturing and distribution of building automation systems. The IAS Manufacturer shall meet the following qualifications as a minimum:
 - 1. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of building integration automation systems as specified herein, and must have been so for a minimum of three (3) years.
 - 2. The manufacturer of the hardware and software components as well as its subsidiaries must be a member in good standing of the BACnet International.

3. At least 75% of the manufacturer's product line shall be produced under their own direction, including R&D and assembly. Rebranding of another manufacture product shall not qualify.
- I. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- J. The Owner shall receive ownership of all job specific configuration documentation, data files, and application-level software developed for the project.
 1. This shall include all custom, job specific software code and documentation for all configuration and programming that is generated for a given project and/or configured for use with the NAC, FMCS Server(s), and any related LAN / WAN / Intranet and Internet connected routers and devices.
 2. Any and all required IDs and passwords for access to any component or software program shall be provided to the Owner.
- K. Intelligent Equipment Integration. Network installation, software integration, network communication, and equipment configuration for all equipment types specified to be "Intelligent" shall be provided with a factory installed or equipment manufacturer provided communication card.
- L. Refer to IAS drawings and coordinate with Mechanical and Electrical contractors to verify the correct communication options have been supplied.
- M. Coordination with other trades to ensure that all equipment to be integrated is ordered with the proper communication cards and/or equipment required for proper integration.
- N. Installation of the new Facility Local Area Network (FAC LAN) as specified on the Drawings and in these specifications to add new controllers to the IAS infrastructure.
- O. All hardware installed for the project shall be constructed in a modular fashion to permit the next generation and support components to be installed in replace of or in parallel with existing components.
- P. Where the project is an expansion of an existing system the Software utilized for the project shall be downward compatible with earlier releases, whenever possible.
- Q. System Integrator shall be responsible to upgrade hardware purchased due to the introduction of software upgrades prior to system acceptance which supersede or replace the version used for IAS Local Area Network operations or other functions specified herein.
- R. Provision of all documentation called out in these specifications including, but not limited to, submittals, O&M manuals, commissioning submittals, CAD based as-built documentation, and training manuals.
- S. Provide both hard copies and electronic files on electronic media.

- T. Training of facility personnel, and or maintenance contractor, on the operation and maintenance of the system as called out in these specifications.
- U. Hardware, Software and Labor as detailed and described on the IAS drawings and the Division 25 specifications.
- V. Coordination and assistance provided to the commissioning authority for system commissioning.
 - 1. This includes providing staff to operate and manipulate the system as required by the commissioning authority in addition to providing the requested documentation as defined in the commissioning specification.
 - 2. Provide up to 120-hours of assistance to the commissioning authority as required.
- W. The repair of all finished surfaces effected as a result of IAS related installation work. This includes but is not limited to carpet, drywall, paint ceiling tiles, furniture, and the like.
- X. DDC Controller programming and commissioning.
 - 1. System point to point check out, verification and documentation.
- Y. Graphical User Interface Development.
 - 1. The Contractor shall develop the graphics, tools, features, and network integration required and as defined in section 25 15 00.
- Z. The low voltage and communication raceway systems, wiring and terminations.
- AA. All requirements, products, and labor as identified in the Division 25 specifications and IAS Drawings.

1.3 CODES

- A. Comply with all current City codes, ordinances, and regulations
- B. In all cases of conflict between the work of this Division and the City Building Code or omission of items required for code compliance, these details shall be brought to the attention of the Owner at the time of bid proposal submission.
- C. It is the Contractor's responsibility to identify any items of conflict or omission.
- D. These items shall be resolved prior to bid submission and included in the bid proposal price.
- E. The IAS work, materials, and equipment shall comply with the latest rules and regulations of applicable local, state, and federal codes and ordinances.
- F. Where codes are listed herein, the applicable portions of the latest editions apply.

- G. Drawings, specifications, codes and standards are minimum requirements. Where requirements differ, apply the more stringent.
- H. Should any change in Drawings or Specifications be required to comply with regulations, the Contractor shall notify the Owner prior to execution of the work and wait for direction from the Owner.

1.4 REFERENCE STANDARDS

- A. The latest published edition of a reference shall be applicable to this Project unless identified by a specific edition date.
- B. All reference amendments adopted prior to the effective date of this Contract shall be applicable to this Project.
- C. All materials, installation and workmanship whose compliance with organizational standards/codes/specifications is regulated by an organization using its own listing or label as proof of compliance, furnish listing or label as required to ensure material complies with applicable referenced standard or specification.
- D. All materials, installation and workmanship whose compliance with organizational standards/codes/specifications is not regulated by an organization using its own listing or label as proof of compliance, furnish certificate stating that material complies with applicable referenced standard or specification.

1.5 FEES AND PERMITS

- A. Pay applicable fees and permits.
- B. Pay royalties and fees required in connection with the use of patented devices and systems.

1.6 COORDINATION OF WORK WITH EXISTING CONDITIONS

- A. Examine and compare the Integrated Automation System (IAS) Specifications and Drawings with the Specifications and Drawings of the other trades and report any discrepancies between them to the Owner.
- B. Obtain the Owner's written instructions for changes necessary in the IAS work. Install and coordinate the IAS work in cooperation with the Commissioning Authority and the other trades installing interrelated work.
- C. Before installation, make proper provisions to avoid interferences in a manner approved by the Owner.
- D. All changes required in the work of the Contractor, caused by noncompliance with the specifications, shall be made at the Contractor's expense.

- E. Certain products, systems and interface devices may be provided by other trades.
- F. Examine the Contract Documents to ascertain the requirements to install, wire, program, commission, and/or interface to these systems.
- G. Particular attention must be paid towards the interface boards submitted by the various equipment providers.
- H. It is the Contractor's responsibility to verify the submitted interfaces will integrate properly into the IAS. Report any discrepancies to the Owner.
- I. Carefully check space requirements with other trades to insure that all material can be installed in the allotted spaces, including above finished suspended ceilings and under floors.
- J. Transmit to other trades information required for work to be provided under their respective sections in ample time for installation.
- K. Wherever work interconnects with work of other trades, coordinate with other trades and with the Owner's representative to insure that all trades have the information necessary so that they may properly install all the necessary connections and equipment.
- L. Identify all work items (valves, dampers, coils, etc.) in an accepted manner and notify the responsible trade to install access doors and panels at these locations.
- M. Provide notification in writing to both the contractor and the Owner of these locations.
- N. Provide sleeves and conduit for passage of pipes, and wiring through structural masonry, concrete walls and floors, and elsewhere for the proper protection of the IAS work.
- O. Coordinate, project and schedule work with other trades and with the Commissioning Authority in accordance with the construction sequence.
- P. Adjust locations of panels, equipment, devices, and the like, to accommodate work and prevent interferences. Determine the exact route and location of each pipe, conduit or tubing prior to fabrication and installation.

1.7 PARTS LIST

- A. As part of the submittal, provide an accurate parts list including manufacturer, model number and quantity.

1.8 DEFINITIONS

- A. Adjustable (Adj): A characteristic of a control logic parameter such that it can be varied by the operator without downloading the program.

- B. Advanced Application Controller (AAC): A device with limited resources relative to the Building Controller (BC). It may support a level of programming and may also be intended for application specific applications.
- C. Algorithm: A logical procedure for solving a recurring problem.
- D. Analog: A continuously varying signal value (temperature, current, velocity, etc.).
- E. Application Programming Tool: A vendor unique software tool used to create applications for programmable controllers. This software tool may also be used for system programming, controller commissioning, network management.
- F. Application Protocol Data Unit (APDU): A unit of data specified in an application protocol and consisting of application protocol control information and possible application user data (ISO 9545).
- G. Application Specific Controller (ASC): Control product that incorporates solid-state components based upon a microprocessor to perform multiple control loops or functions as part of a specific application.
 - 1. ASC shall conform to the BACnet/BTL certification and integration standards
- H. BACnet or BACnet Standard: BACnet communication requirements as defined by ASHRAE/ANSI 135 and all current addenda and annexes.
- I. BACnet Interoperability Building Blocks (BIBB): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task.
 - 1. BIBBS are combined to build the BACnet functional requirements for a device in a Specification.
- J. BACnet over Internet Protocol (BACnet/IP): BACnet communication requirements as defined by ASHRAE/ANSI 135 and all current addenda and annexes utilizing Internet Protocol addressing as described in IETF publication RFC 791.
- K. BACnet over Master Slave Token Passing Protocol (BACnet MS/TP or MS/TP): BACnet communication requirements as defined by ASHRAE/ANSI 135 and all current addenda and annexes utilizing a master slave token passing network scheme utilizing RS-485 communications.
- L. Bandwidth Utilization: The average utilization of the network capacity. Generally speaking the amount of present network traffic as it relates to the maximum amount of traffic for which a network can support.
- M. Binary: A two-state system where a high signal level represents an “on” condition and an “off” condition is represented by a low signal level.
- N. Binding: In the general sense, binding refers to the associations or mappings of the sources network variables or objects and their intended or required destinations.

1. The concept of associating an output network variable from one device to the input network variable of a second (third, fourth, etc.) device.
- O. Bridge: A device that routes messages or isolates message traffic to a particular segment, sub-net or domain of the same physical communication media.
- P. Bus Topology: A term used to describe the sequential connection of devices on a DLN segment. The communication cable runs from device to device with no tees or stubs from the main communication cable to a device.
- Q. Change of Value (COV): An event that occurs when a measured or calculated analog value changes by a predefined amount.
- R. Channel: A DLN network consisting of two segments connected by a physical layer repeater or router configured as a repeater.
 1. Each segment can support a theoretical limit of 64 connections.
- S. Client: A device that is the requestor of services from a server.
 1. A client device makes requests of and receives responses from a server device.
- T. Commissioning: A process of ensuring that systems are installed, functionally tested and capable of being operated and maintained to perform in conformity with design intent.
 1. Control System commissioning requires a point to point check out and the detail documentation of each parameter.
 2. Commissioning includes a complete functional test of the sequence of operation for each piece of equipment.
- U. Continuous Monitoring: A sampling and recording of a variable based on time or change of state (e.g. trending an analog value, monitoring a binary change of state).
- V. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including HVAC control, switchgear, uninterruptible power supplies, lighting, security, interlocks, thermostats, EP and IP switches and like devices.
 1. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operation.
- W. Controller or Control Unit (CU): Intelligent stand-alone control panel.
- X. Controller is a generic reference and shall include NCUs, LCUs, TCUs as appropriate.
- Y. Control Systems Server (CSS): A computer that maintains the systems configuration and programming database.
- Z. This may double as an operator workstation for smaller systems.

- AA. Deadband: A temperature or lighting range over which no heating, cooling, or lighting energy is supplied as opposed to single point changeover or overlap.
- BB. Device instance: A number that uniquely identifies a device on the Device Level Network (DLN).
- CC. Direct Digital Control (DDC): Microprocessor-based control including Analog/Digital conversion and program logic.
- DD. Discrete: Binary or digital state.
- EE. Distributed Control: A system whereby control processing is decentralized and independent of a central computer.
- FF. Diagnostic Program: Machine-executable instructions used to detect and isolate system and component malfunctions.
- GG. DLN: Device Level Network – The local control system network that incorporates servers, control devices and software applications.
- HH. EEPROM: Electrically Erasable Programmable Read-Only Memory – non-volatile, user modifiable, read-only memory that can be erased and reprogrammed repeatedly through the application of a higher than normal electrical voltage.
- II. FAC LAN: Facility Local Area Network.
- JJ. Functional Profile: A collection of variables required to define key parameters for a standard application.
 - 1. For the HVAC industry, this includes applications like VAV terminal units, fan coil units, etc.
- KK. Gateway: A device, which contains two or more dissimilar networks/protocols, permitting information exchange between dissimilar systems.
- LL. Graphical User Interface (GUI): A Man Machine Interface device (PC, laptop or dumb display terminal) which incorporates web browsing for remote network client services as a thin client machine.
 - 1. The Graphical User Interfacing allows the operator to manage, command, monitor, configure and program the system.
 - 2. It shall function as the point of interface for all control and monitoring functions as well as all data logs, trends, and alarming.
- MM. Hand Held Device (HHD): Manufacturer's microprocessor based device for direct connection to a Controller.
- NN. HTTP: Hypertext Transfer Protocol: the set of rules for exchanging data files (text, graphic images, sound, video and other multimedia files) over the Internet.

- OO. Integrated Automation System (IAS). The complete facility control system comprised of mechanical system automation, security control, lighting control, automatic temperature control, etc., as defined in the contract documents.
1. The IAS is comprised of a tiered network structure.
 - a. The primary tier uses Ethernet, TCP/IP protocol in a 10/100/1000 Base T wiring configuration.
 - 1) The IAS also includes interface panels, bridges, network controllers, LAN wiring, raceways, etc.
 - 2) All system data shall be made available to the Owner's Wide Area Network for building management.
 - 3) The functionality of the system will allow building engineers the ability to view and modify the facility from any point on the Owner's WAN.
 - b. The second tier uses BACnet for distributed control processing.
- PP. Interface Panel: A device that contains an I/O software driver to translate data from a particular format to that conforming to BACnet standards. Also see Gateway
- QQ. IT LAN: Reference to the facility's Information Technology network, used for normal business-related e-mail and Internet communication.
- RR. LAN: Local Area Network – a group of computers and/or associated devices which share a common communications line and typically share the resources of a single processor or server within a small geographic area.
- SS. LAN Interface Device (LANID): Device or function used to facilitate communication and sharing of data throughout the IAS.
- TT. MAC address: The MAC (Media Address Control) address uniquely identifies a device on its MS/TP network.
- UU. Master Devices: Master devices can initiate requests for data but require more processing and memory capacity than slave devices.
- VV. Master-Slave/Token Passing (MS/TP) network segment: An electrically separate section of a network. An MS/TP network segment contains no more than 32 full Unit Loads. Repeaters connect the segments of an MS/TP network.
- WW. Maximum Send Time Parameter: A parameter used to ensure the periodic update of network data. If a time period equal to the value of this parameter has expired without a broadcast of the variable, a re-broadcast of the current value shall be executed. See also minimum send time parameter definitions.
- XX. Minimum Send Time Parameter: A parameter used to control unnecessary broadcasting of data onto the network. A broadcast of an updated value shall not occur unless a time period equal to the value of this parameter has expired. The expiration of the time period does not mandate a re-broadcast. See also maximum send time parameter definitions.

- YY. Network: A system of distributed control units and intelligent devices that are linked together on a communications bus. A network allows sharing of point information between all control units. Additionally, a network provides central monitoring and control of the entire system from any distributed control unit location.
- ZZ. Network Controller Unit (NCU): A device that incorporates 1 or more network service host APIs to perform localized network management and network access services over a group of channel(s).
1. Supervises groups of intelligent devices and Control Units to perform a global sequence of operation (ex: fire and life safety control).
 2. Can be configured to serve as a SCADA client on the IAS, Tier 1, and Local Area Network.
 3. Provides integration to Enterprise level systems and other protocols.
 4. The NCU serves four primary functions:
 - a. Time Schedules: Time schedule algorithms shall reside in the NCU. Occupancy/energize commands shall be broadcast to the building level controllers in the number required by the sequence of control.
 - b. Trend Data Storage: The NCU shall collect data from the building level controls at specified intervals and store the data for periodic uploading to the server. Polling communication techniques are acceptable for data collection by the network controller.
 - c. Alarm Generation: The NCU shall receive binary alarm variables from the building level controllers and transmit this data to the alarm handling software module within the server and operator work stations. Receipt of alarm data from the building level controls shall be based on broadcasting from the building level controls and not based on polling by the Network Controller.
 - d. Interlock and control: The network controller shall perform sequence of operation logic and control where appropriate.
- AAA. Node: a Device connected to a communications network.
- BBB. Open Database Connectivity (ODBC): An open standard application-programming interface (API) for accessing a database. ODBC compliant systems make it possible to access any data from any application, regardless of which database management system (DBMS) is handling the data.
- CCC. Operator Interface (OI): A device used by the operator to manage the BAS including OWSs, POTs, and HHDs.
- DDD. Operating System (OS): Software which controls the execution of computer programs and which provides scheduling, debugging, input/output controls, accounting, compilation, storage assignment, data management, and related services.
- EEE. Operator Workstation (OWS): A Man Machine Interface device (PC, laptop or display terminal) which incorporates web browsing for remote network client services.
1. As the BAS network devices are stand-alone, the OWS is not required for normal operation.

FFF. Peripheral: Input/Output equipment used to communicate to and from the computer and make hard copies of system outputs and electronic files. Peripherals include CRT, printer, hard drives, disk drives, modems, etc.

GGG.Point: Analog or discrete instrument with addressable database values.

HHH. Point-to-Point (PTP): Serial communication as defined in the BACnet standard.

III. Polling: The concept of a control device requesting a network variable from a second control device at a specified interval.

JJJ. Polling communication is typically used to populate dynamic data on an active graphic page and for temporary or short term trending of data where the trend data is not stored at the controller level.

KKK. Portable Operators Terminal (POT): Laptop PC used both for direct connection to a controller and for remote dial up connection.

LLL. Protocol Implementation Conformance Statement (PICS): A written document, created by the manufacturer of a device, which identifies the particular options specified by BACnet that are implemented in the device.

MMM. Repeater: A physical device used to connect two segments while amplifying, conditioning, or strengthening the signal. A Repeater does not provide any routing or filtering of network traffic.

NNN. Router: A device which routes or forwards messages destined for a node on another subnet or domain of the DLN. The device controls message traffic based on node address and priority. Routers also serve as communication interfaces between power line, twisted pair and RF media.

OOO.RS-232: EIA/TIA-232 Standard

PPP. RS-485: EIA/TIA-485 Standard

QQQ.Secure Socket Layer (SSL): A commonly used protocol for managing the security of messages transmission on the Internet.

RRR. Server: A device that is a provider of services to a client. A client device makes requests of and receives responses from a server device.

SSS. Simple Object Access Protocol (SOAP): A method for a program running in one type of operating system to communicate with a program on the same or different type of operating system by using the World Wide Web's Hyper Text Transfer Protocol (HTTP) and its Extensible Markup Language (XML) as the mechanisms for information exchange.

TTT. Slave Devices: Slave devices cannot initiate requests for data; they can reply only to messages from other devices. They are best suited for simple, low-cost functions.

UUU. Smart Device: A control I/O device such as a sensor or actuator that can directly communicate with the controller network to which it is connected. This differs from an ASC in that it typically deals only with one variable (e.g. a single relay output).

VVV. Solenoid: Electric two-position actuator.

WWW. Structured Query Language (SQL): A standard interactive and programming language for retrieving information from and for updating a database via an organized series of queries.

XXX. Stand-Alone Controller: A stand-alone controller has provisions for all of the physical inputs and physical outputs associated with a single mechanical component such as a terminal unit, air handling unit, chiller or boiler. The controller shall also have embedded in it all of the control logic that associated the physical inputs to the physical outputs. A stand-alone controller may rely on other networked devices for time schedule inputs and trend data storage.

YYY. Supervisory Control And Data Acquisition (SCADA) Node: An MMI incorporating a graphical object oriented user interface software application which provides supervisory control and data acquisition from a high level processing personnel computer.

ZZZ. Supervisory Logic: The concept of gathering performance data from multiple terminal units to determine if a specific condition exists within the family of terminal devices.

AAAA. Terminator: An electric component that consists of a resistive and capacitive circuit specifically designed to enhance the quality of communication on a segment. On a bus topology, terminators are connected to both ends of a segment. On MS/TP and free topology network segments a single terminator is required. The terminator is placed at the end-of-line for the MS/TP network segment.

BBBB. Trend Log: A trend log is a collection of samples from a specified variable that are stored within a device on the IAS Network. This data may be periodically sent up to or requested by a Network Controller or an Operator Workstation for the purpose of report generation.

CCCC. WAN: Wide Area Network - Internet-based network connecting multiple facilities with a central data warehouse and server, accessible via standard web-browser.

DDDD. XML (Extensible Markup Language): A specification developed by the World Wide Web Consortium. XML is a pared-down version of SGML, designed especially for Web documents. It allows designers to create their own customized tags, enabling the definition, transmission, validation, and interpretation of data between applications and between organizations.

1.9 ABBREVIATIONS

A. AHU Air Handling Unit

B.	AI	Analog Input
C.	ANSI	American National Standards Institute
D.	AO	Analog Output
E.	Approx.	Approximately
F.	ASC	Application Specific Controller
G.	ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
H.	ASPE	American Society of Plumbing Engineers
I.	ASME	American Society of Mechanical Engineers
J.	ASTM	American Society for Testing and Materials
K.	ATC	Automatic Temperature Control System
L.	AWG	American Wire Gauge (Standard)
M.	BAS	Building Automation System
N.	BMS	Building Management System
O.	CAD	Computer Aided Design
P.	CCC	Central Communications Controller
Q.	CCU	Central Control Unit
R.	Contr.	Contractor
S.	COS	Change of State
T.	CPU	Central Processing Unit
U.	CRAC	Computer Room Air Conditioning
V.	CRT	Cathode Ray Tube
W.	DALI	Digital Addressable Lighting Interface
X.	DCP	Digital Control Panel
Y.	DDC	Direct Digital Controls
Z.	Deg. F or °F	Degree Fahrenheit

AA.	DI	Discrete or Digital Input
BB.	Dia. or diam.	Diameter
CC.	DMA	Direct Memory Access
DD.	DO	Discrete or Digital Output
EE.	Dpr.	Damper
FF.	Dwgs.	Drawings
GG.	EP	Electric-pneumatic
HH.	BAS	Energy Management Control System
II.	FAC LAN	Facility Local Area Network
JJ.	FPB	Fan powered (VAV) box
KK.	FPM	Feet per minute
LL.	FACP	Fire Alarm Control Panel
MM.	FCC	Fire Command Center
NN.	FCIP	Firefighters' Control and Indicating Panel
OO.	FMS	Facility Management System
PP.	Galv.	Galvanized
QQ.	GUI	Graphical User Interface
RR.	HVAC	Heating Ventilating and Air Conditioning
SS.	IAS	Integrated Automation System
TT.	I/O	Input / Output
UU.	ISA	Intelligent Sensor or Actuator
VV.	LCU	Local Control Unit
WW.	NCU	Network Controller Unit
XX.	NSS	Network Services Server
YY.	NSI	Network Services Interface

ZZ.	Mfr.	Manufacture
AAA.	Mfgr.	Manufacturer
BBB.	Max.	Maximum
CCC.	Min.	Minimum or Minute
DDD.	MMI	Man-Machine Interface
EEE.	MSCP	Mass Storage Control Protocol
FFF.	MSI	Master System Integrator
GGG.	NCP	Network Control Panel
HHH.	NEC	National Electrical Code
III.	NI	Network Integrator
JJJ.	NIC	Not in Contract
KKK.	NFPA	National Fire Protection Association
LLL.	O.C.	On Center
MMM.	O.D.	Outside Diameter
NNN.	OS	Operating System
OOO.	PE	Pneumatic-electric
PPP.	Per	According to, in accordance with
QQQ.	PRV	Pressure Reducing Valve
RRR.	Provide	Furnish and install
SSS.	RAM	Random Access Memory
TTT.	ROM	Read Only Memory
UUU.	RTD	Resistance Temperature Device
VVV.	SCADA	Supervisory Control and Data Acquisition System
WWW.	SI	Systems Integrator
XXX.	SNVT	Standard Network Variable Type

YYY.	TCP/IP	Transmission Control Protocol / Internet Protocol
ZZZ.	TCU	Terminal Control Unit
AAAA.	THHN	Thermoplastic High Heat Resistant Nylon Coated-Cable coating
BBBB.	TP	Twisted Pair
CCCC.	UBC	Uniform Building Code
DDDD.	UL	Underwriters' Laboratory
EEEE.	UMC	Uniform Mechanical Code
FFFF.	UML	Unified Modeling Language
GGGG.	UPS	Uninterruptible Power Supply
HHHH.	VAV	Variable Air Volume
IIII.	VCS	Voice Communication System
JJJJ.	VFD	Variable Frequency Drive
KKKK.	XML	Extensible Markup Language

1.10 QUALITY ASSURANCE

- A. All new building automation system products on this project shall be provided by a firm that is a registered ISO 9001:2000 manufacturer at time of bid.
- B. The IAS shall be furnished, engineered, installed, tested and calibrated by factory certified technicians qualified for this work. The Systems Integrator shall be Factory Authorized in good standing with the Manufacturer. Factory trained technicians shall provide instruction, routine maintenance, and emergency service within 24 hours upon receipt of request.
- C. Upon request, installer shall present records of successful completion of factory training courses including course outlines.
- D. Upon request the installer shall provide a letter from the manufacturer that they are Factory Authorized in good standing.
 - 1. All microprocessor based control products used shall conform to BTL Certified Standards.
- E. For equipment types that certified devices do not exist, another interface to that equipment must be provided upon approval of the Design Team.

- F. In addition the Owner and Design Team approval must be obtained if only proprietary control equipment is available.
- G. The use of all proprietary equipment specified for the Integrate Automation System (IAS) integration shall be limited to devices and systems for which non-proprietary software drivers are available for the proposed Enterprise infrastructure platform.
- H. It is the Contractor's responsibility to verify that the equipment manufacturers provide the appropriate interface boards as defined in these specifications and design drawings.
- I. The contractor shall provide hardware and software components of the same manufacturer wherever possible.
- J. The contractor shall use standard off-the-shelf components and/or products whenever possible. Custom products shall not be used unless approved prior to the installation.
- K. Materials and equipment shall be catalogued products and shall be manufacturer's latest standard design that complies with the specification requirements. Where multiple units of the same type or function are required for this project, these units shall be products of a single manufacturer.
- L. All equipment shall be manufactured, installed and tested to comply with the acceptance testing requirements specified herein.
- M. Product Line Demonstrated History: The product line being proposed for the Project must have an installed history of demonstrated satisfactory operation for a length of one (1) year since date of final completion in at least ten (10) installations of comparative size and complexity.
- N. Submittals shall document this requirement with references.
- O. The IAS and components shall be listed by Underwriters Laboratories (UL 916) as an Energy Management System.

1.11 IAS INSTALLER'S QUALIFICATIONS

- A. IAS Installer to:
 - 1. Have local office within 50 miles of project for at least 5 years, staffed by trained personnel capable of providing instruction, routine maintenance, emergency service on systems,
 - 2. Provide record of successful installations of similar size, performed by Systems Integrator submitting the tender, showing successful experience with similar computer based systems.
 - 3. Have access to local supplies of essential parts and provide 7 year guarantee of availability of spare parts after manufacturer's declaration of obsolescence.
 - 4. Have in-house staff with expertise in pneumatic controls where applicable.
 - 5. Provide Profiles for each employee who will be involved in this project.

1.12 SYSTEM ARCHITECTURE

- A. The system provided shall incorporate hardware and software resources sufficient to meet the functional requirements of these Specifications.
- B. The FAC LAN and DLN shall be based on industry standard open platforms as specified herein and utilize commonly available operation, management and application software.
- C. All software packages shall be licensed to the Owner to allow unrestricted maintenance and operation of the IAS.
- D. Contractor shall include all items not specifically itemized in these Specifications that are necessary to implement, maintain, and operate the system in compliance with the functional intent of these Specifications, including but not limited to:
 - 1. Network Operating software
 - 2. Device Drivers and Plug-ins
 - 3. File Server Software
 - 4. Graphical User Interface (GUI) and Utility software
 - 5. Network Management, Configuration, Controller/System Programming and Utility software.
 - 6. Original electronic media and licenses for all software packages utilized to implement the IAS
- E. The system architecture for the building IAS and consists of an Ethernet-based, wide area network (WAN), Local Area Network(s) (LAN) that supports NCUs, LCUs, TCUs, Operator Workstations (OWS), Smart Devices (SD), and Remote Communication Devices (RCDs) as applicable. The following indicates a functional description of the existing IAS structure. The contractor shall utilize these components of the IAS for the scope of this project.
- F. Facility Local Area Network (FAC LAN): The FAC LAN shall be an Ethernet-based, 10/100/1000 Ethernet LAN connecting Local NCUs, IAS server(s) as required and OWSs.
- G. The FAC LAN serves as the backbone for the NCUs, communications path.
- H. Contractor shall provide this as a dedicated LAN for the control system.
- I. LAN shall be IEEE 802.3 Ethernet over Fiber or Category 6 cable with switches and routers that support 1000 base-T gigabit Ethernet throughput.
- J. The FAC LAN must be installed in accordance with IEEE 802.3, TIA/EIA 568-B and TIA/EIA 569-A. The FAC LAN shall support multiple NCs and OWS.
- K. Device Level Network (DLN): Network used to connect LCUs and TCUs.

- L. Dynamic Data Access: Data throughout any level of the network shall be available to and accessible by all other devices, Controllers and OWS, whether directly connected or connected remotely as defined in the point list schedules.
- M. Browser-based access: A remote/local user using a standard browser will be able access all control system facilities and graphics via the WAN or direct connection, with proper username and password.
 - 1. Only Internet browser-based user interfaces (HTML5, Java, XML, CCS3 JAVA Script, etc.) are acceptable.
- N. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser.
- O. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface.
 - 1. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.
- P. The communication speed between the controllers, LAN interface devices, CSS, and operator interface devices shall be sufficient to ensure fast system response time under any loading condition. Contractor shall submit guaranteed response times with Shop Drawings including calculations to support the guarantee. In no case shall delay times between an event, request, or command initiation and its completion be greater than those listed herein. Contractor shall reconfigure LAN as necessary to accomplish these performance requirements:
 - 1. 5 seconds between a Level 1 (critical) alarm occurrence and enunciation at operator workstation.
 - 2. 10 seconds between a Level 2 (Trouble) alarm occurrence and enunciation at operator workstation.
 - 3. 20 seconds between a Level 3 to 5 alarm occurrence and enunciation at operator workstation.
 - 4. 10 seconds between an operator command via the operator interface to change a setpoint and the subsequent change in the controller.
 - 5. 5 seconds between an operator command via the operator interface to start/stop a device and the subsequent command to be received at the controller.
 - 6. 10 seconds between a change of value or state of an input and it being updated on the operator interface.
 - 7. 10 seconds between an operator selection of a graphic and it completely painting the screen and updating at least ten (10) points.
- Q. Control Systems Server (CSS): A server that maintains the systems configuration and programming database.
 - 1. It holds the backup files of the information downloaded into the individual controllers and as such support uploading and downloading that information directly to/from the controllers.

2. It also acts as a control information server to non-control system based programs. It shall allow secure multiple-access to the control information.
- R. The Operator Interface shall provide for overall system supervision, graphical user interface, management report generation, alarm annunciation, and remote monitoring. The system shall be capable of supporting an unlimited number of clients using a standard Web browser such as Internet Explorer™, FireFox™ or Chrome™.
- S. The LCUs and TCUs shall monitor, control, and provide the field interface for all points specified. Each LCU, and TCU shall be capable of performing all specified energy management functions, and all DDC functions, independent of other LCUs and TCUs, and operator interface devices.
- T. Systems Configuration Database: The system architecture shall support maintaining the systems configuration database on a server that resides on the FAC LAN.
- U. User tools for DLN and FAC LAN management shall be provided and licensed to the Owner and shall allow unrestricted configuring, updating, maintaining, and expanding of all current devices, configurations and settings.
- V. Database Schema shall be published and provided to the Owner to facilitate easy access to DLN and FAC LAN data.
- W. All line drivers, signal boosters, and signal conditioners etc. shall be provided as necessary for proper data communication.

1.13 SUBSTITUTIONS

- A. Wherever the words “for review” or “for acceptance” are used in regard to manufactured specialties, or wherever it is desired to substitute a different make or type of apparatus for that specified, submit all information pertinent to the adequacy and adaptability of the proposed apparatus to the Owner’s Representative and secure their approval before the apparatus is ordered. Refer to general condition requirements for substitutions.
- B. Wherever system performance such as material quantities, operating pressure, network throughput, or the like are specified, or a definite make and size of apparatus is specified, for which such quantities are readily determinable, the make and size of the apparatus proposed must conform substantially to the quantities specified or implied. Critical dimensions relating to the installation of apparatus and coordination with the rest of the system shall be considered and adhered to. Substitution of equipment or apparatus shall include all necessary revisions and their costs required to complete the installation.
- C. Approval of request for substitutions may be given only after receipt of complete and satisfactory performance data covering the complete range of operating conditions in tabular and graphical form. Furnish complete and satisfactory information relative to equipment performance, features and accessories, etc. Additional construction and

design costs incurred as a result of any accepted substitution shall be borne by the Contractor.

- D. Substitution Format: Proposed changes and substitutions of systems, apparatus, equipment and manufacturers will be considered subject to the approval of Owner's representative. The proposal shall include the following information:
1. A description of the difference between the existing contract requirements and that which is proposed, the comparative features of each, and the effect of the change on the end result performance. Include the impact of changes on other Contractors and/or subcontractors and acknowledge the inclusion of implementation costs.
 2. Schematic drawings and details to supplement the descriptions.
 3. A list of the contract requirements that must be revised if the change is accepted, including any suggested specification revisions.
 4. Complete list of materials and equipment proposed for use in the change.
 5. Include a description and estimate of costs Owner may incur in implementing the change, such as test, evaluation, operating and support costs.
 6. A projection of any effects the proposed change would have on collateral costs to the Owner.
 7. A statement of the time by which a contract modification accepting the change must be issued, noting any effect on the contract completion time or the delivery schedule.
 8. A statement indicating the reduction to the contract price if the Owner accepts the change. The Contractor shall be responsible for appropriate modification of subcontractor.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Provide factory-shipping cartons for each piece of equipment and control device. Maintain cartons during shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside and protect from weather.

1.15 WARRANTY

- A. The entire IAS and all ancillary equipment required for its operation shall be free from defects in workmanship and material under normal use and service. If within 12 months from the date of substantial completion the installed equipment is found to be defective in operation, workmanship or materials, replace, repair or adjust the defect at no cost to the Owner.
- B. The warranty period for work and systems of this project shall commence after written notification of Owner's final acceptance.
- C. The warranty shall extend to material that is furnished and installed by the Contractor. Materials furnished by, but not installed by the Contractor shall be covered to the extent of the product only.

- D. Installation labor shall be the responsibility of the trade contractor performing the original installation.
- E. If the installing contractor is a sub contractor to the Contractor it shall be the responsibility of the Contractor.
- F. The Contractor shall be responsible for warranting all GUI related hardware including network devices furnished and installed by the Contractor.
- G. The Contractor shall assume cost to troubleshoot and diagnose network communication problems resulting from IAS devices and interface products provided by other trades and utilized as part of the IAS.
- H. Defective products or interfaces provided by other trades shall be the responsibility of the installing trade.
- I. Corrective software modifications made during warranty service periods shall be updated on all user documentation and on user and manufacturer archived software disks.
- J. The Owner reserves the right to make changes to the IAS during the Warranty Period. Such changes do not constitute a waiver of warranty. Contractor shall warrant parts and installation work regardless of any such changes made by Owner, unless the Contractor provides clear and convincing evidence that a specific problem is the result of such changes to the IAS.
- K. At no cost to the Owner, during the Warranty Period, Contractor shall provide maintenance services for software, firmware and hardware components as specified below:
- L. Maintenance services shall be provided for all devices and hardware specified in the Contract Documents. Service all equipment per the manufacturer's recommendations.
- M. Emergency Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would result in property damage or loss of comfort control shall be corrected and repaired following notification by the Owner to the Contractor. Emergency service shall be provided 24 hours per day, 7 days per week, and 365 days per year with no exceptions and at no cost to the Owner.
 - 1. Response by telephone to any request for service shall be provided within two (2) hours of the Owner's initial telephone request for service.
 - 2. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's Site within four (4) hours of the Owner's initial telephone request for such services, as specified.
- N. Normal Service: Any malfunction, failure, or defect in any hardware component or failure of any control programming that would not result in property damage or loss of

comfort control shall be corrected and repaired following notification by the Owner to the Contractor

1. Response by telephone to any request for service shall be provided within eight (8) working hours (Contractor specified 40 hours per week normal working period) of the Owner's initial telephone request for service.
 2. In the event that the malfunction, failure, or defect is not corrected through the telephonic communication, at least one (1) hardware and software technician, trained in the system to be serviced, shall be dispatched to the Owner's Site within three (3) working days of the Owner's initial telephone request for such services, as specified.
- O. At any time during the Warranty Period the Contractor is on Site for maintenance, emergency, or normal service, Contractor shall notify Owner and the local building operating personnel.
1. Contractor shall notify said personnel of all work anticipated being involved for the service work. In addition, no work affecting system operation shall commence until express permission is granted.
 2. After the work is completed a work order ticket describing in detail all work performed (i.e. hardware replaced or serviced, software or firmware modifications made, etc.), hours worked, follow-up work required, etc., must be signed by an authorized building operator.
- P. Owner's Telephonic Request for Service: Contractor shall specify a maximum of three telephone numbers for Owner to call in the event of a need for service. At least one of the lines shall be attended at any given time at all times. One of the three technicians shall respond to every call within 15 minutes.
- Q. Technical Support: Contractor shall provide technical support by telephone throughout the Warranty Period.
- R. Preventive maintenance shall be provided throughout the Warranty Period in accordance with the hardware component manufacturer's requirements.
- S. In the last month of the Warranty Period, all System software and controller firmware, software, drivers, etc. will be upgraded to the latest release (version) in effect at the end of the Warranty Period. Provide the owner with a 3 year option for software upgrade maintenance services

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.

2.2 MANUFACTURERS

- A. Provide a building automation system supplied by a company regularly engaged in the manufacturing and distribution of building automation systems. The BAS Manufacturer shall meet the following qualifications as a minimum:
 - 1. The manufacturer of the hardware and software components must be primarily engaged in the manufacture of building automation systems as specified herein, and must have been so for a minimum of five (5) years.
 - 2. At least 75% of the manufactured product line shall be produced under their own direction, including R&D and assembly. Rebranding of another manufacture product shall not qualify.
- B. The manufacturer of the hardware and software components shall have a technical support group accessible via a toll free number that is staffed with qualified personnel, capable of providing instruction and technical support service for networked control systems.
- C. Acceptable Manufacturers
 - 1. Johnson Controls
 - 2. KMC Controls
 - 3. Schneider Electric
 - 4. If a manufacturer or vendor, other than those listed wishes to seek equivalency to any of the above controls offerings, then the manufacturer or vendor will be subject to the original pre-qualification criteria that were used. Failure to meet the qualifications will render the proposed solution by such a manufacturer or vendor as ineligible.

2.3 MATERIALS AND EQUIPMENT

- A. Materials shall be new, the best of their respective kinds without imperfections or blemishes, and shall not be damaged in any way.
- B. Used equipment shall not be used in any way for the permanent installation except where Drawings or Specifications specifically allow existing materials to remain in place.

2.4 UNIFORMITY

- A. To the extent practical, all equipment of the same type serving the same function shall be identical and from the same manufacturer

PART 3 - EXECUTION

3.1 PREPARATION

- A. Examine areas and conditions under which control systems are to be installed. Do not proceed with Work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. These specifications call out certain duties of the Contractor and any subcontractor(s). They are not intended as a material list of all items required by the Contract.

3.2 INSTALLATION

- A. Utilize licensed electricians for all new and retrofitted electrical distribution systems. Installations of high and low voltage systems shall be in accordance with all building code requirements. Obtain electrical permits, if required by local authorities.
- B. Provide related items and work indicated on the IAS Drawings and items and work called for in this Division of the Specifications.
- C. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems.
- D. Perform start up, configuration, programming and commissioning coordination on each control product and system to provide fully operable systems in accordance with the specified functional performance.
- E. Comply with Federal, State, Municipal and other applicable codes and ordinances. If any conflict arises between these Specification and Drawings, and codes and ordinances, immediately notify the Owner's Representatives. Do not deviate from the Drawings and Specifications nor install any work which may be in conflict with codes and ordinances until the conflict is resolved and the solution accepted by the Owner.
- F. The IAS Drawings show the general arrangement of the respective systems.
- G. Follow these Drawings as closely as actual building construction and the work of other trades will permit.
- H. Provide devices, fittings, sensors, controllers, wiring and accessories, which may be required but are not shown on the Drawings or specified herein.
- I. The Contractor shall be responsible for achieving the sequence of operations and intent of the system design.
- J. Investigate conditions affecting the work and arrange the work accordingly. Provide modifications and accessories as may be required to meet such conditions.

- K. All installation shall be in accordance with manufacturer's published recommendations.
- L. Limit LAN cable lengths to no longer than 80% of the longest dimension published by the manufacturer of the cable between the most remote network nodes.

3.3 DIGITAL CONTROL PANELS, CONTROLLER QUANTITY AND LOCATION

- A. Individual Digital Control Panels (DCPs) are referenced to indicate allocation of points to each DCP and DCP location. Digital control panels shall consist of one or multiple controllers to meet requirements of this Specification.
- B. Where a DCP is referenced, Contractor shall provide at least one (1) controller, and additional controllers as required, in sufficient quantity to meet the requirements of this Specification. Contractor shall extend power to the DCP from an acceptable power panel. Furthermore, Contractor is responsible for ensuring adequate locations for the panels that do not interfere with other requirements of the Project and maintain adequate clearance for maintenance access.
- C. Contractor shall locate DCPs as referenced. It is the Contractor's responsibility to provide enough controllers to ensure a completely functioning system, according to the point list and sequence of operations.
- D. Contractor shall provide a single controller and expansion IO where required per system to ensure distributed control system with no single points of failure (i.e. failure of that controller will not affect other equipment / systems adversely). Controlling and monitoring multiple equipment / systems with a single controller is prohibited.

3.4 NETWORK MANAGEMENT FUNCTIONAL REQUIREMENTS

- A. The Contractor shall coordinate the setup and configuration of the IAS local area network hardware to permit the functional requirements of the IAS herein specified. The setup shall include as a minimum the following network management procedures:
 - 1. Automatic backup of the DDC System database to appropriate media.
 - 2. Program, load and debug all software installations.
 - 3. Network user auditing routine.

3.5 SURGE PROTECTION

- A. Contractor shall furnish and install any power supply surge protection, filters, etc. as necessary for proper operation and protection of all NCs, operator interfaces, printers, routers and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10 percent above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.6 CONTROL POWER SOURCE AND SUPPLY

- A. IAS Contractor shall extend all power source wiring required for operation of all equipment and devices provided under Division 25 and the Drawings.
- B. General requirements for obtaining power include the following:
 - 1. In the case where additional power is required, obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 480V or 600V source, obtain power from the electrically most proximate 120v source fed from a common origin.
 - 2. Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source of power as the equipment. If the equipment's control transformer is large enough and is the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls, or is too noisy for reliable control, provide a separate transformer.
 - 3. Where a controller controls multiple systems on varying levels of power reliability (normal, emergency, and/or interruptible), the controller shall be powered by the highest level of reliability served.
 - 4. Refer to design drawings and if specific power circuiting requirements are provided, those have priority over this section.

3.7 PRODUCT DELIVERY, STORAGE, HANDLING, PROTECTION AND CLEANING

- A. All products and materials shall be new, clean, and free of defects, damage and corrosion.
- B. Ship and store products and materials in a manner which will protect them from damage, weather, and entry of debris. Do not install damaged items - take immediate steps to obtain replacement or repair.
- C. The Contractor shall provide adequate means for and shall fully protect all finish parts of the materials and equipment against damage from any cause during the progress of the work until final acceptance. All materials and equipment in storage and during construction shall be covered in such a manner that no finished surfaces will be damaged or marred, and all moving parts shall be kept clean and dry. The Contractor is responsible for providing storage of materials and equipment.
- D. Equipment and accessories shall be thoroughly cleaned of cement, plaster, and other materials; grease and oil spots shall be removed with cleaning solvent and surfaces carefully wiped.
- E. Panels housing electronic controllers shall be constructed so that the panel and associated wiring may be installed independent of the installation of the electronics. The installation of electronics shall be coordinated with other trades and construction schedules to avoid damage.

3.8 SITE CLEAN UP

- A. At conclusion of each day's work, clean up and remove from the site all rubbish, debris and trash accumulated during the day as a result of work of the Contractor. Sidewalks and streets adjoining the property shall be kept broom clean and free of debris, rubbish, trash and obstructions of any kind caused by work of this Contract.
- B. Upon completion of the work and at times during progress of the work when requested by the Owner, the Contractor shall remove all surplus materials, rubbish, and debris resulting from the operation, and shall leave the entire building and involved portions of the site, insofar as the work of the Contract is concerned, in neat, clean and acceptable condition as approved by Owner.
- C. Marks on walls or ceiling tiles caused by the Contractor shall be cleaned by the Contractor. Ceiling tiles, drywall, carpet, paint, and all architectural finishes damaged by the Contractor shall be replaced by the Contractor.

END OF SECTION

SECTION 250502
BAS: SUBMITTALS AND REVIEW PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes.

1. Methods and procedures for shop drawings submittals, preliminary and detailed review process including review meetings, for building Energy Monitoring and Control System (BAS).

1.2 DEFINITIONS

- A. Acronyms and definitions: refer to Section 250501 - BAS: General Requirements.

1.3 SUBMITTALS

- A. General: Submit Two (2) copies of the materials to be delivered directly to Owner's representatives.
1. In addition, an electronic version of the completed materials shall be provided on electronic media.
 2. Data can be in native file format or scanned where necessary.
- B. Functional Intent: Throughout the Contract Documents, detailed requirements are specified, some of which indicate a means, method or configuration acceptable to meet that requirement.
1. Contractor may submit products that utilize alternate means, methods, and configurations that meet the functional intent.
 - a. These will only be allowed with prior approval.
- C. Electronic Submittals: While all requirements for hard copy submittal apply, IAS control submittals and operation and maintenance (O&M) information shall also be provided in electronic format as follows:
- D. Drawings and Diagrams: Shop Drawings shall be provided on electronic media as an AutoCAD drawing per Owner's CAD standards. All 'x reference' and font files must be provided with AutoCAD files.
- E. Other Submittals: All other submittals shall be provided in Adobe Portable Document Format
- F. Qualifications: Manufacturer, Installer, and Key personnel qualifications as indicated for the appropriate items.

1. Submit a list of no less than five similar projects, which utilize the Enterprise connectivity to provide an Integrated Automation System that consists of web-browser control and monitoring of the proposed field level devices.
 - a. These projects must be on-line and functional such that representatives from the Owner can observe the Integrated Automation System and Interface in full operation. Include proper references and contact numbers of these reference projects.
 2. Submit validation which indicates the successful completion of the required certification course(s).
 3. Submit resumes of installing staff indicating passing certificates for training on the line of controls to be installed as part of this project. Also include prior Instrumentation and Control experience.
 4. Submit an organizational diagram indicating the key technical staff proposed for the project including Project Manager, Application Engineer, Programmers, Superintendent, Electrical Foreman, Electricians, and Technicians etc.
 5. Provide staff quantities to be assigned to the project. Provide contact information for Managers, Programmers, and Lead Technicians upon acceptance of bid.
 6. Submit a record of the number of personal employed by the System Integrator.
 7. This submittal shall clearly indicate the number of managers, technicians, electricians, and programmers certified in the line of DDC controls represented and certified in graphical user interface development and system network management.
 8. Also indicate the number of staff that will be assigned to this project.
 9. Provide certifications of all employed personal trained and certified by an Enterprise Network Infrastructure manufacturer for GUI integration and development.
 10. Identify the number of integrators to be assigned to this project.
 11. The Contractor shall indicate the duration, in which the company has represented the line of controls proposed for this project.
 12. The Contractor shall also disclose all previous manufactures that have been or currently are represented over the last seven (7) years.
 13. GUI development software
 - a. Provide screen captures of graphical user interfaces developed by the Contractor on previous projects. These screen shots shall represent work performed by the contractor and not of the company from the line of controls which the Contractor represents. Provide client contact information for the Owner to validate.
- G. Product Data: Submit manufacturer's technical product data for each Network Control Unit, control device, panel, and accessory furnished, indicating dimensions, capacities, performance and electrical characteristics, and material finishes. Also include installation and start-up instructions.
- H. Products: Within twenty one (21) days after date of execution of General Contractor/Sub-Contractor agreement, submit for acceptance a list of all material and equipment manufacturers whose products are proposed, as well as names of all subcontractors whom the Contractor proposes to employ.

1. Provide a list of devices in schedule form on 8½ x 11 sheets. The schedule shall be organized by columns to define all new devices to be installed as part of the BAS system including the location, system served, controlling unit, model number, performance data, size, range, accuracy, span, operating pressure, etc.
2. Submit documentation indicating BTL compliance and include Protocol Implementation Conformance (PIC) Statements. All PIC statements, product literature, and standard configuration parameters shall be compiled and submitted on electronic media, in addition to providing hard copies.
 - a. Network Controllers
 - b. Intelligent Sensors and Actuators
 - c. Application Specific Controllers
 - d. Local Control Units
 - e. Terminal Control Units.
 - f. Interface Panels
 - g. Network Management Equipment (Routers, Protocol Analyzers, etc.)
3. Submit detailed cut sheets indicating the features, accessories and sub-assemblies of the following, or similar as required:
 - a. All ancillary devices including temperature sensors, flow sensors, and the like, including thermal wells where necessary
 - 1) Pressure gauges, thermometers and indicating devices where shown on the drawings
 - 2) Transformers required for control devices
 - 3) Relays
 - 4) Electrical enclosures and back-plates
 - 5) Wire for DLN, FAC LAN, and all sensors and actuators
 - 6) FAC LAN Hub(s), Switches, and Routers
 - 7) DLN Repeaters
 - 8) Gateway and interface devices
 - 9) Network Management Utility Software
 - 10) Application Programming Tools/Software (DDC controller programming software)
 - 11) Interface devices.
 - 12) Web based configuration and programming for control devices
4. Submit Shop Drawings for each control system, including a complete drawing for each controller identified in the IAS drawings with all point descriptors, addresses and point names indicated. Include mounting details and power supplies. Shop Drawings shall contain the following information:
 - a. System Architecture and System Layout:
 - 1) One-line diagram indicating how the new network controller units will integrate with the IAS field level devices.
 - 2) Provide floor plans locating all NCUs, LCUs and TCUs, workstations, servers, LAN interface devices, etc.
 - 3) Include all WAN, FAC LAN and DLN communication wiring routing, power wiring, power originating sources, and low voltage power wiring. Indicate network number, device ID, MAC

- address, device instance, drawing reference number, and controller type for each NCU.
- 4) Indicate media, protocol, baud rate, and type of each FAC LAN segment.
 - 5) All controllers, sensors located in finished areas, I/O devices installed in mechanical systems, repeaters, end-of-line resistors, other IAS related components, sensors and actuators, etc. shall be located on the floor plans.
 - 6) Wiring routing and as-built conditions shall be maintained accurately throughout the construction period and the drawing shall be updated to accurately to reflect actual installed conditions.
 - 7) Schematic flow diagram of each air system showing fans, coils, dampers, valves, and control devices. Include written description of sequence of operation.
 - 8) All physical and logical points on the schematic flow diagram shall be indicated with names, descriptors, and point addresses as identified in the point list schedule.
- b. With each schematic, provide a point summary table listing building number and abbreviation, system type, equipment type, full point name, point description, Ethernet backbone network number, network number, device ID, object ID (object type, instance number). If this information is not available at the time of Shop Drawings submittals, furnish with O&M manual documentation for Owner review and approval. See Section 25 15 00 for additional requirements.
 - c. Label each control device with setting or adjustable range of control.
 - d. Label each input and output with the appropriate range.
 - e. Provide a Bill of Materials with each schematic. Indicate device identification to match schematic and actual field labeling, quantity, actual product ordering number, manufacturer, description, size, voltage range, pressure range, temperature range, etc. as applicable.
 - f. With each schematic, provide valve and actuator information including size, Cv, design flow, design pressure drop, manufacturer, model number, close off rating, etc. Indicate normal positions of spring return valves and dampers
 - g. Provide detailed schematics for interface connections including installation and commissioning specifics. Include detailed terminal interconnect diagrams for connecting to equipment manufacture's integral communications boards.
 - h. Indicate all required electrical wiring, terminations, terminal blocks, splices, etc.
 - i. Electrical wiring diagrams shall include at a minimum detailed digital interface panel point to point termination diagrams with all wire numbers and terminal block numbers identified. Ladder logic type diagram for motor starter, control, and safety circuits are recommended.
 - j. Provide panel termination details on separate Drawings. Ladder diagrams shall appear on system schematic.

- k. Clearly differentiate between portions of wiring that exists, factory-installed and portions to be field-installed, and differentiate between panel and field wiring.
- l. Provide details for wiring color code assignment.
- m. Provide details of control panels, including controls, instruments, and labeling shown in plan or elevation indicating the installed locations.
- n. Sheets shall be consecutively numbered.
- o. Each sheet shall have a title indicating the type of information included and the system type controlled.
- p. Table of Contents listing sheet titles and sheet numbers.
- q. Legend and list of abbreviations
- r. Submit in Schedule format a detailed list of all spare parts to be provided per the contract documents.
- s. Provide User Interface Graphic Screens as defined in 25 15 00 including:
 - 1) Proposed method of Navigation
 - 2) Summary
 - 3) Floor Plans
 - 4) Trends
 - 5) Alarms

1.4 CONTROL LOGIC DOCUMENTATION:

- A. Submit control logic program listings of graphical programming to document the control software of all control units.
- B. Submit functional temperature control diagrams for each mechanical system served by the IAS. Indicate and tag each input/output served by each LCU and TCU and show locations and functions of ISA's.
- C. Submit logical control diagram indicating each node, node address, Network Variables in and out of each node including message bindings.
- D. Include written description of each control sequence.
- E. Include control response, settings, and setpoints, throttling ranges, gains, reset schedules, adjustable parameters and limits as part of as-built documentation.
- F. Sheets shall be consecutively numbered.
- G. Each sheet shall have a title indicating the controller designations and the HVAC system controlled.
- H. Include Table of Contents listing sheet titles and sheet numbers.
- I. Submit one complete set of programming and operating manuals for all digital controllers concurrently with control logic documentation. This set will count toward the

required number of Operation and Maintenance materials specified below and in Division 01.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- A. Submittals in accordance with **Section 013300** - Submittal Procedures and coordinate with requirements in this Section.
- B. Submit a preliminary design document within 5 working days after contract award, for review by Owners Representative.

1.6 SUBMISSION QUALITY ASSURANCE

- A. Preliminary Design Review Meeting: Convene meeting within 45 working days of award of contract to:
 - 1. Undertake functional review of preliminary design documents, resolve inconsistencies.
 - 2. Resolve conflicts between contract document requirements and actual items (e.g.: points list inconsistencies).
 - 3. Review interface requirements of materials supplied by others.
 - 4. Review "Sequence of Operations".
 - 5. Contractor's programmer to attend meeting.
 - 6. Owners Representative retains right to revise sequence or subsequent CDL prior to software finalization without cost to Owner.

PART 2 - PRODUCTS

2.1 NOT USED

- A. Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- A. Not Used.

END OF SECTION

SECTION 250503
BAS: PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 DEFINITIONS

- A. Acronyms and definitions: refer to Section 25 05 01 - BAS: General Requirements.

1.2 RECORD DOCUMENTS:

- A. Provide record copies of product data and control Shop Drawings updated to reflect the final installed condition at the completion of the project.
- B. Provide record copies of approved control logic programming and database on paper and on electronic media. Accurately record actual setpoints and settings of controls, final sequence of operation, including changes to programs made after submission and approval of Shop Drawings and including changes to programs made during specified testing.
- C. Provide record copies of approved Project specific graphic software on electronic media.
- D. Provide as-built network architecture Drawings showing all nodes including a description field with specific controller identification, description and location information, TCP/IP addresses and BACnet device instance, logical address and drawing reference number.
- E. Record copies shall include individual floor plans with controller locations with all interconnecting wiring routing including space sensors, LAN wiring, power wiring, low voltage power wiring.
- F. Provide record riser diagram showing the location of all controllers and actual wiring order when using daisy-chain wiring topology and Ethernet ring topology.
- G. Maintain Project record documents throughout the Warranty Period and submit final documents at the end of the Warranty Period.

PART 2 - PRODUCTS

2.1 NOT USED

- A. Not Used.

PART 3 - EXECUTION

3.1 NOT USED

A. Not Used.

END OF SECTION

SECTION 251001
BAS: NETWORKS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 10 02, BAS: Computer Systems, MMI
- B. SECTION 25 30 01, BAS: Field Controllers
- C. Definitions
- D. Acronyms and definitions: refer to Section 25 05 01 - BAS: General Requirements.

1.2 NETWORKS

- A. The BAS network(s) must be based on Open Systems.
- B. High-speed data transfer rates for alarm reporting, quick report generation form multiple controllers and upload/download efficiency between network devices.
- C. Support of any combination of controllers and operator workstations directly connected to the local area network. A minimum of 50 devices shall be supported on a single local area network.
- D. Detection and accommodation of single or multiple failures of workstations, controller panels and the network media. The network shall include provisions for automatically reconfiguring itself to allow all operational equipment to perform their designated functions as effectively as possible in the event of single or multiple failures.
- E. Message and alarm buffering to prevent information from being lost.
- F. Error detection, correction, and retransmission to guarantee data integrity.
- G. Default device definition to prevent loss of alarms or data, and ensure alarms are reported as quickly as possible in the event an operator device does not respond.
- H. Commonly available, multiple sourced, networking components shall be used to allow the system to coexist with other networking applications such as office automation. Ethernet to IEEE 802.3 standard is the only acceptable technology.
- I. Synchronization of the real-time clocks in all NCU panels shall be provided.
- J. The BAS network shall be a 100 Megabits/sec Ethernet network supporting BACnet, Java, XML, HTTP, SOAP, OBIX, SNMP and SMTP Protocols for maximum flexibility for integration of building data with enterprise information systems and providing

support for multiple Network Control Units (NCUs), user workstations and where specified, a local server. Local area network minimum physical and media access requirements:

1. Ethernet; IEEE standard 802.3
 2. Cable; 100 Base-T, UTP-8 wire, category 5 minimum
 3. Minimum throughput; 100 Mbps
- K. Provide access to the BAS network via a Wireless Application Protocol (WAP) device. Through this connection the BAS network will provide authorized staff with the ability to monitor and control the BAS from any location within the through a web browser, cellular phone, pager, web-enabled media players, or PDA (Pocket Computer).
- L. Provide access to the BAS network from a remote location, via the Intranet or Internet. The owner shall provide a connection to the Internet to enable access via high-speed cable modem, asynchronous digital subscriber line (ADSL) modem, ISDN line, T1 Line or access to an Internet Service Provider (ISP). If required, the owner will provide a switch/firewall between the building LAN and the BAS network. Through this connection the BAS network will provide authorized staff with the ability to monitor and control the BAS from a remote location through a web browser, cellular phone, pager, web-enabled media players, or PDA. (Pocket Computer).
- M. Controller Local Area Network (BAS sub network)
- N. Provide a network of stand-alone, distributed direct digital controllers that operate on the following protocol using the specified physical layers:
1. The BAS sub network shall employ the BACnet protocol for communication between controllers. BACnet protocol implementation shall adhere to the ANSI/ASHRAE Standard 135. Communications between BACnet devices shall be 76.8 kbps over approved twisted shielded pair cabling utilizing Master/Slave Token Passing BACnet protocol. BACnet defines a comprehensive set of object types and application services for communication requirements among all levels of control in a distributed, hierarchical Building Automation System. BACnet is intended to provide a single, uniform standard for the BAS to provide the required interoperability.
- O. Strict adherence to industry standards including ANSI/ASHRAE Standard 135, BACnet, certified by BACnet Testing Laboratory (BTL listed) to assure interoperability between all system components. Controllers that are not BTL listed are unacceptable.
- P. The design of the BAS sub network shall network Local Control Unit (LCU) and Terminal Control Unit (TCU) to a Network Control Unit (NCU).
- Q. This level of communication shall support a family of application specific controllers and shall communicate bi-directionally with the network through DDC Controllers for transmission of global data.
- R. Terminal Control Unit (TCU) shall be arranged on the BAS sub LAN's in a functional relationship manner with Local Control Unit (LCU). Ensure that a Variable Air Volume

(VAV) Terminal Control Unit (TCU) is logically on the same LAN or segment as the Local Control Unit (LCU) that is controlling its corresponding Air Handling Unit (AHU).

PART 2 - PRODUCTS

2.1 GENERAL

- A. Data communications equipment necessary to achieve an BAS data transmission system including LAN hardware and software for a BACnet® system
- B. Software complete with full documentation for software and equipment.

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- A. Installation to be to manufacturer's recommendations. Provide printed copies of recommendations with shop drawings or product data.

3.2 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.
- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.3 FIELD QUALITY CONTROL

- A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances.
- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Contractor shall arrange for work inspection by authorities having jurisdiction over the work.

3.4 COMMUNICATIONS WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.
- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor / Surge protection device (SPD) according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available.
 - 1. Runs that are longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.5 FIBER OPTIC CABLE

- A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125 μm .
- B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.
- C. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- D. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

END OF SECTION

SECTION 253001
BAS: FIELD CONTROLLERS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 10 01, BAS: Networks
- B. SECTION 25 10 02, BAS: Computer Systems, MMI

1.2 DEFINITIONS

- A. Acronyms and definitions: refer to Section 250501 - BAS: General Requirements.

PART 2 - PRODUCT

2.1 BAS CONTROLLERS

- A. Controllers –BACnet/IP Protocol
 - 1. Provide BACnet Controllers that are BACnet Testing Laboratory listed (v12 or later) as specified herein:
 - a. BACnet Building Controller (B-BC)
 - b. BACnet Advanced Application Controller (B-AAC)
 - c. BACnet Application Specific Controller (B-ASC)
 - 2. All BACnet/IP Controllers shall use the following communication specifications and achieve performance as specified herein:
 - a. All controllers shall be able to communicate peer-to-peer without the need for a Network Control Unit (NCU).
 - 1) Any controller on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.
 - b. Performance
 - 1) Each BACnet controller shall have a minimum of 512KB of RAM and 4GB of non-volatile flash memory.
 - 2) Each controller shall have a 32-bit microprocessor operating at 600 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.

- c. BACnet Controllers shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Variable Air Volume (VAV) Terminals and other applications as shown on the drawings.
 - 1) The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
- d. Control Unit (LCU) and Terminal Control Unit (TCU)
 - 1) Shall be fully programmable and the programming software shall have a library of pre-built, tested, and user re-definable control sequences for a wide range of typical HVAC applications.
 - 2) All control sequences programmed into the LCU and TCU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
 - 3) LCU and TCU controllers that are not fully programmable and/or cannot retain programming as outlined in .2 are not acceptable.
- e. BACnet Controllers shall communicate with the Network Control Unit (NCU) via a BACnet/IP connection at a baud rate of not less than 100 Mbps
- f. BACnet TCU to have a communications port for connecting a matching room temperature and/or humidity sensor and does not utilize any of the I/O points of the Controller.
 - 1) The TCU and all other devices on the BACnet bus shall be accessible from this communications port.
- g. The Contractor supplying the BACnet Controllers shall provide documentation for each device, with the following information at a minimum:
 - 1) BACnet Device; MAC address, name, type and instance number.
 - 2) BACnet Objects; name, type and instance number
- h. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each BACnet controller, as required by the Point List located in the POINTS LIST section of this specification.

B. Controllers – BACnet MS/TP Protocol

- 1. Provide BACnet Controllers that are BACnet Testing Laboratory listed (v12 or later) as specified herein:
 - a. BACnet Building Controller (B-BC)
 - b. BACnet Advanced Application Controller (B-AAC)
 - c. BACnet Application Specific Controller (B-ASC)
- 2. All BACnet MS/TP Controllers shall use the following communication specifications and achieve performance as specified herein:
 - a. All controllers shall be able to communicate peer-to-peer without the need for a Network Control Unit (NCU).

- 1) Any controller on the MS/TP Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.
- b. Performance
 - 1) Each BACnet MS/TP controller shall have a minimum of 64KB of RAM and 384KB of non-volatile flash memory.
 - 2) Each controller shall have a 32-bit microprocessor operating at 68 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
 - 3) Each BACnet controller on the BACnet MS/TP communications trunk shall provide a loading characteristic of minimum 1/8th Load.
 - 4) Manufacturers, who wish to supply LCU and TCU controllers with less than a 32-bit microprocessor and/or a MS/TP loading characteristic of greater than 1/8th Load, may do so as long as they only provide a maximum of 32 controllers on a single bus segment per NCU.
- c. BACnet Controllers shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, Variable Air Volume (VAV) Terminals and other applications as shown on the drawings.
 - 1) The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.
- d. Control Unit (LCU) and Terminal Control Unit (TCU)
 - 1) Shall be fully programmable and the programming software shall have a library of pre-built, tested, and user re-definable control sequences for a wide range of typical HVAC applications.
 - 2) All control sequences programmed into the LCU and TCU shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
 - 3) LCU and TCU controllers that are not fully programmable and/or cannot retain programming as outlined in .2 are not acceptable.
- e. BACnet Controllers shall communicate with the Network Control Unit (NCU) via a BACnet/IP connection at a baud rate of not less than 100 Mbps or via the RS485 MS/TP connection at a baud rate of not less than 76.8 kbps.
- f. BACnet TCU to have a communications port for connecting a matching room temperature and/or humidity sensor and does not utilize any of the I/O points of the Controller.
 - 1) The TCU and all other devices on the BACnet bus shall be accessible from this communications port.

- g. The Contractor supplying the BACnet Controllers shall provide documentation for each device, with the following information at a minimum:
 - 1) BACnet Device; MAC address, name, type and instance number
 - 2) BACnet Objects; name, type and instance number
 - h. It is the responsibility of the Contractor to ensure that the proper BACnet objects are provided in each BACnet controller, as required by the Point List located in the POINTS LIST section of this specification.
- C. Local Control Units (LCU) (Primary Systems such as AHU, MAU, Chiller, Boiler, Water System)
 - 1. The Local Control Units (LCU) shall be 32 bit microprocessor-based.
 - a. The LCU can have an optional factory installed integral color operator interface that provides real-time access to monitored inputs, setpoints, modes, values, statuses, and outputs.
 - 1) Alternatively a field mounted display and interface, meeting the specified functionality, shall be supplied for each controller in lieu of this requirement.
 - 2. Each LCU shall have sufficient memory, to support its own operating system and databases, including:
 - a. Control processes
 - b. Energy management applications
 - c. Alarm management applications
 - d. Historical/trend data for points specified
 - e. Maintenance support applications
 - f. Custom processes
 - g. Manual override monitoring
 - 3. Each LCU shall support:
 - a. Monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet:
 - 1) Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
 - 2) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - 3) Each LCU shall be capable of providing the following control outputs without the addition of equipment outside the DDC controller cabinet:
 - 4) Digital outputs (contact closure for motor starters up to size 4).
 - 5) Analog outputs of 4-20 mA and 0-10 Vdc.
 - 4. The LCU analog or universal input shall use a 16 bit A/D converter.
 - a. Controllers with less than 16 bit A/D converters must provide all analog input sensors with 4-20ma transmitters.
 - 5. The LCU analog or universal output shall use a 10 bit D/A converter.

6. Each LCU shall have a minimum of 10% spare capacity for each point type for future point connection.
 - a. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
 - b. As a minimum, provide one of each type of point available on the controller.
7. Provide sufficient internal memory for the specified control sequences and have at least 25% of the memory available for future use.
8. The LCU's optional factory installed color operator interface will provide real-time access to monitored inputs, setpoints, modes, values, statuses, and outputs.
 - a. The operator interface shall consist of :
 - 1) An icon-based, interactive backlit color display.
 - 2) A turn and select navigation jog dial to access, edit, and modify internal controller functions. The jog dial shall be used to navigate through menus, select options and icons, and change parameters. Scroll buttons (up, down, left and right) shall not be acceptable.
 - 3) Navigable menus to display, select, edit, and modify values and other controller information.
 - 4) List-based menus with a minimum of eight (8) lines of text.
 - 5) Icon-based menus.
 - 6) A display with the following minimum characteristics: a resolution of 400 W x 240 H pixels with an effective viewing area of 2.4" L x 1.4" H, and 2.8" diagonal viewing area.
 - b. The operator interface shall use color-codes with icons and text lists to indicate values and controller statuses.
 - c. The operator interface shall, at a minimum, have the following functions:
 - 1) Points. The operator interface shall provide points list menus to view the inputs, setpoints, and output values such as hardware inputs/outputs, analog values, binary values, multistate values, Intelligent Space Sensor (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) inputs, and wireless inputs.
 - a) The points list menus shall allow the operator to monitor, set, and override controller points and values.
 - b) A color-code shall be used to indicate the conditions and statuses of points displayed in the points list menus.
 - 2) Alarms. The operator interface shall provide a controller's alarms menu to view details of an alarm, to acknowledge the alarm, and to view the alarm history.

- a) The alarm menu shall allow the operator to view the following type of alarms: active not acknowledged, active acknowledged, and inactive not acknowledged.
 - b) The combination of an icon and its color state shall notify the operator of an alarm condition.
 - c) The operator shall be able to select a single point in alarm to view further details such as the alarm to/from status, current status, event date and time, alarm event threshold, and alarm event value.
- 3) Overrides. The operator interface shall provide an overrides menu to view a list of the controller's overridden points such as hardware input, hardware output, value, constant, or variable. The menu shall allow the operator to select an overridden point and to modify or release the override on the selected point.
- 4) PID loops. The operator interface shall provide a PID Loops menu to view, configure, and adjust the PID parameters. The interface shall also provide visual PID tuning with live system response graphing (live-trend).
- 5) The operator interface shall support Latin-based languages and allow the interface user to select from three (3) defined languages.
- 6) The operator interface shall allow personalization of a contact information screen with a minimum of eight (8) lines of user configurable text as well as the option to add a color graphic such as a company logo. The tool shall support, but not be limited to; image file formats such as GIF, PNG, JPG, etc.
- 7) Favorites. The operator interface shall allow access to a list of bookmarked points.
- 8) Weather. The operator interface shall provide a weather menu to view the current weather conditions with a weather status icon. The units shall be configured to be displayed in either metric or US units.
- 9) Password protected. The controller operator interface shall provide multi-level password protection, with user-defined, alphanumeric, name/password combinations. The operator interface shall return to lock mode after a user-defined log-off delay. A password icon shall indicate the lock mode state.
- 10) Settings. The operator interface shall provide a settings menu to view and configure date and time parameters such as the current time, time zone, and daylight savings time.
- 9. The LCU shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all panel components.
 - a. The controller shall provide both local and remote annunciation of any detected component failures or repeated failure to establish communication.
- 10. Should the LCU memory be lost for any reason, the user shall have the capability of reloading the controller software via the BAS LAN OWS or Server.

- a. Controller requiring a local port to reload the controller software is not acceptable.
 - 11. Provide an onboard network communication jack for connection to the BACnet Network (RJ-45 or equivalent quick connect)
 - 12. Wireless port supporting a wireless transceiver for communication with wireless sensors/switches
 - 13. Acceptable Products:
 - a. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) or BACnet Advanced Application Controller (B-AAC)
- D. IP Plant Controller (IP-SYS-CTRL)
- 1. The IP-SYS-CTRL shall be 32 bit microprocessor-based operating at a minimum of 1 GHz.
 - a. They shall be multi-tasking, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules.
 - b. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.
 - 2. Each IP-SYS-CTRL shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases, including:
 - a. Control processes
 - b. Energy management applications
 - c. Alarm management applications
 - d. Historical/trend data for points specified
 - e. Maintenance support applications
 - f. Custom processes
 - g. Web Based interface via integral Web Server.
 - h. Support for up to a minimum of 256 I/O points which are added via Expansion I/O modules.
 - i. Shall have a graphical interface with a common library of HVAC system image and animation such as AHU, MAU, Boiler Plant, Chiller Plant, and Rooftop Unit.
 - 3. The IP-SYS-CTRL shall have a Real Time clock.
 - 4. The IP-SYS-CTRL will support the following communications protocols:
 - a. BACnet/IP
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - a) Supporting controller daisy chaining on the Ethernet network via integral switch functionality.

- 4) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
- b. BACnet MS/TP supporting up to minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
 - 1) Supporting 9600 to 115200 baud
- c. Modbus RTU
 - 1) Supporting 9600 to 115200 baud
- d. Modbus TCP
- e. 2 x USB 2.0 Expansion ports for:
 - 1) 802.11 Wi-Fi Adapter enabling wireless connectivity including:
 - a) 'Hot Spot'
 - b) Client
 - c) Access Point.
 - 2) If the above functionality is not available then appropriate wireless router(s) and switches must be supplied to provide the functionality.
5. Shall contain a "FIPS 140-2 Level 1 Compliant" cryptographic module.
6. Acceptable Products:
 - a. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.

E. IP-SYS-CTRL Communication Modules.

1. Each IP-SYS-CTRL Communication module shall be capable of RS-485 communication with the following requirements, without the additional gateways/routers to enable RS-485 communication:
 - a. Include two separate RS-485 communication ports.
 - b. Allow for either Modbus RTU or BACnet MS/TP communication on either of the ports.
2. Allow for a minimum of 32 Modbus RTU communicating devices and/or a minimum of 50 BACnet MS/TP communicating devices to be connected on each RS-485 segment. .

F. IP-SYS-CTRL Expansion I/O modules:

1. Each IP-SYS-CTRL Expansion I/O module shall be capable of monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet:
 - a. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - b. Pulse accumulators at 120Hz resolution.
 - c. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.

- 1) The analog or universal input shall use a 16 bit A/D converter.
 - 2) Controllers with less than 16 bit A/D converters must provide all analog input sensors with 4-20ma transmitters.
 2. Each IP-SYS-CTRL Expansion I/O module shall be capable of providing the following control outputs without the addition of equipment outside the DDC controller cabinet:
 - a. Digital outputs.
 - 1) Optional Form C relay outputs.
 - 2) Optional Triac Outputs.
 - b. Analog outputs of 4-20 mA and 0-10 Vdc.
 - 1) The analog or universal output shall use a 10 bit D/A converter.
 - c. HOA (Hand, Off, Auto) support.
 3. Each completed configuration of IP-SYS-CTRL and Expansion I/O modules shall have a minimum of 10% spare capacity for each point type for future point connection.
 - a. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
 - b. As a minimum, provide one of each type of point available on the controller.
 4. Provide sufficient internal memory for the specified control sequences and have at least 25% of the memory available for future use.
- G. IP nLight ECLYPSE™ System Controller (IP-NE-CTRL)
 1. The IP-NE-CTRL shall be 32 bit microprocessor-based operating at a minimum of 1 GHz.
 - a. They shall be multi-tasking, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, and power supplies.
 - b. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.
 2. Each IP-NE-CTRL shall have minimum of 512MB memory, with a minimum of 4GB non-volatile flash, to support its own operating system and databases, including:
 - a. Control processes
 - b. Alarm management applications
 - c. Maintenance support applications
 - d. Custom processes
 - e. Web Based interface via integral Web Server.
 - f. Shall have a graphical interface with a common library of nLight system images.
 3. The IP-NE-CTRL shall have a Real Time clock.

4. The IP-NE-CTRL will support the following communications protocols:
 - a. BACnet/IP
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - a) Supporting controller daisy chaining on the Ethernet network via integral switch functionality.
 - 4) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
 - 5) Network Lighting Control (NLC)
 - 6) Supporting up to 1500 NLC devices.
 - 7) 3 – RJ45 ports supporting NLC networks.
 - 8) Refer to 26 09 43 for NLC devices.
 - 9) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
 - b. BACnet MS/TP supporting up to minimum of 50 additional BACnet MS/TP controllers in addition to the Expansion I/O modules.
 - 1) Supporting 9600 to 115200 baud
 - c. 2 x USB 2.0 Expansion ports for:
 - 1) 802.11 Wi-Fi Adapter enabling wireless connectivity including:
 - a) 'Hot Spot'
 - b) Client
 - c) Access Point.
 - d) Spanning Tree Protocol
 - 2) If the above functionality is not available then appropriate wireless router(s) and switches must be supplied to provide the functionality.
 5. Shall contain a "FIPS 140-2 Level 1 Inside" cryptographic module.
 6. Refer to SECTION 26 09 43 ELECTRICAL Network Lighting Control for additional information and end devices.
 7. Acceptable Products:
 - a. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC) with outlined enhanced features.
- H. IP Equipment Controller (IP-EQUIP-CTRL).
1. The IP-EQUIP-CTRL shall be 32 bit microprocessor-based operating at a minimum of 600 MHz.
 - a. They shall be multi-tasking, real-time digital control processor based supporting a fixed I/O point count.

2. Each IP-EQUIP-CTRL shall have minimum of 512MB memory, with a minimum of 4 GB non-volatile flash, to support its own operating system and databases, including:
 - a. Control processes
 - b. Maintenance support applications
 - c. Custom processes
 - d. Energy management applications
 - e. Alarm management applications
 - f. Historical/trend data for points specified
3. Embedded Web Server for local hosting of graphicsThe IP-EQUIP-CTRL shall have a Real Time clock with rechargeable battery.
4. Power Requirements
 - a. 24 VAC with local transformer power
 - b. The IP-EQUIP-CTRL will support the following communications protocols:
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - 4) Supporting controller daisy-chain topology on the wired IP network via integrated switch functionality.
 - 5) Integrated fail-safe should allow for communication when the controller is powered down.
 - 6) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
 - c. BACnet/IP
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - 4) Supporting controller daisy-chain topology on the wired IP network via integrated switch functionality.
 - 5) Integrated fail-safe should allow for communication when the controller is powered down.
 - 6) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
 - d. 2 x USB 2.0 Expansion ports for:
 - 1) 802.11 Wi-Fi Adapter enabling wireless connectivity including:
 - a) 'Hot Spot'.
 - b) Client
 - c) Access Point.
 - 2) If the above functionality is not available then appropriate wireless router(s) and switches must be supplied to provide the functionality..
5. The IP-EQUIP-CTRL controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 20 to 28 VAC ($\pm 15\%$), allowing for power source fluctuations and voltage drops.
6. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range.
7. The controllers shall also function normally under ambient conditions of -40 °F to 158 °F and 0% to 90% RH (non-condensing).
8. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.

9. Provide a minimum of 8 software configurable Universal Inputs capable of supporting the following input signal types: .
 - a. Analog Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - b. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
 - 1) The analog or universal input shall use a 16 bit A/D converter.
 - c. Controllers with less than 16 bit A/D converters must provide all analog input sensors with 4-20ma transmitters.
 10. Provide a minimum of 2 software configurable Universal Outputs capable of supporting the following output signal types:
 - a. Digital outputs.
 - b. Analog outputs of 4-20 mA and 0-10 Vdc.
 - 1) The analog or universal output shall use a 10 bit D/A converter.
 11. Provide a minimum of 4 digital/Triac outputs. .
 12. Provide a minimum of 2 software configurable outputs that can either be utilized as additional digital/Triac outputs or as universal outputs. .
 13. Provide a minimum of 3 Modbus connected devices. .
 - a. Provide on-board RS-485 communication for Modbus RTU communication to a minimum of 3 connected devices on the RS-485 segment. .
 - b. Provide Modbus TCP communication to a minimum of 3 connected devices.
 14. Provide connection to Intelligent Space Sensors (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) via on-board RJ-45 subnetwork port.
 15. Shall contain a "FIPS 140-2 Level 1 Compliant" cryptographic module.
- I. IP Terminal Unit Controller (IP-TU-CTRL) .
1. The IP-TU-CTRL shall be 32 bit microprocessor-based operating at a minimum of 600 MHz. .
 - a. They shall be multi-tasking, real-time digital control processor based supporting a fixed I/O point count.
 2. Each IP-TU-CTRL shall have minimum of 512MB memory, with a minimum of 4 GB non-volatile flash, to support its own operating system and databases, including: .
 - a. Control processes
 - .1 Maintenance support applications
 - .2 Custom processes
 - .3 Energy management applications
 - .4 Alarm management applications
 - .5 Historical/trend data for points specified
 - .6 Embedded Web Server for local hosting of graphics.

3. The IP-TU-CTRL shall have a Real Time clock with rechargeable battery.
4. Power Requirements.
 - a. 24 VAC with local transformer power.
5. The IP-TU-CTRL will support the following communications protocols: .
 - a. BACnet/IP.
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - a) Supporting controller daisy-chain topology on the wired IP network via integrated switch functionality.
 - b) Integrated fail-safe should allow for communication when the controller is powered down.
 - c) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
 - b. 2 x USB 2.0 Expansion ports for:
 - 1) 802.11 Wi-Fi Adapter enabling wireless connectivity including: .
 - a) 'Hot Spot'.
 - b) Client
 - c) Access Point.
 - 2) If the above functionality is not available then appropriate wireless router(s) and switches must be supplied to provide the functionality..
 - c. 1 x micro-USB 2.0 Expansion port
6. The IP-TU-CTRL controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 20 to 28 VAC ($\pm 15\%$), allowing for power source fluctuations and voltage drops.
7. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range.
8. The controllers shall also function normally under ambient conditions of 41 °F to 104 °F and 0% to 90% RH (non-condensing).
9. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
10. Provide a minimum of 3 software configurable Universal Inputs capable of supporting the following input signal types:
 - a. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - b. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
 - 1) The analog or universal input shall use a 16 bit A/D converter.
 - 2) Controllers with less than 16 bit A/D converters must provide all analog input sensors with 4-20ma transmitters.

11. Provide a minimum of 1 digital Input capable of supporting the following input signal types:
 - a. Digital inputs from dry contact closure.
12. Provide a minimum of 1 relay contact output.:
13. Provide a minimum of 3 unpowered relay outputs.:
14. Provide a minimum of 2 digital/Triac outputs at 24VAC.
15. Provide a minimum of 2 analog outputs.
16. Provide a minimum of 2 software configurable outputs that can either be utilized as additional digital outputs or as analog outp
17. Provide connection to Intelligent Space Sensors (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) via on-board RJ-45 subnetwork port.
18. Shall contain a "FIPS 140-2 Level 1 Compliant" cryptographic module

J. IP Power Terminal Unit Controller (IP-PTU-CTRL) .

1. The IP-PTU-CTRL shall be 32 bit microprocessor-based operating at a minimum of 600 MHz. .
 - a. They shall be multi-tasking, real-time digital control processor based supporting a fixed I/O point count.
2. Each IP-PTU-CTRL shall have minimum of 512MB memory, with a minimum of 4 GB non-volatile flash, to support its own operating system and databases, including: .
 - a. Control processes
 - .7 Maintenance support applications
 - .8 Custom processes
 - .9 Energy management applications
 - .10 Alarm management applications
 - .11 Historical/trend data for points specified
 - .12 Embedded Web Server for local hosting of graphics.
3. The IP-PTU-CTRL shall have a Real Time clock with rechargeable battery.
4. Power Requirements.
 - a. 100 – 220 VAC.
5. The IP-PTU-CTRL will support the following communications protocols: .
 - a. BACnet/IP.
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - a) Supporting controller daisy-chain topology on the wired IP network via integrated switch functionality.
 - b) Integrated fail-safe should allow for communication when the controller is powered down.
 - c) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.

- b. 2 x USB 2.0 Expansion ports for:
 - 1) 802.11 Wi-Fi Adapter enabling wireless connectivity including: .
 - a) 'Hot Spot'.
 - b) Client
 - c) Access Point.
 - 2) If the above functionality is not available then appropriate wireless router(s) and switches must be supplied to provide the functionality..
 - c. 1 x micro-USB 2.0 Expansion port
- 6. The IP-PTU-CTRL controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 20 to 28 VAC ($\pm 15\%$), allowing for power source fluctuations and voltage drops.
- 7. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range.
- 8. The controllers shall also function normally under ambient conditions of 41 °F to 104 °F and 0% to 90% RH (non-condensing).
- 9. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
- 10. Provide a minimum of 3 software configurable Universal Inputs capable of supporting the following input signal types:
 - a. Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
 - b. Analog inputs of 4-20 mA, 0-10 Vdc, thermistor and RTD in the range 0 to 350,000 ohm.
 - 1) The analog or universal input shall use a 16 bit A/D converter.
 - 2) Controllers with less than 16 bit A/D converters must provide all analog input sensors with 4-20ma transmitters.
- 11. Provide a minimum of 1 digital Input capable of supporting the following input signal types:
 - a. Digital inputs from dry contact closure.
- 12. Provide a minimum of 1 relay contact output.:
- 13. Provide a minimum of 3 unpowered relay outputs.:
- 14. Provide a minimum of 2 digital/Triac outputs at 24VAC.
- 15. Provide a minimum of 2 analog outputs.
- 16. Provide a minimum of 2 software configurable outputs that can either be utilized as additional digital outputs or as analog outp
- 17. Provide connection to Intelligent Space Sensors (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) via on-board RJ-45 subnetwork port.
- 18. Shall contain a "FIPS 140-2 Level 1 Compliant" cryptographic module

K. IP VAV Controller (IP-VAV)

1. Refer to 25 30 01 Variable Air Volume (VAV) Terminal Control Units (TCU) for VAV related functionality requirements.
 - a. In cases of conflict between this section (IP-VAV) and the referenced section (VAV) this section (IP-VAV) takes precedence.
2. The IP-VAV-CTRL shall be 32 bit microprocessor-based operating at a minimum of 400 MHz.
3. They shall be multi-tasking, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules.
4. Controller size shall be sufficient to fully meet the requirements of this specification and the attached point list.
5. Each IP-VAV-CTRL shall have minimum of 512MB memory, with a minimum of 1GB non-volatile flash, to support its own operating system and databases, including:
 - a. Control processes
 - b. Maintenance support applications
 - c. Custom processes
6. The IP-VAV-CTRL shall have a Real Time clock with rechargeable battery.
7. Power Requirements
 - a. 24 VAC with local transformer power
 - b. 50 VAC utilizing Power Over Ethernet (POE)
8. The IP-VAV-CTRL will support the following communications protocols:
 - a. BACnet/IP
 - 1) Supporting IPv4 addressing.
 - 2) DHCP support and Auto DNS.
 - 3) 2 - RJ45 ports each capable of supporting 10/100 Base-T.
 - 4) If the above functionality is not available then appropriate router(s) and switches must be supplied to provide the functionality.
 - b. 2 x USB 2.0 Expansion ports for:
 - 1) 802.11 Wi-Fi Adapter enabling wireless connectivity including:
 - a) 'Hot Spot'
 - b) Client
 - c) Access Point
 - 2) If the above functionality is not available then appropriate wireless router(s) and switches must be supplied to provide the functionality.
9. Shall contain a "FIPS 140-2 Level 1 Compliant" cryptographic module
10. Acceptable Products:
 - a. BACnet Testing Laboratory (BTL listed) using Device Profile BACnet Building Controller (B-BC)

L. Variable Air Volume (VAV) Terminal Control Units (TCU)

1. The VAV TCU controllers shall be powered from a 24 VAC source and shall function normally under an operating range of 20 to 28 VAC ($\pm 15\%$), allowing for power source fluctuations and voltage drops.
2. The BAS contractor shall provide a dedicated power source and separate isolation transformer for each controller unable to function normally under the specified operating range.
3. The controllers shall also function normally under ambient conditions of 32 °F to 122 °F and 5% to 90% RH (non-condensing).
4. Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.
5. The VAV TCU shall include a built-in 'flow thru' differential pressure transducer.
 - a. The controller shall convert this value to actual air flow.
 - b. Single point differential pressure sensing device is not acceptable.
 - c. Membrane based pressure differential transducer is not acceptable.
 - d. The VAV TCU differential pressure transducer shall have a measurement range of 0 to 2 in. W.C. and measurement accuracy of $\pm 4\%$ at 0.05 to 2 in. W.C. and a minimum resolution of 0.0001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within $\pm 5\%$ of setpoint at the specified minimum and maximum air flow parameters.
 - e. VAV TCU differential pressure transducer requiring periodic zero value air flow calibration is not acceptable.
6. The BAS contractor shall verify the type of differential pressure sensors used in the existing boxes, and ensure compatibility with the VAV TCU controllers.
7. The VAV TCU shall include provision for air flow balancing using a local air flow balancing interface.
8. An Intelligent Space Sensor (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) shall be used for balancing air flow.
 - a. In lieu of an ISS, a portable air flow balancing interface capable of balancing air flow is acceptable.
9. The portable air flow balancing interface shall connect to the VAV TCU or the matching room temperature sensor.
10. The VAV TCU shall also provide an air flow balancing tool.
11. This tool shall allow the air balancer to manually control the action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.
12. Systems not able to provide a web based air balance tool or a portable air flow balancing interface or an Intelligent Space Sensor (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) capable of balancing air flow as part of the VAV TCU controller shall provide an individual full time technician during the air flow balancing process to assure full balance compliance.
13. The VAV box controller shall interface to a matching room temperature sensor as previously specified. The controller shall function to maintain space temperature to within ± 1.5 °F of setpoint at the room sensor location.
14. Each controller shall also incorporate an algorithm that allows for resetting of the associated air handling unit discharge temperature if required to satisfy space requirements.

- a. This algorithm shall function to signal the respective controller to perform the required discharge temperature reset in order to maintain space temperature setpoint.
- 15. It shall be possible to view and reset the space temperature, temperature setpoint, maximum airflow setting, minimum airflow setting, and actual airflow, through the BAS LAN.

2.2 LOCAL DISPLAY UNIT (LDU)

- A. The LDU must provide for a color operator interface allowing for real-time access to monitored inputs, setpoints, modes, values, statuses, and outputs.
 - 1. The operator interface shall consist of :
 - a. An icon-based, interactive backlit color display.
 - b. A turn and select navigation jog dial to access, edit, and modify internal controller functions. The jog dial shall be used to navigate through menus, select options and icons, and change parameters. Scroll buttons (up, down, left and right) shall not be acceptable.
 - c. Navigable menus to display, select, edit, and modify values and other controller information.
 - d. List-based menus with a minimum of eight (8) lines of text.
 - e. Icon-based menus.
 - f. A display with the following minimum characteristics: a resolution of 400 W x 240 H pixels with an effective viewing area of 2.4" L x 1.4" H, and 2.8" diagonal viewing area.
 - 2. The operator interface shall use color-codes with icons and text lists to indicate values and controller statuses.
 - 3. The operator interface shall, at a minimum, have the following functions:
 - a. Points. The operator interface shall provide points list menus to view the inputs, setpoints, and output values such as hardware inputs/outputs, analog values, binary values, multistate values, Intelligent Space Sensor (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) inputs, and wireless inputs.
 - 1) The points list menus shall allow the operator to monitor, set, and override controller points and values.
 - 2) A color-code shall be used to indicate the conditions and statuses of points displayed in the points list menus.
 - b. Alarms. The operator interface shall provide a controller's alarms menu to view details of an alarm, to acknowledge the alarm, and to view the alarm history.
 - 1) The alarm menu shall allow the operator to view the following type of alarms: active not acknowledged, active acknowledged, and inactive not acknowledged.
 - 2) The combination of an icon and its color state shall notify the operator of an alarm condition.

- 3) The operator shall be able to select a single point in alarm to view further details such as the alarm to/from status, current status, event date and time, alarm event threshold, and alarm event value.
 - c. Overrides. The operator interface shall provide an overrides menu to view a list of the controller's overridden points such as hardware input, hardware output, value, constant, or variable. The menu shall allow the operator to select an overridden point and to modify or release the override on the selected point.
 - d. PID loops. The operator interface shall provide a PID Loops menu to view, configure, and adjust the PID parameters. The interface shall also provide visual PID tuning with live system response graphing (live-trend).
 - e. The operator interface shall support Latin-based languages and allow the interface user to select from three (3) defined languages.
 - f. The operator interface shall allow personalization of a contact information screen with a minimum of eight (8) lines of user configurable text as well as the option to add a color graphic such as a company logo. The tool shall support, but not be limited to; image file formats such as GIF, PNG, JPG, etc.
 - g. Favorites. The operator interface shall allow access to a list of bookmarked points.
 - h. Weather. The operator interface shall provide a weather menu to view the current weather conditions with a weather status icon. The units shall be configured to be displayed in either metric or US units.
 - i. Password protected. The controller operator interface shall provide multi-level password protection, with user-defined, alphanumeric, name/password combinations. The operator interface shall return to lock mode after a user-defined log-off delay. A password icon shall indicate the lock mode state.
 - j. Settings. The operator interface shall provide a settings menu to view and configure date and time parameters such as the current time, time zone, and daylight savings time.
- B. The LDU shall be provided as a din-rail mount or (panel) flush mount as shown on the mechanical drawings.
 - C. The LDU shall utilize a single cable connection via on-board RJ-45 port, and can be connected to the subnetwork port of any LCU, IP-SYS-CTRL, or IP-EQUIP-CTRL, IP-VAV-CTRL and therefore can be utilized as a hand-held portable operator display.
 - D. The LDU shall have a minimum rating of IP54 for dusty or splash-prone environments

2.3 IP CONNECTED LOCAL DISPLAY UNIT (IP-LDU)

- A. The IP Connected Local Display Unit (IP-LDU) shall be provided as a surface mount or flush mount, as noted in construction documents.

- B. The IP-LDU shall consist of a touch screen display, with included power adapter port and one RJ45 Ethernet port.
- C. The IP-LDU Connected Local Display Unit shall support connectivity to any single supported field controller accessible on the same IP network.
- D. The IP-LDU shall support user authentication via credential entry. This authentication will determine the user's level of access to the connected field controller.
- E. The IP-LDU shall support the following functions, without any configuration required, other than IP address configuration and association with a connected field controller:
 - 1. PID Loop Tuning: The IP-LDU shall provide the ability to view PID Loop Performance on a connected field controller in a timestamped, multi-variable chart, and make adjustments to tuning parameters.
 - 2. Trend Viewing: The IP-LDU shall provide the ability to view charts for data points on a connected field controller, such as setpoints or hardware inputs and outputs.
 - 3. Schedule & Calendar Adjustment: The IP-LDU shall provide the ability to view and adjust weekly schedules residing on a connected field controller, as well as calendars (e.g. to make operational exceptions for holidays).
 - 4. Point Data View & Override: The IP-LDU shall provide the ability to view and override data points on a connected field controller, such as setpoints or hardware inputs and outputs.
 - 5. Alarm View & Acknowledgement: The IP-LDU shall provide the ability to view and acknowledge alarms present on the connected field controller.

2.4 MOBILE APPLICATION FOR ANDROID¹ AND IOS² PLATFORMS

- A. The application for mobile platforms shall provide real-time access to monitored inputs, setpoints, modes, values, statuses, and outputs.
 - 1. The operator interface consists of :
 - a. An icon-based, interactive application for Android and iOS devices.
 - b. Standard Android and iOS navigation methods shall be used to access, edit, and modify internal controller functions and shall be used to navigate through menus, select options and icons, and change parameters.
 - c. Navigable menus to display, select, edit, and modify values and other controller information.
 - d. List-based menus.
 - e. Icon-based menus.
 - 2. The operator interface shall use color-codes with icons and text lists to indicate values and controller statuses.
 - 3. The operator interface shall, at a minimum, have the following functions:

¹ An open source operating system by Google, based on the Linux kernel.

² A mobile operating system developed by, and a registered mark of, Apple Inc.

- a. Points. The operator interface shall provide points list menus to view the inputs, setpoints, and output values such as hardware inputs/outputs, analog values, binary values, multistate values, Intelligent Space Sensor (ISS) (see section 25 30 01 2.5 INTELLIGENT SPACE SENSORS (ISS)) inputs, and wireless inputs.
 - 1) The points lists menus shall allow the operator to monitor, set, and override controller points and values.
 - 2) A color-code shall be used to indicate the conditions and statuses of points displayed in the points list menus.
- b. Alarms. The operator interface shall provide a controller's alarms menu to view details of an alarm, to acknowledge the alarm, and to view the alarm history.
 - 1) The alarm menu shall allow the operator to view the following type of alarms: active not acknowledged, active acknowledged, and inactive not acknowledged.
 - 2) The combination of an icon and its color state shall notify the operator of an alarm condition.
 - 3) The operator shall be able to select a single point in alarm to view further details such as the alarm to/from status, current status, event date and time, alarm event threshold, and alarm event value.
- c. Overrides. The operator interface shall provide an overrides menu to view a list of the controller's overridden points such as hardware input, hardware output, value, constant, or variable. The menu shall allow the operator to select an overridden point and to modify or release the override on the selected point.
- d. PID loops. The operator interface shall provide a PID Loops menu to view, configure, and adjust the PID parameters. The interface shall also provide visual PID tuning with live system response graphing (live-trend).
- e. The operator interface shall support Latin-based languages and allow the interface user to select from three (3) defined languages.
- f. The operator interface shall allow personalization of a contact information screen with a minimum of eight (8) lines of user configurable text as well as the option to add a color graphic such as a company logo. The tool shall support, but not be limited to; image file formats such as GIF, PNG, JPG, etc.
- g. Favorites. The operator interface shall allow access to a list of bookmarked points.
- h. Weather. The operator interface shall provide a weather menu to view the current weather conditions with a weather status icon. The units shall be configured to be displayed in either metric or US units.
- i. Password protected. The controller operator interface shall provide multi-level password protection, with user-defined, alphanumeric, name/password combinations. The operator interface shall return to lock mode after a user-defined log-off delay. A password icon shall indicate the lock mode state.

- j. Settings. The operator interface shall provide a settings menu to view and configure date and time parameters such as the current time, time zone, and daylight savings time.

2.5 INTELLIGENT SPACE SENSORS (ISS)

- A. Intelligent Space Sensors (ISS) shall communicate on a daisy-chained network connected to any Local Control Unit (LCU) or Terminal Control Unit (TCU) and shall provide ambient space condition sensing without the use of hardware I/O at the LCU or TCU.
- B. Each ISS shall provide a white Liquid Crystal Display (LCD), where indicated on the drawings, with the following minimum features:
 - 1. Minimum 1.4" x 1.18" display area
 - 2. Backlit
- C. The ISS shall be capable of displaying on its LCD the measured space temperature from 50 °F to 104 °F and/or humidity from 0 % RH to 100 % RH with one decimal and/or the CO2 measurement from 0 to 2000 ppm.
- D. The ISS with motion sensor shall have a motion indicator LED that provides a visual confirmation whenever motion is detected. A feature used to enable or disable this motion indicator shall be provided.
- E. The ISS shall be capable of displaying the following elements:
 - 1. Space temperature
 - 2. Cooling space temperature set point
 - 3. Heating space temperature set point
 - 4. Current heating or cooling mode
 - 5. Current occupancy mode
 - 6. Fan speed
 - 7. Light status
 - 8. Blind position
 - 9. Alarm condition
 - 10. Current time
 - 11. Energy consumption indicator
- F. Each ISS shall provide a local keypad for local user interface to perform navigation and adjustment of points configured as adjustable.
- G. The ISS shall be configured for the LCU or TCU intended application requirements.
- H. Provide an ISS where indicated on the drawings each ISS shall provide at a minimum the following on-board integral I/O without the consumption of any inputs and/or outputs at the host LCU or TCU:
 - 1. Temperature Sensor

- a. Sensing Element: 10k Thermistor
 - b. Accuracy: ± 0.9 °F
 - c. Resolution: ± 0.18 °F
 - d. Range: 41 °F to 104 °F
- 2. Relative Humidity Sensor
 - a. Accuracy: ± 3 % RH
 - b. Resolution: 1 % RH
 - c. Range: 10 % RH to 90 % RH
- 3. CO2 Sensor
 - a. Accuracy: 400 to 1,250 ppm ± 30 ppm or 3% of reading, 1,250 to 2,000 ppm $\pm 5\%$ of reading + 30 ppm
 - b. Range: 0 to 2,000 ppm
 - c. Operating elevation: 0 to 16,000 ft
 - d. Calibration method: self-calibration method eliminates the need for manual calibration and calibrates the sensor based on baseline concentrations measured during unoccupied periods in the space. Sensor shall not require manual calibration over a minimum product rated life of 15 years.
 - e. Temperature dependence: 0.11% FS per °F
 - f. Stability: <2% of FS over life of sensor (15 years)
 - g. Pressure dependence: 0.135% of reading per mm Hg
 - h. Sensing method: Non-dispersive infrared (NDIR) absorption and Gold plated optics shall be provided.
- 4. Motion Sensor
 - a. Type: Passive Infrared (PIR) sensor with Fresnel lens
 - b. Vertical detection range: up to 20 ft. x 30 degree detection angle
 - c. Horizontal detection range: up to 20 ft. x 120 degree detection angle
- I. The ISS shall provide function to fully balance the air flow of a Variable Air Volume (VAV) Terminal Control Unit (TCU).
 - 1. The ISS shall allow the air balancer to control the action of the VAV TCU including the following function: open VAV damper, close VAV damper, go to flow setpoint.
 - 2. The ISS shall allow the air balancer to enter flow related parameters including minimum air flow, maximum air flow and K factor.
 - 3. The ISS shall be capable of operating as a handheld tool for air balancing functions in situations where the ISS is not required as an installed sensor.
- J. The ISS menus provide function to configure the Terminal Control Unit (TCU) shall define items such as I/O configurations, set point and delays.
- K. The configuration tool or through an Intelligent Space Sensor (ISS) menus shall allow to commission the TCU application and perform action such as inputs calibration, outputs override.

- L. The ISS shall provide password protected menus or any other mechanism to prevent a local user to access advanced configuration menus including air flow balancing menu and network addressing.
- M. Programmable to display up to ninety six (96) data points in any combination of local and/or networked values from any device on the internetwork.
- N. Each ISS shall provide a point of access for a Service Tool, Supervisory Tool, etc. to the internetwork via the ISS communication port.
- O. The ISS shall be capable of promoting good energy usage practices to the room occupant by displaying an Energy Consumption Indicator (ECI).
 - 1. The ECI shall be modified in real-time when the room occupant modifies a parameter of the Local Control Unit (LCU) or Terminal Controller Unit (TCU) such as the room temperature setpoint or the fan speed.
 - 2. The ECI shall indicate to the room occupant the energy impact of the parameter changes via a 5 level display icon where a full display (5th level) indicates excellent energy conservation and no display indicating no energy conservation.
 - 3. The ECI follows the algorithm for energy efficiency as outlined in ASHRAE 55-2004.
 - 4. If ECI is not available then:
 - a. A stainless steel plate with 4 LEDs must be mounted adjacent to the thermostat.
 - b. The plate is to be engraved, adjacent to each LED, with symbology which will encourage the occupant to conserve energy.
 - c. ECI level (0 to 4) is to be indicated via digital outputs driving the LEDs.
 - d. Algorithm to be used; as defined in ASHRAE 55-2004

2.6 BLE-ENABLED INTELLIGENT ROOM INTERFACE (BEIRI) (ALLURE UNITOUCH)

PART 3 - EXECUTION

3.1 MANUFACTURER'S RECOMMENDATIONS

- A. Installation to be to manufacturer's recommendations. Provide printed copies of recommendations with shop drawings or product data.

3.2 GENERAL WORKMANSHIP

- A. Install equipment, piping, and wiring or raceway horizontally, vertically, and parallel to walls wherever possible.
- B. Provide sufficient slack and flexible connections to allow for piping and equipment vibration isolation.

- C. Install equipment in readily accessible locations as defined by National Electrical Code (NEC) Chapter 1 Article 100 Part A.
- D. Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.
- E. Equipment, installation, and wiring shall comply with industry specifications and standards and local codes for performance, reliability, and compatibility.

3.3 FIELD QUALITY CONTROL

- A. Work, materials, and equipment shall comply with rules and regulations of applicable local, state, and federal codes and ordinances.
- B. Continually monitor field installation for code compliance and workmanship quality.
- C. Contractor shall arrange for work inspection by authorities having jurisdiction over the work.

3.4 WIRING

- A. Control and interlock wiring and installation shall comply with national and local electrical codes, Division 26, and manufacturer's recommendations. Where the requirements of this Section differ from other Divisions, this Section shall take precedence.
- B. NEC Class 1 (line voltage) wiring shall be UL listed in approved raceway as specified by NEC
- C. Low-voltage wiring shall meet NEC Class 2 requirements. Subfuse low-voltage power circuits as required to meet Class 2 current limit.
- D. NEC Class 2 (current-limited) wires not in raceway but in concealed and accessible locations such as return air plenums shall be UL listed for the intended application.
- E. Install wiring in raceway where subject to mechanical damage and at levels below 3 m (10ft) in mechanical, electrical, or service rooms.
- F. Install Class 1 and Class 2 wiring in separate raceways. Boxes and panels containing high-voltage wiring and equipment shall not be used for low-voltage wiring except for the purpose of interfacing the two through relays and transformers.
- G. Do not install wiring in raceway containing tubing.
- H. Run exposed Class 2 wiring parallel to a surface or perpendicular to it and tie neatly at 10 ft. intervals

- I. Use structural members to support or anchor plenum cables without raceway. Do not use ductwork, electrical raceways, piping, or ceiling suspension systems to support or anchor cables.
- J. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes shall not be hung on or attached to ductwork, electrical raceways, piping, or ceiling suspension systems.
- K. Size raceway and select wire size and type in accordance with manufacturer's recommendations and NEC requirements.
- L. Include one pull string in each raceway 1 in. or larger.
- M. Use color-coded conductors throughout.
- N. Locate control and status relays in designated enclosures only. Do not install control and status relays in packaged equipment control panel enclosures containing Class 1 starters.
- O. Conceal raceways except within mechanical, electrical, or service rooms. Maintain minimum clearance of 6 in. between raceway and high-temperature equipment such as steam pipes or flues.
- P. Adhere to requirements in Division 26 where raceway crosses building expansion joints.
- Q. Install insulated bushings on raceway ends and enclosure openings. Seal top ends of vertical raceways.
- R. Terminate control and interlock wiring related to the work of this section. Maintain at the job site updated (as-built) wiring diagrams that identify terminations.
- S. Flexible metal raceways and liquid-tight flexible metal raceways shall not exceed 1 m (3 ft) in length and shall be supported at each end. Do not use flexible metal raceway less than ½ in. electrical trade size. Use liquid-tight flexible metal raceways in areas exposed to moisture including chiller and boiler rooms.
- T. Install raceway rigidly, support adequately, ream at both ends, and leave clean and free of obstructions. Join raceway sections with couplings and according to code. Make terminations in boxes with fittings. Make terminations not in boxes with bushings.

3.5 COMMUNICATIONS WIRING

- A. Communication wiring shall be low-voltage Class 2 wiring and shall comply with Article 3.7 (Wiring).
- B. Install communication wiring in separate raceways and enclosures from other Class 2 wiring.

- C. During installation do not exceed maximum cable pulling, tension, or bend radius specified by the cable manufacturer.
- D. Verify entire network's integrity following cable installation using appropriate tests for each cable.
- E. Install lightning arrestor according to manufacturer's recommendations between cable and ground where a cable enters or exits a building.
- F. Each run of communication wiring shall be a continuous length without splices when that length is commercially available.
 - 1. Runs that are longer than commercially available lengths shall have as few splices as possible using commercially available lengths.
- G. Label communication wiring to indicate origination and destination.
- H. Ground coaxial cable according to NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.6 FIBER OPTIC CABLE

- A. Optical Cable. Optical cables shall be duplex 900 mm tight-buffer construction designed for intra-building environments. Sheath shall be UL listed OFNP in accordance with NEC Article 770. Optical fiber shall meet the requirements of FDDI, ANSI X3T9.5 PMD for 62.5/125mm.
- B. Connectors. Field terminate optical fibers with ST type connectors. Connectors shall have ceramic ferrules and metal bayonet latching bodies.
- C. During installation do not exceed maximum pulling tensions specified by cable manufacturer. Post-installation residual cable tension shall be within cable manufacturer's specifications.
- D. Install cabling and associated components according to manufacturers' instructions. Do not exceed minimum cable and unjacketed fiber bend radii specified by cable manufacturer.

END OF SECTION

SECTION 253513
BAS: ACTUATORS AND OPERATORS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 01 12, BAS: Training
- B. SECTION 25 05 01, BAS: General Requirements
- C. SECTION 25 05 02, BAS: Submittals and Review Procedures
- D. SECTION 25 05 03, BAS: Project Record Documents
- E. SECTION 25 10 01, BAS: Networks
- F. SECTION 25 10 02, BAS: Computer Systems, MMI
- G. SECTION 25 30 01, BAS: Field Controllers
- H. SECTION 25 35 16, BAS: Sensors and Transmitters
- I. SECTION 25 35 19, BAS: Control Valves
- J. SECTION 25 35 23, BAS: Control Dampers

1.2 DEFINITIONS

- A. Acronyms and definitions: refer to Section 25 05 01 - BAS: General Requirements.

PART 2 - PRODUCT

2.1 REFER TO ACTUATOR SCHEDULE ON DRAWINGS

PART 3 - EXECUTION

3.1 ACTUATORS

- A. General. Mount actuators and adapters according to manufacturer's recommendations.
- B. Electric and Electronic Damper Actuators.
 - 1. Mount actuators directly on damper shaft or jackshaft unless shown as a linkage installation.

2. Link actuators according to manufacturer's recommendations.
 3. For low-leakage dampers with seals, mount actuator with a minimum 5° travel available for damper seal tightening.
 4. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately the 5° open position, manually close the damper, and then tighten linkage.
 5. Check operation of damper-actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 6. Provide necessary mounting hardware and linkages for actuator installation.
- C. Valve Actuators.
1. Connect actuators to valves with adapters approved by actuator manufacturer.

END OF SECTION

SECTION 253516
BAS: SENSORS AND TRANSMITTERS

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 01 12, BAS: Training
- B. SECTION 25 05 01, BAS: General Requirements
- C. SECTION 25 05 02, BAS: Submittals and Review Process
- D. SECTION 25 05 03, BAS: Project Record Documents
- E. SECTION 25 10 01, BAS: Networks
- F. SECTION 25 10 02, BAS: Computer Systems, MMI
- G. SECTION 25 30 01, BAS: Field Controllers
- H. SECTION 25 35 13, BAS: Actuators and Operators
- I. SECTION 25 35 19, BAS: Control Valves
- J. SECTION 25 35 23, BAS: Control Dampers

1.2 DEFINITIONS

- A. Acronyms and definitions: refer to Section 25 05 01 - BAS: General Requirements.

PART 2 - PRODUCT

2.1 SEE PRODUCT SCHEDULES ON DRAWINGS

PART 3 - EXECUTION

3.1 INSTALLATION OF SENSORS

- A. Install sensors according to manufacturer's recommendations.
- B. Mount sensors rigidly and adequately for operating environment.

- C. Install room temperature sensors on concealed junction boxes properly supported by wall framing.
- D. Air seal wires attached to sensors in their raceways or in the wall to prevent sensor readings from being affected by air transmitted from other areas.
- E. Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in a serpentine manner vertically across duct. Support each bend with a capillary clip.
- F. Install mixing plenum low-limit sensors in a serpentine manner horizontally across duct. Support each bend with a capillary clip. Provide 1 ft. of sensing element for each 1 ft² of coil area.
- G. Install pipe-mounted temperature sensors in wells. Install liquid temperature sensors with heat-conducting fluid in thermal wells.
- H. Install outdoor air temperature sensors on north wall at designated location with sun shield.
- I. Differential Air Static Pressure.
 - 1. Supply Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 2. Return Duct Static Pressure. Pipe high-pressure tap to duct using a pitot tube. Make pressure tap connections according to manufacturer's recommendations.
 - 3. Building Static Pressure. Pipe pressure sensor's low-pressure port to the static pressure port located on the outside of the building through a high-volume accumulator. Pipe high-pressure port to a location behind a thermostat cover.
 - 4. Piping to pressure transducer pressure ports shall contain a capped test port adjacent to transducer.
 - 5. Pressure transducers, except those controlling VAV boxes, shall be located in control panels, not on monitored equipment or on ductwork. Mount transducers in a vibration-free location accessible for service without use of ladders or special equipment.
 - 6. Mount gauge tees adjacent to air and water differential pressure taps. Install shut-off valves before tee for water gauges.
- J. Smoke detectors, high and low limit thermostats, high-pressure cut-offs, and other safety switches shall be hard-wired to de-energize equipment as described in the sequence of operation. Switches shall require manual reset. Provide contacts that allow DDC software to monitor safety switch status.
- K. Flow Sensors
 - 1. Insert-style Impeller Flow Sensor, Liquid
 - a. Follow manufacturer's recommendation for installation and conform to the guidelines provided by the Installation & Operation Manual.
 - b. Straight pipe requirement for mounting shall be 10 diameters up stream and 5 downstream.

- c. Sensor shall be located with the least possible circumferential displacement from top-center of pipe; any circumferential location in vertical pipes is acceptable.
 - d. Sensor mounted in 2" NPT tap in either pipe saddle or weld on fitting.
 - e. An insertion depth of 1 1/2" for pipe sizes 2.5" and larger is required for accurate flow monitoring.
 - f. Sensor orientation shall be such that flow arrow on sensor is aligned with flow direction.
2. Electromagnetic Flow Meter, Liquid
- a. Follow manufacturer's recommendation for installation. Installation will conform to the guidelines provided by the Installation & Operation Manual.
 - b. Straight pipe requirement shall be an equivalent of three diameters on the inlet (upstream) side, and two diameters on the outlet (downstream) side.
 - c. For best performance, place meter vertically, with liquid flowing upward and meter electrodes in a closed, full pipe.
3. Impeller Flow Sensor and Energy Meter, Liquid
- a. Follow manufacturer's recommendation for installation.
 - b. Straight pipe requirement shall be 10 diameters upstream and 5 diameters downstream. Pipe bends, valves, other fittings, pipe enlargements and reductions should not be present in this length of pipe.
 - c. Apply pipe compound over the first 3 or 4 threads of the mating pipe.
 - d. Thread the pipe into the sensor tee until hand tight, and then tighten the pipe an additional 1-1/2 turns, using a wrench.
 - e. System requires isolated 12-24 V AC/DC power supply. To avoid ground fault conditions, power should not be shared with other devices.
 - f. The RS-485 requires three connections: RS-485+, RS-485- and REF. RS-485 is a high-speed connection and should be wired to meet TIA-EIA-485-A standards.
 - g. The pulse output is a simple solid state switch. The switch is not polarity sensitive, however, the maximum voltage and current ratings should not be exceeded.
4. Impeller Flow Sensor, Liquid
- a. Follow manufacturer's recommendation for installation and conform to the guidelines provided by the Installation & Operation Manual.
 - b. Straight pipe requirement for mounting shall be 10 diameters up stream and 5 downstream.
 - c. Tee sensor shall be vertically upright in horizontal locations; any circumferential orientation in vertical installations is acceptable.
 - d. Sensor orientation shall be such that flow arrow on sensor is aligned with flow direction.

3.2 FLOW SWITCH INSTALLATION

- A. Use correct paddle for pipe diameter.
- B. Adjust flow switch according to manufacturer's instructions.

END OF SECTION

SECTION 253519
BAS: CONTROL SEQUENCES

PART 1 - GENERAL

1.1 RELATED SECTIONS

- A. SECTION 25 01 12, BAS: Training
- B. SECTION 25 05 01, BAS: General Requirements
- C. SECTION 25 05 02, BAS: Submittals and Review Procedures
- D. SECTION 25 05 03, BAS: Project Record Documents
- E. SECTION 25 35 13, BAS: Actuators and Operators

1.2 DEFINITIONS

- A. Acronyms and definitions: refer to Section 25 05 01 - BAS: General Requirements.

PART 2 - PRODUCT

2.1 REFER TO CONTROL VALVE SCHEDULE ON DRAWINGS.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide a complete and operational temperature control and building automation system based on the following points and sequence of operation. The system shall be complete as to sequences and standard control practices. The determined point list is the minimum amount of points that are to be provided. If additional points are required to meet the sequence of operation, they will be provided.
- B. BACnet Object List
 - 1. The following points as defined for each piece of equipment are designated as follows:
 - a. Binary Out (BO) - Defined as any two-state output (start/stop) (enable/disable), etc.
 - b. Binary In (BI) - Defined as any two-state input (alarm, status), etc.

- c. Analog In (AI) - Defined as any variable input (temperature) (position), etc.
- d. Analog Out (AO) - Defined as any electrical variable output. 0–20mA, 4–20mA and 0–10VDC are the only acceptable analog outputs. The driver for analog outputs must come from both hardware and software resident in the controllers. Transducers will not be acceptable under any circumstance.

3.2 CONTROL SEQUENCES

- A. Ductless Split System Heat Pump Units: Each unit shall be controlled by a wall-mounted thermostat with programmable setpoints provided with each unit.
 - 1. The supply fan shall operate continuously.
 - 2. On a call for cooling, the controls shall stage on the DX cooling to maintain setpoint.
 - 3. On a call for heating, the controls shall modulate the reversing valve to maintain heating setpoint.
 - 4. The BAS shall monitor the space temperature, supply fan status, supply fan run-time, and provide unit enable disable and alarm of off normal conditions.
 - 5. Safeties: An alarm shall annunciate the BAS whenever the condensate pump malfunctions. The BAS shall monitor unit status and room temperature.
- B. Single Zone Packaged Rooftop Heat Pump Unit (Constant Volume RTU-1 & RTU-2):
 - 1. Morning Warm-up/Cool Down Mode: The controls shall optimally start the unit and modulate the heat pump heating, electric heat or energize the heat pump cooling to reach occupied setpoint by scheduling occupied time. The outside air damper shall be closed and the return air damper shall be open.
 - 2. Occupied Mode: The supply air fan shall operate continuously and the outside air damper shall open to the minimum outside air position. The heat pump cooling shall sequence and the electric heat shall modulate to maintain room temperature setpoint. The outdoor air damper shall further modulate open in the economizer cycle. The return air damper shall modulate proportionately toward the closed position. Occupied heating set-point shall be 70°F (adjustable). Unoccupied cooling set-point shall be 74°F (adjustable).
 - 3. Unoccupied Mode: The controls shall optimally stop the unit and control heating and cooling to reach unoccupied set-point prior to the scheduled unoccupied time. The supply air fan shall cycle, the outside air damper shall close, the return air damper shall open, the unit heat pump heat, electric heat shall modulate and the heat pump cooling shall energize as required to maintain setback temperature. Unoccupied heating set-point shall be 62°F (adjustable). Unoccupied cooling set-point shall be 82°F (adjustable).
 - 4. Economizer Mode: An enthalpy economizer shall compare indoor and outdoor enthalpy and modulate the unit outdoor air damper and return air damper during the cooling cycle to provide up to 100% outdoor air for free cooling. The economizer supply air temperature shall be limited to 55 Deg. F.
 - 5. Safeties: A duct smoke detector shall be provided in the return duct upstream of the air filters. On detection of products of combustion, the duct smoke detectors shall stop the unit supply air fan, and alarm the BAS and the Fire Alarm System.

- C. Existing Rooftop Air Handling Units (AHU-1, AHU-2, & AHU-3 – Existing Sequences to remain with alteration for dehumidification):
1. Dehumidification Control (Controls Contractor shall land new points for the new humidistat and the VAV boxes for this sequence – provide all hardware, software, and wiring modifications as necessary to accomplish the revised sequence): Space humidity shall be measured by a new return air duct-mounted humidistat. Upon a call for dehumidification (setpoint adjustable), the unit's new cooling discharge air reset control shall be over-ridden to lower the discharge air temperature to provide dehumidification of the supply air to satisfy the space humidity setpoint. Variable air volume terminal boxes shall modulate and provide reheat to prevent over-cooling of the spaces.
- D. Variable Air Volume Terminals (VAV-):
1. Occupied Mode: On a call for cooling from the zone temperature sensor, the BAS shall modulate the air damper between its minimum (20%) and maximum settings to maintain zone temperature setpoint of 74°F in cooling and 70°F in heating (adjustable). On a call for heating the first stage shall modulate the electric heating coil SCR while the airflow is maintained at the deadband flowrate. If the electric heating coil SCR is at its maximum position and the space temperature continues to fall, the second stage of heating shall modulate the air flowrate from the deadband flowrate up to the heating maximum flowrate (50% of the zone peak design flowrate). If the air damper operates at maximum air flow and is unable to maintain heating or cooling setpoint, then the BAS shall reset the associated air handling unit supply air temperature.
 2. Deadband: Temperature deadband between heating and cooling mode shall be 5°F, at which time the electric heating to the VV box is disabled.
 3. Unoccupied Mode: On a call for heating from the zone temperature sensor, the BAS shall modulate open the air damper from the minimum to the maximum setting to maintain night temperature setback of 80 Deg. F in cooling and 65 Deg. F in heating (adjustable, confirm with Owner). If the air damper operates at maximum air flow and is unable to maintain the night temperature setback, then the BAS shall reset up the associated air handling unit supply air temperature. On a manual call for override from the space override button, the system shall return to the occupied mode of operation for a set period of time.
 4. Morning Warm-Up/Cool-Down: On a signal from its associated unit, the air damper shall open to its maximum setting until the morning warm-up/cool down setpoint is reached for its respective zone temperature sensor. If the air damper operates at maximum air flow and is unable to reach the morning setpoint, then the BAS shall reset the associated air handling unit supply air temperature.
- E. Fan Coil Units (FC-):
1. General: Each fan coil unit shall be controlled and monitored as directed by the wall-mounted digital temperature sensor. Unit controller shall be provided for each fan coil unit and wired to the 24V terminal strip provided by the Fan Coil Unit manufacturer. Unit controller shall be suitable for simultaneously controlling the fan coil unit and the associated baseboard heating (where applicable).
 2. The unit controller shall perform the following fan coil control strategies and provide the specified monitoring and diagnostics:

- a. Fan Operation: The supply fan shall cycle on/off and vary speed to maintain set-point within the room.
- b. Heating and Cooling Control: In heating mode, the BAS shall energize the associated fan coil unit(s) to modulate the electric heating coil SCR and the unit fan to maintain the heating set-point temperature (adjustable) and the cooling valve shall be fully closed. In cooling mode, the cooling valve shall be modulated to maintain the cooling set-point (adjustable) and the electric heating coil SCR shall be off. In either mode, the discharge air temperature set-point shall be limited to an adjustable low (50 Deg. F. adjustable) and high (90 Deg. F. adjustable) to prevent extremely cold or hot air from blowing into the space.
- c. Humidity Control: When return air humidity rises above the set-point (50% adjustable) as sensed by the return duct humidity sensor, the BAS shall modulate the unit supply fan and modulate the chilled water valve open for dehumidification. The BAS shall modulate the heating water valve to prevent over-cooling of the space.
- d. Deadband: Temperature deadband between heating and cooling mode shall be 5°F, at which time the heating and cooling water to the fan coil units is disabled.
- e. A condensate overflow switch shall shut off the fan coil unit fan and close the chilled water valve if the high condensate level trips the switch.
- f. Occupied mode: During occupied periods (as determined by the BAS, adjustable), the BAS shall enable the unit fan to run continuously. Space temperature set-points shall be 74 Deg. F in cooling and 70 Deg. F in heating (adjustable).
- g. Unoccupied mode: During unoccupied periods (as determined by the BAS) the supply fan shall cycle and the heating and cooling shall operate as required to maintain the setback temperature (82 Deg. F in cooling and 62 Deg. F in heating - adjustable). The BAS shall optimally start and stop the unit and control heating and cooling to reach occupied and unoccupied setpoint prior to the scheduled occupied and unoccupied time.
- h. On a manual call for override through control system, the system shall return to the occupied mode of operation for a period of up to 2 hours (adjustable).

F. Rooftop Exhaust Fans (EF-2A):

- 1. Exhaust Fan EF-2A shall be controlled through the BAS scheduling time clock. The fan shall be energized and the motorized damper shall open during the occupied mode.

3.3 POINT LISTS

- A. The following point lists are provided as a minimum basis for control. Other points shall be provided as required to accomplish the Control Sequences and to provide a complete control system for automatic and safe control of the HVAC equipment.
- B. See attached pages 253519 - 5 through 253519 – 9.

SYSTEM POINT LIST

[illegible]

GENERAL NOTES: PROVIDE ONE COLOR GRAPHIC PER UNIT WITH ALL DYNAMIC DATA SHOWN.

SYSTEM POINT LIST

[illegible]

GENERAL NOTES: PROVIDE ONE COLOR GRAPHIC PER UNIT WITH ALL DYNAMIC DATA SHOWN.

SYSTEM POINT LIST

[illegible]

GENERAL NOTES:
PROVIDE ONE COLOR GRAPHIC PER UNIT WITH ALL DYNAMIC DATA SHOWN.

SYSTEM POINT LIST

[illegible]

GENERAL NOTES:
PROVIDE ONE COLOR GRAPHIC PER UNIT WITH ALL DYNAMIC DATA SHOWN.

SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Copper building wire.
 - 2. Metal-clad cable, Type MC.
 - 3. Armored cable, Type AC.
 - 4. Tray cable, Type TC.
 - 5. Fire-alarm wire and cable.
 - 6. Connectors and splices.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Conductor Insulation:
1. Type NM: Comply with UL 83 and UL 719.
 2. Type RHH and Type RHW-2: Comply with UL 44.
 3. Type USE-2 and Type SE: Comply with UL 854.
 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 5. Type THHN and Type THWN-2: Comply with UL 83.
 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 7. Type UF: Comply with UL 83 and UL 493.
 8. Type XHHW-2: Comply with UL 44.
- E. Shield:
1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.

2.2 METAL-CLAD CABLE, TYPE MC

- A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.
- B. Standards:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 2. Comply with UL 1569.
 3. RoHS compliant.
 4. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Circuits:
1. Single circuit and multicircuit with color-coded conductors.
 2. Power-Limited Fire-Alarm Circuits: Comply with UL 1424.
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- E. Ground Conductor: Insulated.

- F. Conductor Insulation:
 - 1. Type TFN/THHN/THWN-2: Comply with UL 83.
 - 2. Type XHHW-2: Comply with UL 44.
- G. Armor: Steel, interlocked.
- H. Jacket: PVC applied over armor.

2.3 TRAY CABLE, TYPE TC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.
- B. Standards:
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
 - 2. RoHS compliant.
 - 3. Comply with UL 1277.
 - 4. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
 - 5. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
 - 6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.
- D. Ground Conductor: Insulated.
- E. Conductor Insulation: Type XHHW-2. Comply with UL 44.
- F. Shield: Metallic.

2.4 FIRE-ALARM WIRE AND CABLE

- A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- B. Signaling Line Circuits: Twisted, shielded pair, size as recommended by system manufacturer.
 - 1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

- C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
 - 1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 - 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 - 3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor[with outer jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper or Bronze.
 - 2. Type Two hole barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders:
 - 1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits:
 - 1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.3 INSTALLATION OF FIRE-ALARM WIRE AND CABLE

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system.
 - a. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 3. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, NFPA 70.
- C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- E. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory

circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

- F. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

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
 - 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 12 inches of slack.

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 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."

3.7 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

SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Underground distribution grounding.
 - 2. Ground bonding common with lightning protection system.
 - 3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Ground rods.
 - 3) Ground rings.
 - 4) Grounding arrangements and connections for separately derived systems.
 - 5) **<Insert items>**.
 - b. Instructions for periodic testing and inspection of grounding features at **[test wells] [ground rings] [grounding connections for separately**

derived systems] <Insert locations> based on [NETA MTS] [NFPA 70B]
<Insert reference>.

- 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
- 2) Include recommended testing intervals.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 CONDUCTORS

- A. Insulated Conductors: **Copper** wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 1. Solid Conductors: ASTM B3.
 2. Stranded Conductors: ASTM B8.
 3. Tinned Conductors: ASTM B33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.3 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. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.
- E. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- F. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- G. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- H. Conduit Hubs: Mechanical type, terminal with threaded hub.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with **hex head bolt**.
- J. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- K. Lay-in Lug Connector: Mechanical type, **copper rated for direct burial** terminal with set screw.
- L. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- M. Straps: Solid copper. Rated for 600 A.
- N. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- O. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with bolts.

2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel 3/4 inch by 10 feet.
 - 1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches long.
 - 2. Backfill Material: Electrode manufacturer's recommended material.

- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

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. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
- E. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0

AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- E. Metallic Fences: Comply with requirements of IEEE C2.
 - 1. Grounding Conductor: Bare[, **tinned**] copper, not less than [**No. 8**] **<Insert number>** AWG.
 - 2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
 - 3. Barbed Wire: Strands shall be bonded to the grounding conductor.
- F. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground the fence and bond the fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2. Use exothermic welds for all below-grade connections.
 - 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 - 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - 1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - 2. Make connections with clean, bare metal at points of contact.
 - 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 - 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections
- E. Tests and Inspections:
 - 1. 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, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than

natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method according to IEEE 81.
- F. Grounding system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
- I. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260527
TELECOMMUNICATIONS BONDING INFRASTRUCTURE

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Contractor shall be responsible for the bonding and grounding system and shall follow Section 26 05 26, "Grounding & Bonding" requirements.
- B. Contractor shall supply a bonding system as shown on the Drawings, specified herein and per ANSI/TIA-607-D Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises. All grounding and bonding materials shall meet or exceed all referenced and applicable standards, all federal, state, and local requirements, and conform to all codes and ordinances of any authorities having jurisdiction.
- C. Contractor shall also meet all Division 1 requirements.

1.02 DEFINITIONS

- A. MDF (Main Distribution Frame)
 - 1. The MDF is the primary telecommunications room. This location shall be designed as the network core of the facility and shall be centrally located to optimize connectivity with building Network Locations. All Network Locations in this facility shall connect directly to this distribution frame. External network connectivity shall terminate to this distribution frame.
- B. IDF (Intermediate Distribution Frame)
 - 1. The IDF is the secondary telecommunications room. This location shall be designed to serve the network cable termination needs of a specific building area. This service area may be the entire floor the distribution frame resides on, or a portion of that floor. This IDF shall be centrally located to the area it is designed to serve. The MDF will function as the IDF in smaller deployments.
- C. NC (Network Closet)
 - 1. This location shall be designed to serve the network cable termination needs of a specific building area. It shall be utilized when the size of the network deployment is limited in scope (being defined as all network equipment fitting into a full size rack).
- D. NE (Network Enclosure)
 - 1. This stand-alone location shall be designed to serve the network cable termination needs of a specific building area. It shall be utilized when the size of the network deployment is limited in scope (being defined as all network equipment fitting into a full size cabinet), and a permanent installation is impractical or impossible.
- E. NETLOC (Network Location)
 - 1. Any combination of MDF, IDF, NC or NE.

1.03 SCOPE OF WORK

- A. The aim of this document is to install a proper bonding system to achieve the following needs:
 - 1. Safety from electrical hazards
 - 2. Reliable signal reference within the network
 - 3. Satisfactory and/or enhanced electromagnetic performance of the network
- B. Contractor shall supply and install the bonding and grounding system as specified in Section 26 05 26, "Grounding & Bonding" and also include the following:
 - 1. Provide the PBB (Primary Bonding Busbar) in the MDF.
 - 2. The PBB shall be connected to an earth ground (ground loop surrounding the building, if available) and the building steel.
 - 3. Provide an SBB (Secondary Bonding Busbar) in each IDF, NC, and NE located throughout the facility.
 - 4. Each SBB shall be connected to building steel and the equipment ground terminal of the nearest AC electrical panelboard serving the telecommunications equipment in the IDF, NC, or NE.
 - 5. Provide and connect the TBB (Telecommunications Bonding Backbone) from the PBB to all SBBs.
- C. Connect via compression connectors all equipment, ladder rack, basket rack, telecom racks, cabinets, conduits, sleeves, and other equipment, in each NE, NC, IDF and/or MDF, with bonding conductors to the SBB and/or PBB located in each NC, IDF and/or MDF.
- D. Ensure that all aspects of the grounding system are complete and operational.

PART 2 PRODUCTS

2.01 BUSBARS

- A. The PBB (Telecommunication Main Grounding Busbar) shall be solid copper grounding busbar, 1/4 inch thick x 4 inches high x 12 inches (minimum) length, as required.
- B. The SBB (Telecommunication Grounding Busbar) shall be solid copper grounding busbar, 1/4 inch thick x 2 inches high x 10 inches (minimum) length, as required.
- C. The PBB and SBB shall be drilled with holes per NEMA standard for attaching compression fittings.
- D. Vertical Rack Bonding Busbars (RBBs) shall be provided for all equipment racks. RBBs provide clean bond to any rack mounted equipment regardless of whether or not equipment has an integrated grounding terminal. RBBs shall be a minimum 45U with universal mounting hole pattern.

2.02 COPPER CABLES

- A. All wire used for telecommunications bonding purposes shall be stranded copper and identified with green insulation. Non-insulated wire shall use green tape wrap at each termination point. When conductors are insulated, they shall be listed for the application (e.g., plenum). The bonding conductors shall not decrease in size as the bonding path moves closer to the termination point of the grounding electrode system.
- B. If not shown on Drawings, Contractor shall size bonding conductors to be used for connecting the SBBs to the PBB and the building steel.
- C. Telecommunications Bonding Backbone (TBB) Conductors
 - 1. The TBB is a conductor that equalizes potentials between Network Locations on multiple floors of a building with an ultimate connection to the PBB.
 - 2. The TBB shall be installed in conduit.
 - 3. The TBB shall be minimum conductor size #6 AWG, and sized at 2 kcmil per linear foot up to a maximum size of 750 kcmil. These sizes are based upon TBB length per ANSI/TIA-607-D recommendations. Contractor shall bring to the attention of the A/E anywhere the TBB sizing appears insufficient per the Table below.

Sizing of the TBB	
TBB Length in Linear Feet	TBB Size (AWG)
Less than 13	6
14-20	4
21-26	3
27-33	2
34-41	1
42-52	1/0
53-66	2/0
67-84	3/0
85-105	4/0
106-125	250 kcmil
126-150	300 kcmil
151-175	350 kcmil
176-250	500 kcmil
251-300	600 kcmil
Greater than 301	750 kcmil

- D. Backbone Bonding Conductors (BBC)
 - 1. The BBC is a conductor that equalizes potentials between TRs on the same floor.
 - 2. The BBC shall be installed in conduit.
 - 3. Multi-story buildings with multiple risers (multiple TBBs) shall employ a BBC between vertical grounding backbones at the top floor of the building and minimally at every third floor in between to the lowest floor level. The BBC conductor shall be no smaller than the largest sized TBB.

- E. Telecommunications Bonding Conductor (TBC)
 - 1. The TBC is a conductor that bonds the PBB to the AC grounding (earthing) electrode system.
 - 2. The TBC shall be installed in conduit.
 - 3. The TBC conductor shall be no smaller than the largest sized TBB.
- F. Telecommunications Equipment Bonding Conductor (TEBC)
 - 1. The TEBC is a conductor that bonds the equipment racks to the SBB or PBB.
 - 2. Racks and cabinets shall have individual rack bonding conductors (RBC) bonding to the TEBC.
 - 3. In smaller Network Locations (3-5 racks), it is acceptable to have TEBCs that go directly from each individual rack to the SBB.
- G. Alternating Current Equipment Ground (ACEG)
 - 1. The ACEG is a conductor that bonds the nearest AC electrical panelboard serving the telecommunications equipment in the Network Location to the SBB or PBB.
- H. Secondary Bonding Conductor (SBC)
 - 1. The SBC connects the SBB to the TBB.
 - 2. The SBC shall be sized to be a minimum of the greater of #6 AWG or the largest conductor bonded to the associated SBB.
- I. Unit Bonding Conductor (UBC)
 - 1. The UBC connects rack-mounted equipment to the RBB.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide the PBB and the SBB in each room requiring bonding.
- B. Provide all bonding cabling required connecting the PBB to earth and building steel and all cabling required connecting the SBBs to building steel and to the PBB.
- C. Provide all BBC conductors where required.
- D. Provide and connect all bonding cables required in the Network Location to properly bond all equipment to the PBB and SBB.
- E. All metallic substrates shall be grounded and bonded independently to the bonding conductor.
- F. Daisy chaining from one device to the other is not acceptable.
- G. Cable tray and ladder rack shall be continuously bonded across junctions with a bonding jumper.

3.02 TESTING

- A. The telecommunications bonding and grounding system shall be tested with an earth ground resistance tester used in the two-point testing method. If the resistance value is less than 0.1 Ohm between the two test points, the bonding is acceptable.
- B. Tests to be conducted:
 - 1. The installer and tester must be certified to conduct the testing.
 - 2. Test between the PBB and the service equipment (power) ground.
 - 3. Test between the PBB and each SBB in the system.
 - 4. Test between the SBB and:
 - a. Equipment racks
 - b. Cable tray
 - c. Telecommunications conduits
 - d. Electronic equipment
 - 5. Test results shall be recorded and submitted to Owner and A/E. Include these test results in the "Record and Information Manual."

3.03 LABELING

- A. Provide labeling for all bonding conductors that originate in or are routed through the MTRs and TRs. Labels shall include the following or similar language, "If this connector or cable is loose or must be removed, please call the building telecommunications manager."

END OF SECTION

SECTION 260529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Steel slotted support systems.
 - 2. Conduit and cable support devices.
 - 3. Structural steel for fabricated supports and restraints.
 - 4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
 - 5. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Fasteners.
 - e. Anchors.
 - 2. Include rated capacities and furnished specialties and accessories.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 2. Material for Channel, Fittings, and Accessories: Galvanized steel
 - 3. Channel Width: 1-5/8
 - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- D. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - 2. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 3. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
 - 5. Toggle Bolts: **[All] [Stainless]**-steel springhead type.
 - 6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
 2. NECA 101
 3. NECA 105.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
1. Secure raceways and cables to these supports
 2. Retain paragraph below for projects where seismic design requirements do not apply. Consider retaining for light-commercial projects only.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, raceways may be supported by openings through structure members, according to NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
1. To Wood: Fasten with lag screws or through bolts.
 2. To New Concrete: Bolt to concrete inserts.
 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.

5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 6. To Light Steel: Sheet metal screws.
 7. 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

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 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete.
- C. Anchor equipment to concrete base as follows:
 1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
 3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide 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 A780.

END OF SECTION

SECTION 260533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal conduits and fittings.
 - 2. Nonmetallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Surface raceways.
 - 5. Boxes, enclosures, and cabinets.
 - 6. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Sustainable Design Submittals:
 - 1. [<Double click to insert sustainable design text for solvents and adhesives.>](#)
- C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with ANSI C80.1 and UL 6.
3. IMC: Comply with ANSI C80.6 and UL 1242.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; **[zinc-coated steel] [or] [aluminum]**.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.
2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Fittings, General: Listed and labeled for type of conduit, location, and use.
4. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
5. Fittings for EMT:
 - a. Material: Steel
 - b. Type: Setscrew or compression.
6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.
2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

- a. Fittings for LFNC: Comply with UL 514B.
- 3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R 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.
- B. 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.
- C. Wireway Covers: Screw-cover type, Flanged-and-gasketed type unless otherwise indicated.
- D. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover.
- D. 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.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep
- I. Gangable boxes are allowed.
- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250

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.

K. Cabinets:

1. NEMA 250, Type 1 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.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC
2. Concealed Conduit, Aboveground: GRC
3. Underground Conduit: RNC, Type EPC-40-PVC concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. 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, Not Subject to Severe Physical Damage: EMT
 3. Exposed and Subject to Severe Physical Damage: GRC.
 4. Concealed in Ceilings and Interior Walls and Partitions: EMT
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: GRC
 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 in damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
- E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Install surface raceways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Stub-Ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- M. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- N. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- P. 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.
- Q. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- R. 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.
- S. 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.
- T. 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.
- U. Surface Raceways:
 - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway

section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- V. 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.
- W. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by NFPA 70.
- X. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- Y. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
 - 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
 - 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
 - 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 - 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific

location at time of installation. Install conduit supports to allow for expansion movement.

- Z. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- AA. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements.
- BB. 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.
- CC. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- DD. Locate boxes so that cover or plate will not span different building finishes.
- EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- GG. Set metal floor boxes level and flush with finished floor surface.
- HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Section 312000 "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

3.5 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."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 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

SECTION 260535
LOW VOLTAGE OUTLET BOXES

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Low Voltage Outlet boxes shall be provided for IT devices, AV devices, security devices, special technology outlets, and as otherwise required.
- B. Low Voltage Outlet boxes shall be of sufficient size to provide free space for all conductors/cables enclosed in the box and to not exceed the minimum bend radius for any cable. Boxes shall be not less than the minimum size required by NEC Article 314 for the number and size of conductors contained within.
- C. Contractor shall also meet all Division 1 requirements.

1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled and in accordance with applicable NEMA and ANSI Standards.

1.03 SUBMITTALS

- A. For Review:
 - 1. Product data sheets
 - 2. Layout drawings for television and monitor outlet box locations
- B. To be included in Record and Information Manuals:
 - 1. One (1) copy each of approved submittal

PART 2 PRODUCTS

2.01 LOW VOLTAGE OUTLET BOXES

- A. Flush device boxes in masonry walls to be masonry boxes designed for the purpose with raised covers designed for masonry.
- B. Where outlet boxes are to be cast in concrete slabs, they shall be boxes designed for concrete installation.
- C. Flush boxes for data / voice cabling shall be 4-11/16 inches square by 3-1/4 inches deep with one (1) gang plaster ring installed. Outlet boxes shall accommodate 1 inch conduit as required.
- D. Unless otherwise noted, all television and monitor locations shall use an in-wall storage box for both power and low-voltage. This box is intended to provide an organized, recessed space for routing excess cables and for attaching surge

protectors/power conditioners or other interface devices. Wall Box shall be FSR PWB-100 Series.

- E. Flush boxes for audio / video cabling (other than television and monitor locations) shall be 4-11/16 inches square by 3-1/4 inches deep with one (1) gang plaster ring cover installed. Coverplates shall be blank stainless steel. Outlet boxes shall have knockouts for 1-1/4 inch conduits, and knockouts for up to 2 inch conduits as required.
- F. Flush boxes for security cabling 4-11/16 inches square by 2-1/8 inches deep with one (1) gang plaster ring cover installed. Coverplates shall be blank stainless steel. Outlet boxes shall accommodate 3/4 inch conduits as required.

PART 3 EXECUTION

3.01 INSTALLATION

- A. All boxes shall be rigidly supported from building structure independent of the conduit system. Boxes cast into masonry or concrete are considered to be rigidly supported. Framing members of suspended ceiling systems shall not be permitted as a support.
- B. Flush boxes shall finish within 1/4 inch of surface of non-combustible materials. Boxes shall not project beyond finished surfaces.
- C. Locations of all outlets are approximate. Final location shall be verified with the Architect in the field prior to installation.
- D. Install knockout closures for unused openings.
- E. Outlet boxes installed on opposite sides of a fire rated wall shall have a minimum of 24 inch spacing between adjacent boxes.
- F. All outlet boxes shall use stud to stud box brackets with far side supports.
- G. "Through-wall" type boxes shall not be used.
- H. Boxes shall not be installed in a "back-to-back" manner. Boxes shall be spaced at least 10 inches apart where in opposite walls within the same stud cavity, unless a sound absorptive barrier is placed between boxes.

END OF SECTION

SECTION 260544
SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Round sleeves.
- 2. Rectangular sleeves.
- 3. Sleeve seal systems.
- 4. Grout.
- 5. Pourable sealants.
- 6. Foam sealants.

- B. 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.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ROUND SLEEVES

- A. Wall Sleeves, Steel:

- 1. Description: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends and integral waterstop.

- B. Wall Sleeves, Cast Iron:

- 1. Description: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop.

C. Pipe Sleeves, PVC:

1. Description: ASTM D1785, Schedule 40.

D. Molded Sleeves, PVC:

1. Description: With nailing flange for attaching to wooden forms.

E. Molded Sleeves, PE or PP:

1. Description: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sheet Metal Sleeves, Galvanized Steel, Round:

1. Description: Galvanized-steel sheet; thickness not less than 0.0239-inch; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

2.2 RECTANGULAR SLEEVES

A. Sheet Metal Sleeves, Galvanized Steel, Rectangular:

1. Description:
 - a. Material: Galvanized sheet steel.
 - b. Minimum Metal Thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness must be 0.052 inch.
 - 2) For sleeve cross-section rectangle perimeter not less than 50 inches or with one or more sides larger than 16 inches, thickness must be 0.138 inch.

2.3 SLEEVE SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable or between raceway and cable.

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 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
 - 1. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
 - 2. Design Mix: 5000-psi, 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
 - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless sleeve seal system is to be installed
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
- C. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
 - 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- D. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- E. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seal systems. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

F. Underground, Exterior-Wall and Floor Penetrations:

1. Install steel pipe sleeves with integral waterstops. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve seal system. Grout sleeve into wall or floor opening.

3.2 INSTALLATION OF RECTANGULAR SLEEVES AND SLEEVE SEALS

- A. Install sleeves in existing walls without compromising structural integrity of walls. Do not cut structural elements without reinforcing the wall to maintain the designed weight bearing and wall stiffness.
- B. Install conduits and cable with no crossings within the sleeve.
- C. Fill opening around conduits and cables with expanding foam without leaving voids.
- D. Provide metal sheet covering at both wall surfaces and finish to match surrounding surfaces. Metal sheet must be same material as sleeve.

3.3 INSTALLATION OF SLEEVE SEAL SYSTEMS

- A. Install sleeve seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

END OF SECTION

SECTION 260553
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. Labels.
 - 2. Tapes and stencils.
 - 3. Tags.
 - 4. Signs.
 - 5. Cable ties.
 - 6. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.

- E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color shall be factory applied.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Color for Neutral: White.
 - 5. Color for Equipment Grounds: Bare copper or Green.
 - 6. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:
 - 1. Black letters on an orange field.
 - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
 - 1. Identify system voltage with black letters on an orange background.
- E. Warning labels and signs shall include, but are not limited to, the following legends:
 - 1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:

1. Black letters on a white field.
- 2.

2.3 LABELS

- A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, flexible label with acrylic pressure-sensitive adhesive.
 1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

2.4 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape:
 1. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 2. Color and Printing:

- a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
- 3. Tape For Data, Service and Feeder Duct Banks:
 - a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, compounded for direct-burial service.
 - b. Width: 3 inches.
 - c. Overall Thickness: 5 mils.
 - d. Foil Core Thickness: 0.35 mil.
 - e. Weight: 28 lb/1000 sq. ft.
 - f. Tensile according to ASTM D882: 70 lbf and 4600 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 SIGNS

- A. Laminated Acrylic or Melamine Plastic Signs:
 - 1. Engraved legend.
 - 2. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with white letters on a dark gray background.
 - d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting Self-adhesive.
 - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.6 CABLE TIES

- A. UV-Stabilized Cable Ties for exterior use: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 1. Secure tight to surface of conductor, cable, or raceway.

- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
- L. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- M. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- N. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- O. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- P. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- Q. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- R. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- S. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use

multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

2. Install underground-line warning tape for direct-buried cables and cables in raceways.

T. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

U. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:
 1. "EMERGENCY POWER."
 2. "POWER."
 3. "UPS."
 4. .
- E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels or self-adhesive vinyl tape to identify the phase.

1. Locate identification 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.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.
- H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- J. Workspace Indication: Apply floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.
 1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
- M. Arc Flash Warning Labeling: Self-adhesive labels.
- N. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.
- O. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.
- P. Equipment Identification Labels:
 1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
 2. Outdoor Equipment: Laminated acrylic or melamine sign.

3. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchgear.
- e. Emergency system boxes and enclosures.
- f. Motor-control centers.
- g. Enclosed switches.
- h. Enclosed circuit breakers.
- i. Enclosed controllers.
- j. Variable-speed controllers.
- k. Push-button stations.
- l. Power-transfer equipment.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Power-generating units.

END OF SECTION

SECTION 260610
CABLE TRAY FOR COMMUNICATIONS SYSTEM

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Contractor shall furnish and install a complete cable tray system routed as shown on the Drawings and herein specified. Cable tray shall be a continuous run around any and all obstructions. Provide all hangers, splice hardware, wall brackets, wall sleeves, dropouts, and other hardware as required for a complete system.
- B. Cable tray is intended for voice, data, audio, and video cables only. All other systems shall have cabling run in conduits.
- C. Contractor shall also meet all Division 1 requirements.

1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled in accordance with applicable NEMA and ANSI Standards and meet NEC Article 392. Cable tray shall meet NEMA VE1-1991.

1.03 SUBMITTALS

- A. For Review:
 - 1. Product data sheets of cable tray and accessories.
 - 2. Dimensioned layout Drawings showing all cable tray sections, and support location. Include all HVAC ductwork and piping, fire protection, plumbing and roof drain piping where crossing cable tray for coordination purposes.
- B. To be included in Record and Information Manuals:
 - 1. One (1) copy of each approved submittal.

PART 2 PRODUCTS

2.01 CABLE TRAY

- A. Cable tray shall be wire mesh construction of galvanized steel. Wire shall be spot welded at all intersections. Tray shall utilize a double wire construction for side rails. All straight sections and fittings shall be assembled with bolted connections. Hardware shall be zinc plated. Cable tray supports shall be of the trapeze type with threaded rod. Use L-brackets for supporting cable tray from wall.
- B. Unless otherwise noted on the Drawings, cable tray width shall be minimum 12 inches and cable tray depth shall be minimum 4 inches.
- C. All straight sections shall be provided in standard 10 foot sections.

- D. Wall sleeves shall be constructed of steel and equal in dimension to accommodate the cable tray.
- E. Connect conduits in exposed areas directly to the cable tray to conceal cabling.

2.02 MANUFACTURERS

- A. Wire Mesh Cable Tray
 - 1. Eaton FlexTray

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall install cable tray and components in accordance with Manufacturer's written instructions and EIA/TIA Standards.
- B. Coordinate layout of cable tray including specific routing and mounting elevations with building structure and work of other Trades.
- C. Cable trays are for low voltage voice/data/audio/video security cables only. No other cables, including other low voltage cables for fire alarm, HVAC, etc. are permitted in tray.
- D. Install wall sleeves where tray passes through non-fired rated walls.
- E. Install cable tray from building structure. Cable tray shall be located above suspended lay-in ceilings but below HVAC ductwork and piping systems, unless otherwise noted. Cable tray shall be supported a maximum of every 5 feet.
- F. Ground all sections of cable trays with a No. 6 AWG copper conductor bonded to building steel every 100 feet. Cable tray shall not be used as an equipment grounding means.
- G. Conduits extended to cable trays shall be secured to the tray with a metal clamping device. Provide grounding bushing on conduit end. If the clamping device does not firmly bond the conduit, run No. 12 AWG bonding jumper to cable tray.
- H. Cable trays shall not penetrate fire rated walls, fire rated floors, and smoke barriers. Stop trays at the wall/floor on each side and penetrate the wall/floor with STI EZ-Path multi-gang fire-rated cable pathway (or approved equivalent) as noted below. Where bottom of pathway is installed more than 2 inches above bottom of cable tray, provide radius control modules for each pathway. Provide multi-gang wall brackets and modular floor grids as required.
 - 1. 6 inch wide cable tray - two (2) EZ-Path Series 44+
 - 2. 12 inch wide cable tray - three (3) EZ-Path Series 44+
 - 3. 18 inch wide cable tray - four (4) EZ-Path Series 44+
 - 4. 24 inch wide cable tray - five (5) EZ-Path Series 44+

- I. Cable trays shall be kept a minimum of 12 inches away from power wiring or luminaire ballasts.
- J. Install cable trays with a minimum of 8 inches clearance above.
- K. When cutting cable tray, use wire cutters that make flush cuts without burrs. Shard wire is not acceptable and should be filed smooth to avoid injury to person and damage to cable.

END OF SECTION

SECTION 260710
VOICE/DATA SYSTEMS RACEWAY

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Contractor shall furnish and install outlet boxes, conduits, raceways, risers, service lateral conduits and backboards for voice/data systems raceways.
- B. Conduit stub-ups shall be provided in rooms with lay-in acoustic tile ceilings. In all other rooms, provide continuous conduit runs to nearest lay-in ceiling in corridors or directly to telecom rooms.
- C. Contractor shall also meet all Division 1 requirements.

1.02 DEFINITIONS

- A. MDF (Main Distribution Frame)
 - 1. The MDF is the primary telecommunications room. This location shall be designed as the network core of the facility and shall be centrally located to optimize connectivity with building Network Locations. All Network Locations in this facility shall connect directly to this distribution frame. External network connectivity shall terminate to this distribution frame.
- B. IDF (Intermediate Distribution Frame)
 - 1. The IDF is the secondary telecommunications room. This location shall be designed to serve the network cable termination needs of a specific building area. This service area may be the entire floor the distribution frame resides on, or a portion of that floor. This IDF shall be centrally located to the area it is designed to serve. The MDF will function as the IDF in smaller deployments.
- C. NC (Network Closet)
 - 1. This location shall be designed to serve the network cable termination needs of a specific building area. It shall be utilized when the size of the network deployment is limited in scope (being defined as all network equipment fitting into a full size rack).
- D. NE (Network Enclosure)
 - 1. This stand-alone location shall be designed to serve the network cable termination needs of a specific building area. It shall be utilized when the size of the network deployment is limited in scope (being defined as all network equipment fitting into a full-size cabinet), and a permanent installation is impractical or impossible.
- E. NETLOC (Network Location)
 - 1. Any combination of MDF, IDF, NC or NE.

PART 2 PRODUCTS

2.01 OUTLET BOXES AND PLATES

- A. Refer to Section 26 05 35, "Low Voltage Outlet Boxes".

2.02 CONDUITS

- A. Conduits from voice/data outlet boxes shall be minimum 1 inch.
- B. Conduits and conduit sleeves run between voice/data terminal closets shall be 4 inches.
- C. Conduits run underground as service lateral raceway shall be 4 inches.
- D. All intra-building conduits shall be electrical metallic tubing (EMT).
- E. Refer to Section 26 05 43, "Underground Raceways" and Section 26 05 33, "Conduit and Fittings."

2.03 PULL BOXES

- A. Pull boxes shall be of the following minimum dimensions for conduit sizes as shown:
 - 1. 1 inch conduit – 6" W x 12" L x 3" D
 - 2. 1-1/4 inch conduit – 12" W x 12" L x 4" D
 - 3. 3 inch conduit – 24" W x 24" L x 5" D
 - 4. 4 inch conduit – 12" W x 48" L x 6" D
- B. Pull boxes shall be galvanized or baked enamel steel with screw covers.

2.04 VOICE/DATA WALL FIELD BOARDS

- A. Service lateral conduits and riser conduits and sleeves shall terminate onto plywood voice/data wall field boards. Boards shall be of 4 feet by 8 feet by 3/4 inch fire retardant plywood mounted vertically in room with bottom at 12 inches AFF. Plywood shall be AC grade or better and void-free with Grade A surface exposed. Plywood shall be painted "battleship gray" on all sides with two (2) coats of fire-retardant paint, leaving "Fire Retardant" stamp exposed.

2.05 WALL SLEEVES

- A. Provide sleeve through walls from corridor into rooms where wall goes up to deck above.
- B. EZ-Path "Smoke and Acoustic Reclosable Cable Pathway" shall be utilized in smoke partitions.

2.06 ROOF SLEEVE

- A. Provide appropriate weather tight roof penetration sleeve for Emergency Responder Radio Repeater System cabling to roof mounted antennas.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Provide four (4) 4 inch schedule 80 PVC conduits as service lateral raceways underground from communication service provider point to entrance facility in building. Conduits shall enter through the foundation and extend 12 inches AFF.
 - 1. Industry standard removable seal shall cover the conduit to prevent infiltration by moisture or animals from entering.
 - 2. Industry standard removable seal shall cover the conduit after any cabling installation or removal.
 - 3. The four conduits shall be split into two (2) pairs, and in each pair one conduit is for Owner use and one conduit is for telecom vendor use.
 - 4. The path of the conduit pair shall be as diverse as is possible.
 - a. The pairs shall egress the MDF toward opposite sides of the building.
 - b. The pairs shall head towards different telecom utility connection points if available.
 - c. The path of each pair of conduits shall be at least 25 feet apart.
 - 5. Each conduit shall extend to a conduit-specific hand hole approximately 5 feet outside the building.
 - 6. Each conduit shall have 3'6" of ground cover at the point of exit.
 - 7. The conduits shall never be combined, by hand hole or other means, at any point in their path.
- B. Campus buildings shall be connected via 4 inch schedule 80 PVC conduit, which contains innerduct, terminating in the MDF of each building. Conduit path and installation shall adhere to all local codes, and be coordinated between Owner, Architect/Engineer, and Contractor. Diversity of paths, where feasible, shall follow guidelines set forth in paragraph above.
- C. Provide a minimum of two 4 inch conduits from each voice/data telecom room to above ceiling of main corridor or to cable tray system.
- D. Provide conduit stub-ups from each outlet location to above accessible ceiling space. Provide continuous conduits across exposed areas or areas of inaccessible ceilings. Provide conduits between isolated areas of accessible ceilings to provide a continuous pathway for wiring from main equipment location to each device. Floor outlets in slab on grade shall have conduits run up nearest column or wall to above accessible ceiling. Poke through type outlets shall have conduits run to above ceiling of main corridor on the floor below.
- E. All conduit elbows shall have the following minimum bend radius:

1 inch conduit	-	9 inches
1-1/4 inch conduit	-	12 inches
3 inch conduit	-	36 inches
4 inch conduit	-	48 inches
- F. Conduits for outlets shown exterior to the building shall be continuous from the outlet box back to the telecommunications room for the use of exterior rated cable.

- G. All conduits shall have a pull string installed with a minimum test rating of 200 pounds. Restore all fire ratings of walls, floors, and ceilings penetrated by conduits.
- H. Provide a pull box in each conduit run that exceeds 100 feet in length. All pull boxes shall have straight through conduit entrance and exit. Pull boxes shall be installed in accessible locations.
- I. Conduit runs shall have a maximum aggregate of bends of 180 degrees (e.g., two 90 degree bends) with no single bend greater than 90 degrees. Conduit bends must be long and sweeping.
- J. Provide a blank coverplate on all outlet boxes without completed devices.
- K. Network Locations have been located such that all outlets shall have a maximum of 90 meters of cable length. Install outlet conduits in the shortest manner possible to avoid exceeding this cable length.
- L. All conduits shall be labeled with destination and purpose.
- M. Conduit intended for fiber cabling shall use innerduct and the fiber shall ride therein.
- N. Conduit entering a distribution frame or Network Closet from the floor shall be stubbed in 12 inches AFF.
- O. Conduit entering a distribution frame or Network Closet from the ceiling shall extend no less than 4 inches below finished ceiling.
- P. Conduit entering a distribution frame or Network Closet from the wall shall extend no less than 2 inches with bushings, and least 8'6" AFF.
- Q. Conduit shall be grounded, as necessary, according to the TIA/EIA-607 standard.
- R. Conduit shall be designed as N+1, whereas the following is true:
 - 1. "N" is the conduits necessary to carry all designed network data cables.
 - a. These conduits shall not exceed a fill ratio of 40%.
 - 2. "1" is an additional conduit left intentionally empty for future needs.

END OF SECTION

SECTION 260711
AUDIO/VIDEO SYSTEMS RACEWAY

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Contractor shall furnish and install outlet boxes, conduits, and raceways for audio/video systems.
- B. Conduit stub-ups shall be provided in rooms with lay-in acoustic tile ceilings. In all other rooms, provide continuous conduit runs to cable tray in nearest lay-in ceiling in corridors or directly to telecom rooms.
- C. Contractor shall also meet all Division 1 requirements.

PART 2 PRODUCTS

2.01 OUTLET BOXES AND PLATES

- A. Refer to Section 26 05 35, "Low Voltage Outlet Boxes".

2.02 CONDUITS

- A. Conduits from outlet boxes shall be 1-1/4 inch for video cabling.
- B. Separate conduits shall be run for loudspeaker cabling, line level and communication cabling, microphone level cabling, control and data cabling, and RF cabling to provide signal separation and prevent noise and cross talk.
- C. Conduits used only for loudspeaker cabling, line level and communication cabling, microphone level cabling, control and data cabling, and RF cabling shall be minimum 3/4 inch.
- D. Refer to Section 26 05 33, "Conduit and Fittings."

2.03 PULL BOXES

- A. Pull boxes shall be of the following minimum dimensions for conduit sizes as shown:
 - 1. 3/4 inch conduit - 4" W x 12" L x 3" D
 - 2. 1 inch conduit - 6" W x 12" L x 3" D
 - 3. 1-1/4 inch conduit - 12" W x 12" L x 4" D
 - 4. 3 inch conduit - 24" W x 24" L x 5" D
 - 5. 4 inch conduit - 12" W x 48" L x 6" D
- B. Pull boxes shall be galvanized or baked enamel steel with screw covers.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Contractor shall provide conduit stub-ups from each outlet location to above accessible ceiling space. Provide continuous conduits across exposed areas or areas of inaccessible ceilings. Provide conduits between isolated areas of accessible ceilings to provide a continuous pathway for wiring from main equipment location to each outlet. Floor outlets in slab on grade shall have conduits run up nearest column or wall to above accessible ceiling. Poke through type outlets shall have conduits run to above ceiling of main corridor on the floor below.
- B. All conduit elbows shall have the following minimum bend radius:
 - 1. 3/4 inch conduit - 5 inches
 - 2. 1 inch conduit - 9 inches
 - 3. 1-1/4 inch conduit - 12 inches
 - 4. 2 inch conduit - 18 inches
 - 5. 3 inch conduit - 36 inches
 - 6. 4 inch conduit - 48 inches
- C. All conduits shall have a pull cord installed.
- D. Restore all fire ratings of walls, floors, and ceilings penetrated by conduits.
- E. Provide a pull box in each conduit run that exceeds 100 feet in length. All pull boxes shall have straight through conduit entrance and exit. Pull boxes shall be installed in accessible locations.
- F. Conduit runs shall have a maximum of three 90 degree bends.
- G. Provide a blank coverplate on all outlet boxes without completed devices.

END OF SECTION

SECTION 260923
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Indoor occupancy and vacancy sensors.
 - 2. Switchbox-mounted occupancy sensors.
 - 3. Lighting contactors.
 - 4. Conductors and cables.
- B. Related Requirements:
 - 1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.
- B. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - 2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. General Requirements for Sensors:
 - 1. Wall Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 - 2. Dual technology.
 - 3. Separate power pack.
 - 4. Hardwired connection to switch.
 - 5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 6. Operation:
 - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 - 7. Sensor Output: Sensor is powered from the power pack.
 - 8. Power: Line voltage.
 - 9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 - 10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 12. Bypass Switch: Override the "on" function in case of sensor failure.
- B. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.

2.2 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox using hardwired connection.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.
- B. Wall-Switch Sensor:
1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft..
 2. Sensing Technology: Dual technology - PIR and ultrasonic.
 3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."
 4. Capable of controlling load in three-way application.
 5. Voltage: Match the circuit voltage.
 6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
 9. Color: coordinate with architect.

10. Faceplate: Color matched to switch.

2.3 LIGHTING CONTACTORS

- A. Description: Electrically operated and electrically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
 - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 - 3. Enclosure: Comply with NEMA 250.
 - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.4 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 INSTALLATION OF CONTACTORS

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's written instructions.
- D. Size conductors in accordance with lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- B. Lighting control devices will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

3.8 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

SECTION 262726
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.

1.2 SUMMARY

- A. Section Includes:
 - 1. Standard-grade receptacles, 125 V, 20 A.
 - 2. GFCI receptacles, 125 V, 20 A.
 - 3. Toggle switches, 120/277 V, 20 A.
 - 4. Occupancy sensors.
 - 5. Wall-box dimmers.
 - 6. Wall plates.
 - 7. Floor service fittings.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- F. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. Comply with NFPA 70.
- C. RoHS compliant.
- D. Comply with NEMA WD 1.
- E. Devices for Owner-Furnished Equipment:
 - 1. Receptacles: Match plug configurations.
- F. Device Color:
 - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. SPD Devices: Blue.
- G. Wall Plate Color: For plastic covers, match device color.
- H. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

- A. Duplex Receptacles, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498 and FS W-C-596.
- B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:
 - 1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.
 - 3. Standards: Comply with UL 498.
 - 4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.3 GFCI RECEPTACLES, 125 V, 20 A

- A. Duplex GFCI Receptacles, 125 V, 20 A:
 - 1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
 - 2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

2.4 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 1. Standards: Comply with UL 20 and FS W-S-896.
- B. Two-Pole Switches, 120/277 V, 20 A Insert drawing designation:
 1. Comply with UL 20 and FS W-S-896.
- C. Three-Way Switches, 120/277 V, 20 A:
 1. Comply with UL 20 and FS W-S-896.
- D. Four-Way Switches, 120/277 V, 20 A:
 1. Standards: Comply with UL 20 and FS W-S-896.

2.6 OCCUPANCY SENSORS

- A. Wall Switch Sensor Light Switch, Dual Technology:
 1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
 2. Standards: Comply with UL 20.
 3. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
 4. Connections: RJ-45 communications outlet.

2.7 DIMMERS

- A. Wall-Box Dimmers:
 1. Description: Modular, full-wave, solid-state dimmer switch with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
 2. Control: Continuously adjustable slider; with single-pole or three-way switching.
 3. Standards: Comply with UL 1472.

- a. 600 W; dimmers shall require no derating when ganged with other devices.
4. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.8 WALL PLATES

- A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
- B. Single and combination types shall match corresponding wiring devices.
 1. Plate-Securing Screws: Metal with head color to match plate finish.
 2. Material for Finished Spaces: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
 3. Material for Unfinished Spaces: Galvanized steel.
 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FLOOR SERVICE FITTINGS

- A. Flush-Type Floor Service Fittings:
 1. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
 2. Compartments: Barrier separates power from voice and data communication cabling.
 3. Service Plate and Cover: Rectangular, with satin finish.
 4. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
 5. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."
- B. Flap-Type Service Fittings:
 1. Description: Type: Modular, flap-type, dual-service units suitable for wiring method used, with flaps flush with finished floor.
 2. Compartments: Barrier separates power from voice and data communication cabling.
 3. Flaps: Rectangular, with satin finish.
 4. Service Plate: Same finish as flaps.
 5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
 6. Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for twisted pair cable, complying with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtail 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.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "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. Test Instruments: Use instruments that comply with UL 1436.

- B. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- C. Perform the following tests and inspections:
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- D. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- E. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz.
- F. Wiring device will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION

SECTION 262816
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Molded-case circuit breakers (MCCBs).
 - 4. Molded-case switches.
 - 5. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 FIELD 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 and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.9 WARRANTY

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

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, 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 an NRTL, and marked for intended location and application.
- D. Comply with NFPA 70.

2.2 FUSIBLE SWITCHES

- A. Type HD, Heavy Duty:
 - 1. Single throw.
 - 2. Three pole.
 - 3. 600-V ac.
 - 4. 1200 A and smaller.
 - 5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate fuses.
 - 6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Accessories:
 - 1. Equipment Ground Kit where required: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit where required: 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 NONFUSIBLE SWITCHES

- A. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- B. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- C. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Lugs: Mechanical type, suitable for number, size, and conductor material.
4. Service-Rated Switches: Labeled for use as service equipment.

2.4 MOLDED-CASE CIRCUIT BREAKERS

- A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 167 deg F rated wire.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.
 4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

- L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
- M. Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 - 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.5 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: The enclosure shall be gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1) gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (NEMA 250 Types 3R, 12) a brush finish on Type 304 stainless steel (NEMA 250 Type 4-4X stainless steel).
- C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 2. Outdoor Locations: NEMA 250, Type 3R.
 3. Wash-Down Areas: NEMA 250, Type 4X,.
 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.3 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- D. Install fuses in fusible devices.
- E. Comply with NFPA 70 and NECA 1.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 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.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections for Switches:
 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.

- b. Inspect anchorage, alignment, grounding, and clearances.
- c. Verify that the unit is clean.
- d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
- e. Verify that fuse sizes and types match the Specifications and Drawings.
- f. Verify that each fuse has adequate mechanical support and contact integrity.
- g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
- i. Verify correct phase barrier installation.
- j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

- e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

- a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
- b. Inspect physical and mechanical condition.
- c. Inspect anchorage, alignment, grounding, and clearances.
- d. Verify that the unit is clean.
- e. Operate the circuit breaker to ensure smooth operation.
- f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
- g. Inspect operating mechanism, contacts, and chutes in unsealed units.
- h. Perform adjustments for final protective device settings in accordance with the coordination study.

2. Electrical Tests:

- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
- c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published

- data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
- d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
 - f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- 5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.
 - 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges

END OF SECTION

SECTION 262913.03
MANUAL AND MAGNETIC MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Manual motor controllers.
 - 2. Enclosed full-voltage magnetic motor controllers.
 - 3. Combination full-voltage magnetic motor controllers.
 - 4. Enclosures.
 - 5. Accessories.
 - 6. Identification.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each type of magnetic controller.

1. Include plans, elevations, sections, and mounting details.
2. Indicate dimensions, weights, required clearances, and location and size of each field connection.
3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
 - a. Listing document proving Type 2 coordination.
7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Routine maintenance requirements for magnetic controllers and installed components.
 - b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
 - c. Manufacturer's written instructions for setting field-adjustable overload relays.
 - d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
 - e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

1.7 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than 23 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet for electromagnetic and manual devices.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.

2.2 MANUAL MOTOR CONTROLLERS

- A. Motor-Starting Switches (MSS): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.
 - 1. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- B. Fractional Horsepower Manual Controllers (FHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Overload Relays: NEMA ICS 2, bimetallic class as schedule on Drawings.
- C. Integral Horsepower Manual Controllers (IHPMC): "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.
 - 1. Overload Relays: NEMA ICS 2, bimetallic class as scheduled on Drawings.

2.3 ENCLOSED FULL-VOLTAGE MAGNETIC MOTOR CONTROLLERS

- A. Description: Across-the-line start, electrically held, for nominal system voltage of 600-V ac and less.
- B. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- C. Configuration: Nonreversing.
- D. Contactor Coils: Pressure-encapsulated type.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- E. Control Power:
 - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
- F. Overload Relays:
 - 1. Thermal Overload Relays:
 - a. Inverse-time-current characteristic.
 - b. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
 - 2. Solid-State Overload Relay:
 - a. Switch or dial selectable for motor-running overload protection.
 - b. Sensors in each phase.

2.4 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- C. Configuration: Nonreversing.
- D. Contactor Coils: Pressure-encapsulated type.
 - 1. Operating Voltage: Manufacturer's standard, unless indicated.
- E. Control Power:
 - 1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.

F. Overload Relays:

1. Thermal Overload Relays:

- a. Inverse-time-current characteristic.
- b. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.

2. Solid-State Overload Relay:

- a. Switch or dial selectable for motor-running overload protection.
- b. Sensors in each phase.

G. Fusible Disconnecting Means:

- 1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
- 2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

H. MCCB Disconnecting Means:

- 1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
- 2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- 3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

2.5 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

2.6 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
 - 1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
 - a. Push Buttons: As indicated in the controller schedule.
 - b. Pilot Lights: As indicated in the controller schedule.

- B. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

2.7 IDENTIFICATION

- A. Controller Nameplates: Laminated acrylic or melamine plastic signs, as described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
 - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
 - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
 - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 - 1) Location designation.
 - 2) Nominal voltage.
 - 3) Flash protection boundary.
 - 4) Hazard risk category.
 - 5) Incident energy.
 - 6) Working distance.
 - 7) Engineering report number, revision number, and issue date.
 - b. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks

complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.

- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
 - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
 - 2. Visual and Mechanical Inspection:
 - a. Compare equipment nameplate data with drawings and specifications.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, and grounding.
 - d. Verify the unit is clean.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION

SECTION 265119
LED INTERIOR 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 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 - 1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
- B. Provide luminaires from a single manufacturer for each luminaire type.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Ambient Temperature: 5 to 104 deg F.
 - 1. Relative Humidity: Zero to 95 percent.
- B. Altitude: Sea level to 1000 feet

2.2 LUMINAIRE REQUIREMENTS

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

- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels 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 characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.

2.3 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
 - 1. Attached to structural members in walls
 - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
 - 1. Ceiling Mount:
 - a. Two 5/32-inch diameter aircraft cable supports adjustable to 10 feet in length.
 - b. Pendant mount with 5/32-inch- diameter aircraft cable supports adjustable to] [10 feet in length.
 - c. Hook mount.
 - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
 - 3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
 - 4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
 - 5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 265213
EMERGENCY AND EXIT 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. Exit signs.
 - 2. Materials.
 - 3. Luminaire support components.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
- B. Product Schedule:
 - 1. For exit signs. Use same designations indicated on Drawings.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.7 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- 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. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with NFPA 70 and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body.
 - 1. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 2. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.

- c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet.
- 3. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
- 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
- 5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.

2.2 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. Operating at nominal voltage of 120 V ac.
 - 2. Lamps for AC Operation:
 - a. LEDs; 50,000 hours minimum rated lamp life.
 - 3. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.3 MATERIALS

- A. Metal Parts:
 - 1. Free of burrs and sharp corners and edges.
 - 2. Sheet metal components shall be steel unless otherwise indicated.
 - 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
 - 1. Smooth operating, free of light leakage under operating conditions.
 - 2. Designed to permit relamping without use of tools.
 - 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- C. Housings: as scheduled

2.4 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- D. Wall-Mounted Luminaire Support:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- 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. Support with approved outlet box and accessories that hold stem and provide

damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

F. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service:

1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.

3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.

- a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

2. Conduct short-duration tests on all emergency lighting.

END OF SECTION

SECTION 27 00 00
COMMUNICATIONS INTRODUCTORY STATEMENT

PART 1 GENERAL

1.01 REQUIREMENTS

- A. All work included under this heading is subject to the Bidding Requirements, the Instructions to Bidders, the General Conditions, and/or the Division 1 General Requirements written for this entire Specification and shall apply to all work herein.
- B. In addition to conforming to the documents listed in Paragraph 1.01A above, the Work performed by the Contractor shall conform to all provisions of Sections 27 00 00 through 27 99 99 as included and made part of this Specification.
- C. Owner will furnish and install all network equipment (routers, switches, WAPs, phones, and other similar network gear). Owner will bring the network service to the building live.
- D. Contractor shall also meet all Division 1 requirements.

1.02 APPLICABLE SECTIONS

- A. Contractor shall perform work described in the preceding paragraphs, and in the following Sections (as included):

03 30 00	Cast-in Place Concrete
26 00 10	Coordination Between Trades
26 00 11	Coordination with Utility Companies
26 00 55	Sleeves, Seals and Firestops
26 05 10	Wire and Cable
26 05 26	Grounding & Bonding
26 05 27	Telecommunications Bonding Infrastructure
26 05 29	Hangers and Supports
26 05 33	Conduit and Fittings
26 05 34	Outlet Boxes
26 05 35	Low Voltage Outlet Boxes
26 05 36	Pull and Junction Boxes
26 05 43	Underground Raceways

- B. Refer to 26 05 27 Telecommunications Bonding Infrastructure for grounding and bonding requirements.

1.03 RESPONSIBILITY

- A. The Engineer's efforts under this Contract are aimed at designing a project that will be safe during construction and after full completion of the project. The Engineer has no expertise in, and takes no responsibility for, construction means and methods or job site safety during construction, which are exclusively the Contractor's responsibility. Processing and/or approving submittals made by the

Contractor which may contain information related to construction methods or safety issues, or participation in meetings where such issues might be discussed must not be construed as voluntary assumption by the Engineer of any responsibility for safety procedures.

- B. If a conflict occurs between the Drawings and/or the Specifications, immediately call the conflict to the attention of the Architect at least ten (10) days before bids are submitted, so an addendum clarification may be issued. Conflicts not brought to the Architect's attention before bids are due, shall be priced by the Contractor to include the most expensive, highest quality and quantity of the conflicting items in question.

1.04 CONTRACTOR QUALIFICATIONS

- A. The Contractor approved for this project shall meet the following qualifications and provide information as listed.
 - 1. Must be a member of Building Industry Consulting Service International (BICSI) or have at least five (5) years' experience in Telecommunications Industry.
 - 2. A list of a minimum of five (5) projects over \$100,000 that the firm has completed along with contact names and phone numbers of the Owner's Representatives for those projects. At least three (3) of the completed facilities shall have been occupied and in full operation for at least one (1) year.
 - 3. Manufacturers shall have, within 150 miles, a service department of a duly authorized distributor who stocks standard parts on the premises.
 - 4. Refer to individual specification sections for additional qualifications.

1.05 SUBSTITUTIONS

- A. Anixter Inc. is a strategic sourcing partner and can be utilized as a suggested source of supply. For product questions, pricing and availability contact the Anixter Columbus Sales department at 614-210-2526.
- B. The Contract Documents may list components produced by specific manufacturers to denote kind, quality, or performance requirements. The component listed first is the Basis of Design Component. Other listed components are Acceptable Components. If the Bidder includes an Acceptable Component in its Bid, the Bidder is responsible for the costs of coordination and modification required.
- C. If the Bidder proposes to use an article, device, material, equipment, form of construction, fixture, or item other than the Basis of Design or Acceptable Components named in the Specifications, the Bidder shall certify that the proposed item is equal in quality and all aspects of performance and appearance, to the item specified.
 - 1. If approval of a Substitution requires changes to the Contract Documents or affects the work of other trades, the Bidder is responsible for the additional costs, including, but not limited to, changes to the design by the A/E.
- D. The Bidder shall submit its request for Substitution to the A/E no later than 10 days prior to the bid opening, which must include:

1. The name and complete description of the proposed Substitution, including Drawings, performance and test data, and other information necessary for a complete evaluation; and
 2. A statement setting forth any changes that the Proposed Substitution will require in the Contract Documents or the Project.
- E. If the A/E approves the Proposed Substitution, the A/E shall issue an Addendum.
- F. If the A/E does not approve the Proposed Substitution, the A/E shall inform the Bidder of its decision, which is final. The A/E may reject a proposed Substitution because the Bidder failed to provide sufficient information to enable the A/E to completely evaluate the Proposed Substitution without causing a delay in the bid deadline.
- G. Proposed Substitutions received by the A/E less than 10 days prior to the bid deadline shall not be considered.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 NOT USED

END OF SECTION

SECTION 27 10 00
STRUCTURED CABLING

PART 1 GENERAL

1.01 REQUIREMENTS

- A. This document describes the product and execution requirements related to furnishing and installing the Structured Cabling System as shown on the Drawings and specified herein.
- B. Provide all power and pathways required to support the structured cabling and A/V systems.
- C. Contractor shall also meet all Division 1 requirements.

1.02 SCOPE OF WORK

- A. The Structured Cabling Contractor (SCC) shall provide a complete Structured Cabling System (SCS) as defined in this section.
- B. As described elsewhere in these Documents the system consists of fiber optic and copper cabling, and related hardware. In addition to the basic cable plant requirements, the testing and identification requirements are also defined. Finally, racks, enclosures and other related hardware are indicated herein.
- C. The installation shall be of an "Open System," using standard media and layout, standard connections and interfaces. The Contractor shall adhere to this Specification, local and national codes and provide quality workmanship.
- D. This section includes:
 - 1. Network Locations
 - 2. Racks, Enclosures and Cable management
 - 3. Ladder Rack / Cable Tray
 - 4. Backbone cabling
 - 5. Horizontal cabling
 - 6. Patch Panels
 - 7. Faceplates
 - 8. Jacks
 - 9. Work Area Extensions to Device
 - 10. Hangers and Supports
- E. The components used on this project for voice, data, and CATV shall be as identified in Part 2 of this Section.
- F. Unless noted otherwise on the Drawings, for all 4 pair Category cable, this project shall use T568B termination for eight (8) position modular jack pair assignments as specified per the ANSI/TIA 568-C wiring standard. For fiber, follow ANSI/TIA 568-C.3, Optical Fiber Cabling Components Standard, and its published addenda.

- G. All continuous pathways (i.e., conduit, cable tray, raceway, etc.) required to support the cabling shall be provided by Contractor unless indicated otherwise in the Contract Documents.
 - 1. All non-continuous or non-rigid pathways (i.e., J-hooks, inner-duct, etc.) required to support the cabling shall be provided by the SCC under the Structured Cabling System, unless indicated otherwise in the Contract Documents.
 - 2. All ladder rack, cable tray, and related pathway hardware built into Telecommunications Spaces shall be provided by the SCC.
- H. The SCC shall be responsible for providing the racks and enclosures as required and specified herein.
- I. The SCC shall test and label the entire installation as specified and required by the codes and standards.
- J. The SCC shall be responsible for providing the hangers and support system specified herein and shown on the Drawings.
- K. Final sizing and location of J-hooks, hangers, and supports shall be the responsibility of the Contractor. However, NO increases to the bid price and/or the schedule extension shall be allowed due to equipment alterations.
- L. For new installations, J-hooks fill capacity shall not exceed 70% of its rated cable fill capacity (i.e., if J-bracket is rated for 100 cables, no more than 70 shall be installed).
- M. J-hooks are intended for voice, data, video, audio, and security cables only. They are intended for cable routing in areas of less than 100 Category 6 cables. All other low voltage cabling systems, such as building controls, shall have cabling run-ins separate raceway system.
- N. All hangers and support material shall be galvanized or stainless steel, rust free material.
- O. The Telecommunications Contractor shall ensure that the General Contractor and Painting Contractor acknowledge that the painting or over spray of any single or group of 4 pair horizontal telecommunications Category cable is not allowed. Any painted or over sprayed cable(s) shall be completely removed and replaced at the Painting Contractor's expense. No in-line connectors, splices, taps or other repairs will be permitted. Painted cable will not be covered as part of an extended warranty. Painted cable obscures the print legend and can alter the cable's mechanical properties and fire rating. Painted cable compromises its integrity and/or performance. It may act as an accelerant or create an additional smoke hazard in the event of a fire and as such this is considered a life safety issue. Paint contamination and/or removing paint from the cable with a solvent can affect the cable's durability and its electrical characteristics.

1.03 CONTRACTOR QUALIFICATIONS

- A. The SCC must meet the following requirements to be approved for this project. He/she shall meet the following qualifications and provide the information, as listed, in the submittal package:
1. Must be a member of Building Industry Consulting Service International (BICSI) or Engineer approved, other Telecommunications Organization, and shall have at least five (5) years of experience in the business of design, installation, and maintenance of structured cabling systems.
 2. Supply a list of a minimum of five (5) projects over \$100,000 that the firm has completed along with contact names and phone numbers of the Owners' Representatives for those projects. At least three (3) of the completed facilities shall have been occupied and in full operation for at least one (1) year.
 3. The SCC shall maintain a valid and current Corning Preferred Installer Certification.
 4. The SCC shall maintain a valid and current Belden or Panduit Certified Installer Certification.
 5. The SCC shall have, as a direct employee, a minimum of one (1) RCDD on staff. The RCDD must be a full-time employee of the company and must be listed with the company on the BICSI Credential Holder website as a current credential holder. This individual shall review all submittals, RFIs, change order proposals, as-built documents, and shall provide system engineering support and oversight of all field work to ensure system installation is fully compliant with all requirements of ANSI/TIA-568-C, ANSI/TIA-569-D, and all associated TSBs, ANSI/TIA-606-B, labeling, and ANSI/TIA-607-D, bonding, including all addenda.
 6. The SCC's RCDD shall stamp all test results included in the Record and Information Manual and the final (field marked) As-Built Drawings, as being correct and accurate, that are included in the Record and Information Manual.
 7. It is the intent of this contract for the Contractor to provide sole responsibility for material, labor, and service for the communication cabling system. The Contractor shall, at a minimum, staff the project with BICSI certified installers for project foremen and crew leader positions.
 8. The SCC must own or have a current lease agreement for equipment to test up to Category 6A and fiber optic cable. He/she shall supply proof as required above in the submittal package, including latest calibration date. The SCC shall own and operate Fluke Versiv DSX-5000 or an equivalent network cable analyzer.
- B. At the time of bid form submission, the SCC shall submit the following information:
1. The SCC's manufacturer certifications for:
 - a. Twisted pair cabling
 - b. Fiber optic cabling
 - c. Connectivity
 2. The RCDD's BICSI certification. Refer to SCC's Qualifications below.
 3. A listing of the like projects within the last three (3) years. Refer to SCC's Qualifications below.
- C. During the bid review, the SCC may be asked to provide any/or all of the following:
1. A listing of the probable team members

2. BICSI and manufacturer certifications for the installation of the Structured Cable Plant.
 3. Certifications for the installation for any firestopping required under the scope of the Structured Cable Plant installation.
- D. Any/all items listed in paragraph 1.03 subparagraph B.1 or B.2, can and will be checked for authenticity and accuracy. The Owner reserves the right to reject any unauthorized or inaccurate submissions.
- E. Should the SCC either fail or refuse to provide any of the items listed and/or requested in paragraph 1.03 subparagraph B.1 or B.2, the Owner reserves the right to determine the SCC as being not fully responsive and as such discard the bid in its entirety.

1.04 SUBMITTALS

- A. Product Data Sheets
1. All products
 2. Copies of all certifications
- B. Shop Drawings
1. The SCC shall submit the following shop drawings:
 - a. A detailed riser diagram demonstrating the SCC's understanding of the backbone cabling.
 - b. Drawings of any floorboxes with details of the various internal faceplates and their respective contents.
 - c. Drawings of any through floor fittings with details of their contents.
 - d. Layout drawings for cable tray and cable runway (1/16" scale minimum) based on trade coordination efforts indicating anticipated routings based on the coordination among the various trades.
 - e. A temporary as-built drawing shall be submitted to Owner a minimum of 5 days prior to Contractor's request for substantial completion certification. Owner needs this to ensure all devices in the building can be brought live. A final as-built drawing shall be submitted to Owner no more than 10 days following substantial completion/Owner acceptance of building. As-built drawings shall indicate all port numbers and locations.

1.05 DEFINITIONS

- A. MDF (Main Distribution Frame)
1. The MDF is the primary telecommunications room. This location shall be designed as the network core of the facility and shall be centrally located to optimize connectivity with building Network Locations. All Network Locations in this facility shall connect directly to this distribution frame. External network connectivity shall terminate to this distribution frame.
- B. IDF (Intermediate Distribution Frame)
1. The IDF is the secondary telecommunications room. This location shall be designed to serve the network cable termination needs of a specific building area. This service area may be the entire floor the distribution frame resides

on, or a portion of that floor. This IDF shall be centrally located to the area it is designed to serve. The MDF will function as the IDF in smaller deployments.

- C. NC (Network Closet)
 - 1. This location shall be designed to serve the network cable termination needs of a specific building area. It shall be utilized when the size of the network deployment is limited in scope (being defined as all network equipment fitting into a full-size rack).
- D. NE (Network Enclosure)
 - 1. This stand-alone location shall be designed to serve the network cable termination needs of a specific building area. It shall be utilized when the size of the network deployment is limited in scope (being defined as all network equipment fitting into a full-size cabinet), and a permanent installation is impractical or impossible.
- E. NETLOC (Network Location)
 - 1. Any combination of MDF, IDF, NC or NE.

1.06 REFERENCES

- A. ANSI/BICSI 004, Information Communication Technology Design and Implementation Practices for Healthcare institutions and Facilities
- B. ANSI/TIA/EIA-568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components
- C. ANSI/TIA 568-D, Commercial Building Telecommunications Cabling Standard
- D. ANSI/TIA-569-B-2004, Commercial Building Standard for Telecommunications Pathways and Spaces
- E. ANSI/TIA 606-B, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
- F. ANSI/TIA-607-D, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- G. ANSI/TIA-758-B 2012, Customer-owned Outside Plant Telecommunications Cabling Standard
- H. ANSI/ICEA S-83-596-2011, Fiber Optic Premises Distribution Cable
- I. TIA-526-14-B: Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
- J. ANSI/IEEE C2-2002, National Electrical Safety Code
- K. ANSI/NFPA 70-2011, National Electrical Code
- L. ANSI/NFPA 75-2003; Standard for the Protection of Information Technology Equipment

- M. BICSI TDMM, Telecommunications Distribution Methods Manual
- N. FCC 47 CFR Part 76, Cable Television Technical and Operational Standards
- O. NEC-2008 National Electrical Code
- P. NFPA/NESC-2002, National Electrical Safety Code
- Q. NFPA 101-2005, Life Safety Code
- R. Telecordia GR-63, NEBS™ Requirements: Physical Protection
- S. Telecordia GR-1089, Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment

1.07 WARRANTY

- A. The SCC shall provide a minimum twenty (20) year extended Product and Applications Warranty on parts and labor from the Connectivity Manufacturers (certified Contractor Program).

PART 2 PRODUCTS

2.01 NETWORK LOCATIONS (NETLOC: MDF, IDF, NC, NE)

- A. The SCC shall provide plywood backboard as shown on the Drawings. If the Drawings do not indicate where or how much plywood is to be installed, Contractor shall provide, as a minimum, two (2) adjacent walls covered edge-to-edge by 3/4 inch x 4 feet x 8 feet fire retardant plywood, painted "battleship gray" on all sides with two (2) coats of fire retardant paint. Plywood shall be AC grade or better and void-free with Grade A surface exposed. To reduce warping, plywood shall be kiln-dried to a maximum moisture content of 15%.
 - 1. Fire retardant plywood shall be securely fastened to wall such that it can and will support equipment to be mounted. Additionally, it shall be mounted such that the 8 feet edge is perpendicular to the floor. Unless otherwise noted, bottom of plywood shall be mounted 12 inches AFF.
 - 2. Contractor shall cover with masking tape the "Fire Retardant" stamp on the plywood, before painting, and remove tape after painting, so that the inspector can still see the original "Fire Retardant" stamp on the plywood.
 - 3. Cut out plywood around all wiring devices.
- B. The SCC shall provide all equipment required and/or shown on the Drawings to make the Network Location a safe and usable room for the Structured Cabling System.
- C. For fiber optic cable entering from outside or between Network Locations, provide 30 feet of slack on re-closeable storage ring before routing cable to rack for termination in rack mounted fiber panel using LC connectors (unless otherwise noted).

- D. Terminate copper station cable coming from Network Locations or work areas in a standard 19 inch data rack, rack mounted patch panel with 110 type punch down terminations located close to incoming protector unit.
- E. Terminate incoming coaxial cable on backboard. Terminate coax station cable coming from Network Locations or work area on same backboards with "F" connectors.
- F. Install racks, cable management, enclosures, patch panels, ladder racks, cables, and other equipment required in Network Location as shown on Drawings. If no equipment location is indicated, coordinate rack and equipment location with Owner before installing equipment.
- G. Provide Network Location with ladder racking or wire mesh cable tray as shown on Drawings. Fasten ladder racking or cable tray to data racks.
- H. Provide grounding and bonding as specified in Section 26 05 27, "Telecommunications Bonding Infrastructure."
- I. Provide "D" rings for cable routing support on backboards, for feeding cables up or down from ladder rack and/or floor.

2.02 RACKS, ENCLOSURES, AND CABLE MANAGEMENT

- A. Two post network equipment racks nominal 19 inches
 - 1. Manufactured from extruded aluminum. Post dimensions to be 84" tall x 20.3" wide x 3" deep with anchor plates at the top and bottom.
 - 2. Free standing data rack, 45 rack units
 - 3. Floor anchored with minimum of four (4) floor anchors, anchor top of rack to either ladder racking / cable tray above rack or to backboard using angle iron or unistrut
 - 4. Minimum load rating for rack shall be 1,000 lbs. weight capacity
 - 5. EIA-310-D compliant, double sided universal mounting holes #12-24, supply fifty (50) #12-24 equipment mounting screws
 - 6. Basis of Design – Black – Chatsworth Standard Rack 55053-703
 - 7. Basis of Design – Glacier White – Chatsworth Standard Rack 55053-E03
- B. Four post network equipment racks nominal 19 inches, adjustable depth
 - 1. Manufactured from extruded aluminum. Post dimensions to be 84" tall x 20.3" wide with anchor plates at the top and bottom.
 - 2. Free standing data rack, 45 rack units
 - 3. Floor anchored with minimum of four (4) floor anchors, anchor top of rack to either ladder racking above rack or to backboard using angle iron or unistrut
 - 4. Minimum load rating for rack shall be 2,000 lbs. weight capacity
 - 5. EIA-310-D compliant, double sided universal mounting holes #12-24, supply (100) #12-24 equipment mounting screws
 - 6. Basis of Design – Black – Chatsworth Quadra Rack 50120-703
 - 7. Basis of Design – Glacier White – Chatsworth Quadra Rack 50120-E03
- C. Wall Mount Cabinets
 - 1. Chatsworth CUBE-iT System

- a. Basis of Design – 12 RU – Black 11900-724
 - b. Basis of Design – 12 RU – Glacier White 11900-E24
 - c. Basis of Design – 19 RU – Black 11900-736
 - d. Basis of Design – 19 RU – Glacier White 11900-E36
 - e. Basis of Design – 26 RU – Black 11900-748
 - f. Basis of Design – 26 RU – Glacier White 11900-E48
 - 2. Chatsworth CUBE-iT Fan Assemblies
 - a. Mounted bottom right and bottom left in cabinet.
 - b. Fans and Filters (1) 40975-001
 - 1) Replacement Filters (40973-001
 - 3. Chatsworth CUBE-iT Additions – utilized as necessary
 - a. LED Light Kit 12803-701
 - b. Power Strip 15A, (8) 5-15R outlets 12820-701
 - c. Power Strip 20A, (8) 5-20R outlets 12820-705
 - d. Grounding Kit 40159-008
 - e. Grounding Jumper, Green 9' 40159-009
 - f. Floor Install Foot Kit 13483-001
- D. Floor Cabinets
- 1. Chatsworth N-Series TeraFrame Gen 3 Cabinet | 45RU | Square-Punch Rails
 - a. Dimensions: 83.4"H x 31.5"W x 47.2"D
 - b. Brush sealed top cable entry which allows for better management in high capacity cable installations.
 - c. Solid side panels.
 - d. Perforated metal doors (single front, dual rear), with two-point keyed locks.
 - e. Basis of Design – BlackNF7U-113C-C42-1
 - f. Basis of Design – Glacier White NF7U-113C-E42-1
 - 2. Chatsworth F-Series TeraFrame Gen 3 Cabinet | 45RU | Square-Punch Rails
 - a. Dimensions: 84.6"H x 31.5"W x 47.2"D
 - b. PVC protected cable points.
 - c. Better suited for lower capacity cable installations.
 - d. Two side and two top panels.
 - e. Perforated metal doors (single front, dual rear), with two-point keyed locks.
 - f. Basis of Design – BlackFF3U-113C-C42-B
 - g. Basis of Design – Glacier White FF3U-113C-E42-B
 - 3. Chatsworth Click Nut Cage Nuts (#12-24)
 - a. Black Zinc – Qty 25 76544-701
 - b. Black Zinc – Qty 50 76544-702
 - c. Zinc – Qty 25 76544-001
 - d. Zinc – Qty 50 76544-002
- E. Rack Mount Power Strips
- 1. Provide (2) power strips for each equipment rack and floor cabinet.
 - 2. 1U Horizontal Power Strip 20A, (6) front-facing outlet, (6) rear-facing outlets
 - a. Basis of Design - Tripp-Lite RS-1215-20
- F. Rack and Cabinet Lighting
- 1. Basis of Design - Chatsworth 19" 8W Universal Cabinet Light 13393-719
- G. Rack Shelving
- 1. Basis of Design – Chatsworth Standard Double-Sided Shelf 150 lb.

- a. Vented Bottom – Black 11231-719
 - b. Vented Bottom – Glacier White 11231-E19
- H. Rack and Cabinet Mounting Rails
 - 1. Mounting rails in racks and cabinets shall be one of the following:
 - a. square-punched (.375", 9.5mm EIA Standard)
 - b. tapped #12-24 (English)
- I. Vertical Cable Management
 - 1. The vertical cable manager nominal height shall match the height of the rack(s)/frame(s).
 - 2. The vertical cable manager shall bolt to the side of racks/frames with included hardware.
 - 3. The cable manager shall be sized to match cabling requirements. Maximum cable fill shall be calculated by dividing 50% of the usable area within the cable manager by the area of a single cable.
 - 4. Vertical Cable Management shall be installed on both the left and right edges of all 4-post racks.
 - 5. A single vertical cable manager may be used in between bayed racks/frames if it is sized to match cable requirements for both racks/frames.
 - 6. The double-sided vertical cable manager shall be a double-sided H-shaped trough with a front door and a rear door. The double-sided trough shall provide independent front and rear cable pathways. The front and rear sides of the cable manager shall have T-shaped cable guides separated by openings that align with each U space on the rack. The middle of the managers shall be mostly open to allow easy cable pass-through. Three movable mid-sections shall allow attachment of cable management accessories inside the cable manager.
 - 7. The dimensions shall be 84" high x 6" wide x 24.5" deep.
 - 8. Basis of Design – Black – Chatsworth Evolution G2 35521-703
 - 9. Basis of Design – Glacier White – Chatsworth Evolution G2 35521-E03
- J. Horizontal Cable Management
 - 1. Units shall be 1U to 2U construction.
 - 2. Units shall be single sided.
 - 3. Units shall have covers that have a dual hinge technology.
 - 4. Access into and out of the top and bottom of the management shall be finger type construction.
 - 5. Basis of Design – 1U horizontal cable manager – Black: Chatsworth Evolution 35441-701
 - 6. Basis of Design – 1U horizontal cable manager – Glacier White: Chatsworth Evolution 35441-E01
 - 7. Basis of Design – 2U horizontal cable manager – Black: Chatsworth Evolution 35441-702
 - 8. Basis of Design – 2U horizontal cable manager – Glacier White: Chatsworth Evolution 35441-E02

2.03 LADDER RACK / CABLE TRAY

- A. Equipment in this section applies to within the Network Locations. For cable tray to be installed outside of the Network Locations, refer to Specification 26 06 10 "Cable Tray for Communications System".
- B. Ladder rack shall be manufactured from aluminum. Maximum fill is equivalent to TIA recommended maximum fill of 6 inches deep.
- C. Ladder Cable Trays shall consist of two longitudinal members (side rails) with transverse members (rungs) mechanically fastened to the side rails. Rungs shall be spaced 9 inches on center and longitudinal members shall be 4 inches deep. Rung spacing in radiused fittings shall be industry standard 9 inches and measured at the center of the tray's width. Each rung must be capable of supporting a 200 lb. concentrated load at the center of an 18 inch wide cable tray with a safety factor of 1.5. Rungs shall be capable of easy removal, reinstallation, or replacement if necessary.
- D. Straight sections shall be supplied in standard 10 foot lengths.
- E. Cable tray widths shall be 18 inches or as shown on drawings.
- F. Splice plates shall have (4) four nuts and bolts per plate. The resistance of fixed splice connections between adjacent sections of tray shall not exceed 0.00033 ohms. Splice plates shall be furnished with straight sections and fittings. Provide a method of splicing ladder rack sections and fabricated turns together end-to-end or side-to-end to form a continuous pathway.
- G. Vertical-to-horizontal and horizontal-to-vertical 90-degree turns shall be provided as required
- H. Ladder rack supports shall be of the trapeze type. Supports shall be sized to match the width of the ladder rack that is supported. Support design shall allow the support to be placed under the ladder rack at any point mid-span, but not under a ladder rack splice.
- I. Dropouts shall be aluminum sheets with round radius attached to either side stringer or cross member to permit cable exit out of bottom of cable tray. Where cable exits or enters the side of overhead ladder rack to access a rack, frame, cabinet or wall-mounted rack, cabinet or termination field, a radius drop shall be used to guide the cable.
- J. Cable straps used for attaching cable bundles to the ladder rack cross members must be reusable with a hook and loop-style closure, at least 3/4 inch wide, and sized for cable bundles that are 2 inches, 3 inches, or 4 inches in diameter.
- K. Separate different cable media types within the ladder rack pathway. Treat each type of cable media separately when determining cable fill limits.
- L. Any ladder rack or cable tray system shall comply with ANSI/TIA/EIA-568-C.

- M. Approved manufacturer: Eaton Redi-Rail Cable Tray System RSI[hh]A 09SL[ww]
 - 1. [hh] = side wall height (04 – 07) in inches
 - 2. [ww] = tray width (06, 09, 12, 18, 24, 30, 36) in inches
- N. Where approved by Owner and indicated on the drawings, wire basket cable tray may be utilized instead of ladder rack.
 - 1. Approved manufacturer: Eaton Flextray
- O. In distribution frame deployments, where there is a significant fiber installation, the Panduit Fiber Routing system (color: Yellow) shall be utilized.

2.04 BACKBONE CABLING

- A. The SCC shall provide all backbone cabling system as shown on the Drawings and as required to make a complete installation (both copper and fiber).
- B. All fiber optic cabling and components shall be manufactured by Corning. Utilize plenum rated cable as required by local Code. Multi-Mode Fiber (MMF) shall be 50 μ m OM4. Single-Mode Fiber (SMF) shall be 9 μ m OS2. Fiber cabling, when suspended or hanging, must be supported at regular intervals not to exceed 4 feet.
- C. Infrastructure:
 - 1. 1RU Fiber Enclosure
 - a. Corning EDGE 1U Housing, 8 EDGE HD Panel Capacity EDGE-01U
 - 2. 2RU Fiber Enclosure
 - a. Corning EDGE 2U Housing, 24 EDGE HD Panel Capacity EDGE-02U
 - 3. 4RU Fiber Enclosure
 - a. Corning EDGE 4U Housing, 48 EDGE HD Panel Capacity EDGE-04U
- D. Multi-Mode Fiber:
 - 1. MMF MTP Trunk Cable Pre-terminated MTP/MTP
 - a. Plenum EDGE Trunk, 50 μ m OM4
 - b. Basis of Design: Corning G7575xxQPNDUyyyF, xx = Fiber strands, yyy = length in feet
 - 2. MMF MTP Trunk Cable Pre-terminated MTP/Unterminated Loose Tube
 - a. Plenum EDGE Trunk, 50 μ m OM4
 - b. Basis of Design: Corning G0075xxQPN0DPyyyFb, xx = Fiber strands, yyy = length in feet
 - 3. 12 Fiber OM4 LC Connector Module
 - a. Pretium EDGE Solutions Module, 12 fiber, LC/MTP Connector, 50 μ m multimode (OM4)
 - b. Basis of Design: Corning ECM-UM12-05-93Q
 - 4. MMF FuseLite MTP Connector Non-Pinned
 - a. Splice-on MTP connect for un-terminated loose tube MMF
 - b. Basis of Design: Corning SOC-MTP-3N-OMT
- E. Single-Mode Fiber:
 - 1. Interior: MIC Tight-buffered 24 strand
 - a. Reel of SMF indoor plenum rated tight tube
 - b. Basis of Design: Corning 024E81-33131-24

2. Exterior: FREEDM One Tight-buffered 24 strand
 - a. Reel of SMF outdoor plenum rated tight tube
 - b. Basis of Design: Corning 024E8P-31131-29
3. 12 Fiber OS2 LC Module LC Connector Module
 - a. Pretium EDGE Solutions Module, 12 fiber, LC Duplex to MTP Connector, Bend-improved Single-mode (OS2)
 - b. Basis of Design: Corning EDGE-CS12-AE
4. LC SMF Splice-on Connector
 - a. LC Connector for non-terminated SMF strands
 - b. Basis of Design: Corning SOC-LCU-FAN-SM

2.05 HORIZONTAL CABLING

- A. All copper cabling shall be supplied from Belden or Panduit, with Belden as the preferred manufacturer. All copper cabling runs in the facility shall be from the same manufacturer. Copper Station Cabling from the Network Location to the work area jack shall be:
 1. Category 6, UTP, 4 pair, plenum rated approved manufacturers:
 - a. Belden
 - 1) CMP, Plenum Rated, Blue 2413 D15A1000
 - 2) CMP, Riser Rated, Blue 2412 006A1000
 - 3) CMP, Plenum Rated, White 2413 009U1000
 - 4) CMP, Riser Rated, White 2412 009U1000
 - b. Panduit
 - 1) CMP, Plenum Rated, Blue PUP6C04BU-U
 - 2) CMP, Riser Rated, Blue PUR6C04BU-U
 - 3) CMP, Plenum Rated, White PUP6C04WH-WBU-U
 - 4) CMP, Riser Rated, White PUR6C04WH-W
 2. Category 6A, UTP, 4 pair, plenum rated approved manufacturers:
 - a. Belden
 - 1) CMP, Plenum Rated, Yellow 10GXS13 0041000 (Small Diameter)
 - 2) CMP, Riser Rated, Yellow 10GXS12 0041000 (Small Diameter)
 - 3) CMP, Plenum Rated, Purple 10GXS13 0071000 (Small Diameter)
 - 4) CMP, Riser Rated, Purple 10GXS12 0071000 (Small Diameter)
 - 5) CMP, Plenum Rated, Shielded 10GX533 00741000 (Shielded)
 - 6) CMP, Riser Rated, Shielded 10GX52 0071000 (Shielded)
 - b. Panduit
 - 1) CMP, Plenum Rated, Yellow PUP 6ASD04YL-UG (Small Diameter)
 - 2) CMP, Riser Rated, Yellow PUR 6ASD04YL-CG (Small Diameter)
 - 3) CMP, Plenum Rated, Violet PUP 6ASD04*VL-UG (Small Diameter)
 - 4) CMP, Riser Rated, Violet PUR 6ASD04*VL-CG (Small Diameter)
 - 5) CMP, Plenum Rated, Shielded PUFP 6X04VL-UG (Shielded)
 - 6) CMP, Riser Rated, Shielded PUFR 6X04VL-UG (Shielded)
 3. Category 6, UTP, 4 pair, OSP rated approved manufacturers
 - a. Belden OSP6U 0101000
 - b. Panduit PUO6C04
 4. Coaxial cable, RG11 or RG6, plenum rated approved cable manufacturers:
 - a. Belden
 - b. CommScope
 - c. West Penn

- B. Copper station cabling from the Network Location shall be terminated in an eight (8) position Category 6 modular jack using T568B termination for eight (8) position modular jack pair assignments.
- C. Cable colors shall be:
- | <u>Purpose:</u> | <u>Category:</u> | <u>Color:</u> |
|-------------------------------------|------------------|---------------|
| Workstations, Analog Phones or MFDs | | CAT6 UTP |
| White | | Blue or |
| Wireless Access Points | CAT6A UTP | Yellow |
| Video Screens and Systems | CAT6A UTP/STP* | Purple |
- *CAT6A shall be unshielded UTP, unless NETENG requires shielded cable
- D. Copper Cabling Maximum Run Distance:
- | <u>Speed:</u> | <u>Medium:</u> | <u>Linear Measurement:</u> | <u>Technology Maximum:</u> |
|---------------|----------------|----------------------------|----------------------------|
| 1G | CAT6/6A | 85m/279ft | 100m/328ft |
| 2.5G | CAT6/6A | 85m/279ft | 100m/328ft |
| 5G | CAT6/6A | 85m/279ft | 100m/328ft |
| 10G | CAT6A | 85m/279ft | 100m/328ft |
1. The linear measurement is the maximum distance that the Owner will support for the following:
 - a. Inter-Network Location Connection, patch panel to patch panel
 - b. Network Outlet Connection, patch panel to wall, desk, cubicle, or WAP port.
 2. The difference between the Linear Measurement and the Technology Maximum provides a buffer in the event of a measurement error or the need for an exceptionally long patch cable between the port and the device.
- E. Cabling for wireless access point (WAP) shall be one (2) Category 6A cables with a 25 foot figure 8 service loop for each WAP (unless otherwise noted).
- F. Cabling for CCTV indoor Cameras shall be one Category 6 cable with a 10 foot figure 8 service loop for each camera (unless otherwise noted).
- G. For Category 6 installations, cable must meet ANSI/TIA/EIA-568-C.2 Category 6 copper cabling 23-4P UTP specs.
- H. For Category 6A installations, cable must meet ANSI/TIA/EIA-568-C.2 Category 6A copper cabling 23-4P UTP specs.
- I. Cable installations for analog phone service shall be Category 6.
- J. Utilize the same manufacturer for all copper cable and components.
- K. Utilize plenum rated cable as required by local code.
- L. Sound masking speaker cable shall be 18 AWG UTP single pair cable as shown on Drawings.
1. Approved cable manufacturers:
 - a. Belden
 - b. CommScope
 - c. West Penn
 - d. General

- M. Program speaker cable shall be 14 AWG UTP single pair cable as shown on Drawings.
 - 1. Approved cable manufacturers:
 - a. Belden
 - b. CommScope
 - c. West Penn
 - d. General

2.06 PATCH PANELS

- A. Patch panels for Category 6 / 6A cables shall be:
 - 1. Category 6
 - a. 24-port 1U DPA24688TGY
 - b. 48-port 2U DPA48688TGY
 - 2. Category 6A
 - a. 24-port 1U CPPA24FMWBLY
 - b. 48-port 2U CPPA48FMWBLY
- B. Patch panels shall be modular type punchdown style.

2.07 FACEPLATES

- A. Work area faceplates for flush devices in interior partitions shall match the color and material of the wire device faceplates. Work area faceplates for flush devices on concrete block walls shall match others but be "Jumbo" plates. Faceplates shall be modular keystone style, single gang, and have ID windows. Provide color matched blanks in all unused positions.
 - 1. Belden KeyConnect
 - a. 1-port – Electric White AX102660
 - b. 1-port - Almond AX103922
 - c. 2-port – Electric White AX102665
 - d. 2-port – Almond AX103923
 - e. 4-port – Electric White AX102249
 - f. 4-port – Almond AX102248
 - 2. Panduit Keystone
 - a. 1-port –White NK1FNIW
 - b. 1-port – Electric Ivory NK1FNEI
 - c. 2-port –White NK2FNIW
 - d. 2-port – Electric Ivory NK2FNEI
 - e. 4-port –White NK4FNIW
 - f. 4-port – Electric Ivory NK4FNEI
- B. Modular furniture adapter faceplates shall match the color and material of the wire device faceplates. Faceplates for cubicles shall be compatible with the opening size of the cubicle knockouts. Faceplates shall be modular keystone style and have ID windows. Provide color matched blanks in all unused positions.
 - 1. Belden
 - a. 3-port – Electric White AX102291
 - b. 3-port - Almond AX103925
 - c. 4-port – Electric White AX102900
 - d. 4-port – Almond AX103926

2. Panduit	
a. 1-port –White	NK1FNIW
b. 1-port – Electric Ivory	NK1FNEI
c. 2-port –White	NK2FNIW
d. 2-port – Electric Ivory	NK2FNEI
e. 4-port –White	NK4FNIW
f. 4-port – Electric Ivory	NK4FNEI

2.08 JACKS

A. Data jacks for Category 6 cables shall be:	
1. Belden RevConnect	
a. Electric White	RV6MJKUEW-S1
b. Blue	RV6MJKUBL-S1
c. Black	RV6MJKUBK-S1
2. Panduit Mini-Com	
a. Arctic White	CJ688TGAW
b. Blue	CJ688TGBU
c. Black	CJ688TGBL
B. Data jacks for Category 6A cables shall be:	
1. Belden RevConnect	
a. Electric White	RVAMJKUEW-S1
b. Blue	RVAMJKUBL-S1
c. Black	RVAMJKUBK-S1
d. Yellow	RVAMJKUYL-S1
e. Purple	RVAMJKUPR-S1
f. Shielded	RVAMJKSME-S1
2. Panduit Mini-Com	
a. Arctic White	CJ6X88TGAW
b. Blue	CJ6X88TGBU
c. Black	CJ6X88TGBL
d. Yellow	CJ6X88TGYL
e. Violet	CJ6X88TGVL
f. Shielded	CJS6X88TGY
C. Coax jacks shall be:	
1. Belden	
a. Electric White	AX102907
b. Almond	AX102906
2. Panduit	
a. White	CMFSRWHY
b. Electric Ivory	CMFSREIY
D. Blank inserts shall be:	
1. Belden	
a. Electric White	AX102262
b. Almond	AX102261
2. Panduit	
a. Electric White	CMBWH-X
b. Almond	CMBEI-X

- E. 2-port surface mount box (biscuit jack) shall be Belden AX102652 or Panduit CBX2WH-AY.
- F. Belden RevConnect termination tool RVUTT01 shall be used for all Belden RevConnect terminations. Panduit termination tool TGJT shall be used for all Panduit terminations.

2.09 WORK AREA EXTENSIONS TO DEVICE

- A. Patch Cords shall be procured by Owner.
- B. Unless otherwise noted, mounting and installing of work area equipment such as computers, phones printers, etc. are not part of the SCC's scope of work under this Specification.

2.10 HANGERS AND SUPPORTS

- A. J-Hooks
 1. J-hooks shall be at least 1 inch hook size, minimum.
 2. J-hooks shall not be over 4 inch hook size (for locations requiring 100 4-PR Category 6 cables or more, use basket tray).
 3. J-hooks shall be manufactured from Spring Steel. Securable to wall, beam, threaded rod, unistrut, or pipe.
 4. May utilize multi-tier configuration.
 5. J-hooks shall have no sharp edges.
 6. Approved J-Hook Manufacturers:
 - a. Cooper B-Line J-hook
 - b. ERICO, type Cable Cat 21 and 32
 - c. Mag Daddy or approved equivalent
- B. Threaded Rods
 1. Threaded rod is to be attached to building steel in a permanent manner. Minimum size of threaded rod shall be 3/8.
 2. Threaded rods are to be used for J-hook support where required.
 3. When used for wire basket or cable tray support, use threaded rods with a hanger trapeze kit or unistrut to form a trapeze type support for the wire basket or cable tray.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Backbone Cabling Installation
 1. The SCC shall provide labor, supervision, and materials as required for a complete installation of the backbone cabling system which includes, but is not limited to, the cabling to and from the Network Locations, pulling, supporting, terminating, labeling and testing.
 2. Vertical cable runs shall be supported by split cable grip every 20 vertical feet.
- B. Network Location Installation

1. The SCC shall provide labor, supervision, and materials as required for a complete installation of the Network Location and cabling.
 2. The SCC shall route incoming cables to proper location by means of ladder racking, cable tray, and/or backboard. Cable shall be routed neatly (vertical/horizontal) with some slack before termination at the proper location.
- C. Ladder Rack / Cable Tray Installation
1. Horizontal Cable trays shall be suspended 8 feet AFF and be secured to the ceiling, and shall not rely on racks or cabinets for any structural support.
 - a. The cable trays shall run parallel to the front of the racks and cabinets and aligned such that the waterfalls and dropouts (see next item) interact seamlessly with the vertical cable management of the racks and cabinets.
 - b. The cable tray system shall utilize waterfalls or dropouts to facilitate the orderly entrance of cables into the vertical management systems of the racks and cabinets.
 2. Vertical Ladder Racks shall be mounted 18 inches AFF and be connected to the overhead cable tray. They shall be aligned with the Telecom Entrance Facility conduit to create a pathway for entrance circuits into the cable trays and ultimately to the racks and cabinets.
- D. Horizontal Cabling Installation
1. The SCC shall provide labor, supervision, and materials as required for a complete installation of the horizontal cabling system that includes, but is not limited to, cabling from the Network Location to the work area, pulling, supporting, terminating, labeling, and testing.
 2. Cables shall be installed in continuous lengths from work area outlet as a home run to the nearest Network Location on the same floor. There shall be not intermediate termination point between Network Location and work area outlet.
 3. Install all cables according to ANSI/TIA 568-C.0. Extending Ethernet and POE Ethernet cabling distances beyond the 100 meter limit is permitted as an exception using Ethernet extenders for devices such as CCTV cameras, wireless access points, and IP blue light telephones. The cable must be tested to the extender manufacturer's specifications. Only use this exception where noted on the drawings.
- E. Work Area Installation
1. The SCC shall provide labor, supervision, and materials as required for a complete installation of work area that includes, but is not limited to, terminating cable, placing the jacks and modules, faceplates, labeling and testing. For modular furniture applications, the SCC shall pull cabling through systems furniture raceways and make final terminations in the systems furniture panels.
 2. Upon completion of the project, the SCC shall clean work area and leave ready for move-in. He/she shall remove all marks, fingerprints, trash, and other debris from area.
- F. Hangers and Supports Installation
1. Hangers and supports for ladder rack and cable tray shall be supported every 5 feet or less in accordance with ANSI/TIA-569-D. Ladder rack and cable tray shall be supported within 2 feet of every splice and within 2 feet on both/all sides of every intersection. Support ladder rack and cable tray within 2 feet on

- both sides of every change in elevation. Support ladder rack every 2 feet when attached vertically to a wall.
2. Threaded rod for support of hooks and/or trays shall be permanently fastened to structural steel.
 3. J-hooks shall be securely fastened to wall, steel, or pipe and shall not be spaced more than 4 feet on center.
- G. The SCC shall furnish all materials, labor, and supervision required to install and put into service the structured cabling system specified and shown on the Drawings.
- H. The SCC shall be aware that they must coordinate their work with other trades and lack of access to the job site does not relieve them of the responsibility to complete the work as scheduled.
- I. The SCC shall furnish sufficient manpower and resources to finish the project when scheduled for completion. If required, the SCC will work their crew overtime to meet the completion schedule with no additional compensation.
- J. All work shall be done in a professional manner; equipment installed vertical and horizontal; cables pulled neat and aligned, but allowing slack; cables bundled, but no tie wraps shall be used; use hook and loop straps loosely, do not tighten cable bundle.
- K. All conduits pull boxes, junction boxes, AP enclosures, cables, jacks, modules and other devices shall be labeled.
- L. WAPs, both internal and external, are Owner-furnished, Contractor-installed. External WAPs with external antennas shall be mounted inside the facility with 1.5" conduit or sleeve to the building exterior for antenna connectivity.
- M. The Contractor shall schedule a pre-installation/pre-mobilization meeting with the Owner to review the structured cabling scope of work and any questions Contractor has for Owner. This meeting shall occur a minimum of (10) days before work in this section is scheduled to start.
- N. All cables shall be installed, terminated, labeled, and tested a minimum of 10 days prior to Contractor's request for substantial completion certification.
- O. Contractor is responsible for documenting the MAC address of each Wireless Access Point and correlation to installation map.
- P. Owner will provide inspections throughout construction. Actions to correct items identified by inspections shall be at the Contractor's cost and shall not affect the schedule. Owner or a designee will conduct a final walk-through (punch-out) inspection to accept completion of the project. Any items requiring remediation will be provided to the Architect / Engineer.
- Q. Cable Routing
1. The SCC shall avoid electromagnetic interference (EMI) by routing all structured cabling a minimum of:

- a. 4 feet from 480 volt motors and transformers
- b. 12 inches from electrical power distribution cables
- c. 6 inches from fluorescent lighting
2. Horizontal cable shall not exceed 90 meters.
3. Conduits shall have no more than an equivalent of two (2) 90 degree bends allowed in any single run between junction boxes.

R. Labeling

1. All Labels shall be machine generated and include all termination and patch panel locations.
2. All cables shall be labeled on each end with unique matching identification on each end.
3. All faceplates shall have labels inserted under the clear label covers.
4. Row Designation shall be included on any label terminating in and MDF or IDF.
5. Labeling Examples
 - a. Inter-Network Location Copper

Structure:
Room.Row#-Rack#.RU#.Port#

Example:
IDF1.1-1.30.01

Explanation:
IDF1(Room).1(Row)-1(Rack).30(RU).1(Port)
 - b. Inter-Network Location Fiber

Structure:
Room.Row#-Rack#.RU#.ModuleRow#.ModuleLetter.DuplexPort#

Example:
IDF2.1-2.40.01.A.01

Explanation:
IDF2(Room).1(Row)-2(Rack).40(RU).01(ModuleRow).A(ModuleLetter).01(DuplexPort)
 - c. Network Location Patch Panels to Network Outlet Cover Plate (End Stations)
 - 1) Network Outlet Panels use special identification to keep labeling short. We identify the NETLOC, the User Patch Panel (they should be grouped together), and the port number only.
 - 2) The Network Outlet Panels shall be labeled alphabetically beginning with 'A', in each room.
 - 3) The Network Outlet cover plate shall be labeled with the identical identifier.

Structure:Structure:
Room.PanelAlpha.Port#

Example:
IDF2.C.37

Explanation:
IDF2(Room).C(PanelAlpha).01(Port#)

3.02 TESTING

- A. The SCC shall provide a copy of the unaltered certification test reports to the Engineer in both hardcopy and electronic format. The Contractor shall also

provide a copy of the associated Cable Tester's Database Management Software with unedited soft copy.

- B. Upon completion of the balanced twisted-pair cable installation, the SCC shall perform copper cable certification tests on the complete channel for every cable, included but not limited to:
 - 1. Wire map
 - 2. Length
 - 3. Attenuation
 - 4. Near End Cross Talk (NEXT)
 - 5. Attenuation to Crosstalk Ratio (ACR-F)
 - 6. Propagation Delay and Delay Skew
 - 7. Return Loss
 - 8. Power Sum Near End Cross Talk (PSNEXT)
 - 9. Power Sum Equal Level Far End Cross Talk (PSELFEXT)
 - 10. Insertion Loss
- C. Test shall be performed to published standards, including but not limited to, the latest revisions of ANSI/TIA 568-C, ISO/IEC 11802 and other applicable standards at the time of installation.
- D. All UTP/STP field testers shall be factory calibrated each calendar year by the field test equipment manufacturer as stipulated by the manuals provided with the field test unit. The calibration certificate shall be provided to the Engineer for review prior to the start of testing.
- E. All Category 6 permanent links are qualified for linear transmission performance up to 250 MHz and all Category 6A permanent links are qualified for linear transmission performance up to 500 MHz to ensure that high frequency voltage phase and magnitude contributions do not prove cumulative or adversely affect channel performance.
- F. Upon completion of the coaxial cable installation, the SCC shall perform cable certification tests on every cable including, but not limited to:
 - 1. Direct current loop resistance
 - 2. Impedance
 - 3. Length
 - 4. TDR
 - 5. Noise
- G. Upon completion of the fiber optic cable installation, the SCC shall perform optical time domain reflectometer (OTDR) testing and optical loss testing with a light source power meter on every cable.
- H. In addition to any specific tests mentioned here, the SCC shall perform all required testing and documentation to obtain a fully certified installation from the manufacturer.
- I. As may be required for extended applications warranties by the manufacturer, the manufacturer shall provide site inspection services of the installation in completed

and/or in progress. The SCC shall make all necessary arrangements for such site visits.

- J. Upon completion of all installation, termination and testing, the SCC shall review the entire installation with the Engineer and, at the discretion of the Owner, the Owner's authorized representative. At the time of this review, the Contractor shall present the hard copies of all unadulterated test results. The Engineer and Owner will review these test results, assess the installation, and return a written letter of acceptance to the Contractor for the Structured Cabling System.
- K. General Requirements for Testing
 - 1. Outlets, cables, patch panels and associated components shall be fully assembled and labeled prior to field-testing.
 - a. Any testing performed on incomplete systems shall be redone on completion of the work at the expense of the GC.
 - 2. Perform testing on each cabling link (connector to connector), including copper twisted pair, fiber optic (multi-mode and single-mode) and coaxial cabling.
 - 3. Fiber optic Intra-Building Links shall be tested as Tier 1 (defined herein).
 - 4. All fiber optic links including more than one segment shall be tested as Tier 2 (defined herein) whether involving fusion splicing or mechanical connection.
 - 5. Testing shall not include any active devices or passive devices within the link other than cable, connectors, and splices.
 - a. Link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 - 6. In addition to the tests identified in this document, GC shall notify Owner and Architect / Engineer of any additional tests that are deemed necessary to guarantee a fully functional system.
 - a. These tests shall be implemented with additional measurement results recorded at no additional costs.
- L. Test Equipment Requirements
 - 1. Subject to compliance with requirements, available test equipment manufacturers that may be used for testing include, but are not limited to the following:
 - a. Fluke Corporation
 - b. Ideal
 - c. Softing
 - d. Viavi
 - 2. UTP Cable Test Equipment: Category 6 and 6A (Augmented Category 6)
 - 3. The test equipment (tester) shall comply with the accuracy requirements for field testers as defined in ANSI/TIA-1152.
 - 4. The tester, including the appropriate interface adapter, must meet the specified accuracy requirements.
 - a. The accuracy requirements for the permanent link test configuration (baseline accuracy plus adapter contribution) are specified in Table 2 of ANSI/TIA-1152.
 - 1) Level III – Category 6 (250 MHz)
 - 2) Level IV – Category 6A (500MHz) ^[L]_[SEP]
 - 5. The test plug shall fall within the values specified in ANSI/TIA-568-C Annex C for NEXT, FEXT and Return Loss.

6. The tester shall be within the calibration period recommended by the vendor in order to achieve the vendor-specified measurement accuracy.
7. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.
8. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests (detailed in Section 4.2.2 of ANSI/TIA-1152). Any Fail or Fail* result yields a Fail for the link-under-test. In order to achieve an overall Pass condition, the results for each individual test parameter must Pass or Pass*.
9. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter. The test result of a parameter shall be marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer must provide documentation as an aid to interpret results marked with asterisks.

M. Measurement Capabilities

1. Wire Map
2. Length
3. Propagation Delay
4. Delay Skew
5. DC Loop Resistance
6. DC Resistance Unbalance within a pair
7. DC Resistance Unbalance between pairs
8. Insertion Loss
9. NEXT (Near-End Crosstalk)
10. PS NEXT (Power Sum Near-End Crosstalk)
11. ACR-N (Attenuation to Crosstalk Ratio Near-End)
12. PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End)
13. ACR-F (Attenuation to Crosstalk Ratio Far-End)
14. PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End)
15. Return Loss
16. TCL (Transverse Conversion Loss)
17. ELTCTL (Equal Level Transverse Conversion Transfer Loss)
18. Time Domain Reflectometer
19. Time Domain Xtalk Analyzer
20. PS ANEXT (Power Sum Alien Near-End Crosstalk)
21. Average PS ANEXT (Average Power Sum Alien Near-End Crosstalk)
22. PS AACR-F (Power Sum Alien Attenuation to Crosstalk Ratio Far-End)
23. Average PS AACR-F (Average Power Sum Alien Attenuation to Crosstalk Ratio Far-End)

N. Fiber Optic Cable Test Equipment

1. The test equipment shall be within the calibration period recommended by the manufacturer.
2. Fiber optic test jumpers and adapters shall be of high quality and shall not show excessive wear.
3. Optical Loss Test Set
 - a. An OLTS is comprised of two components: an optical light source and an optical power meter. After making a reference measurement, the source and meter are located at opposite ends of the fiber under test. A source and meter may be contained within the same package to enable bi-directional testing without swapping end test equipment.
4. Multimode Optical Fiber Light Source
 - a. Dual LED light sources with central wavelengths of 850nm (30nm) and 1300nm (20nm).
 - b. Output power of -20dB minimum.
 - c. The light source shall meet the launch requirements of ANSI/EIA/TIA-455-50B, Method A. This launch condition can be achieved either within the field test equipment or by use of an external mandrel wrap (as described in clause E.7 of ANSI/TIA-568-C.0) with a Category 1 light source.
5. Singlemode Optical Fiber Light Source
 - a. Dual laser light sources with central wavelengths of 1310nm (20nm) and 1550nm (20nm).
 - b. Output power of -10dB minimum.
6. Power Meter
 - a. 850nm, 1300/1310nm, and 1550nm wavelength test capability.
 - b. Power measurement uncertainty of 0.25dB.
 - c. Store reference power measurement.
 - d. Save at least 100 results in internal memory.
 - e. PC interface (serial or USB).
7. Optical Time Domain Reflectometer (OTDR)
 - a. Internal non-volatile memory and removable memory device with at least 16MB capacity for results storage.
 - b. Serial and USB ports to transfer data to a PC.
8. Multimode OTDR
 - a. Wavelengths of 850nm (20nm) and 1300nm (20nm).
 - b. Event dead zones of 3.7m maximum at 850nm and 1300nm.
 - c. Attenuation dead zones of 10m maximum at 850nm and 13m maximum at 1300nm.
 - d. Distance range at least 2,000m.
 - e. Dynamic range at least 10dB at 850nm and 1300nm.
9. Singlemode OTDR
 - a. Wavelengths of 1310nm (20nm) and 1550nm (20nm).
 - b. Event dead zones of 3.5 m maximum at 1310 nm and 1550 nm.
 - c. Attenuation dead zones of 10m maximum at 1310nm and 12m maximum at 1550nm.
 - d. Distance range not less than 10,000m.
 - e. Dynamic range at least 10dB at 1310nm and 1550nm.
10. Fiber Microscope
 - a. Magnification of 200X or 400X for endface inspection.
 - b. Optional requirements:
 - 1) Video camera systems are preferred.

- 2) Camera probe tips that permit inspection through adapters are preferred.
 - 3) It is preferable to use test equipment capable of saving and reporting the end face image.
- 11. Integrated OLTS, OTDR, and Fiber Microscope
 - a. Test equipment that combines into one instrument an OLTS, an OTDR and a fiber microscope may be used.
- O. UTP Cable Testing
 - 1. Expectations
 - a. Field test UTP cabling upon completion of the installation.
 - b. Every cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard."
 - c. The installed twisted-pair horizontal links shall be tested from the MDF/IDF (ER/TR) in the telecommunications room to the telecommunication wall outlet in the work area against the "Permanent Link" performance specification.
 - d. One hundred percent of the installed cabling links must be tested and must pass the requirements of the standards mentioned above and as further detailed herein.
 - 1) Any failing link must be diagnosed and corrected.
 - 2) The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements.
 - e. The final and passing result of the tests for links shall be provided in the test results documentation (below).
 - f. Field-test instruments shall have the latest software and firmware installed.
 - g. Link test results from the Test Equipment shall be recorded in the test instrument upon completion of each test for subsequent insertion into the administrative documentation (reports) to be provided to Owner.
 - h. Testing shall be performed on each cabling segment (panel to panel, panel to connector or connector to connector).
 - i. Testing of the cabling shall be performed using high-quality test cords of the same Category and manufacturer as the cabling under test.
 - 2. Performance Test Parameters - Category 6 and Category 6A (Augmented Category 6)
 - a. The field test specifications are defined in ANSI/TIA-568-C.2 "Commercial Balanced Twisted-Pair Telecommunications Cabling and Components Standard."
 - b. The test of each link shall contain the following parameters as detailed below.
 - 3. Category 6
 - a. In order to pass the test, measurements at each frequency in the range from 1 MHz through 250 MHz must meet or exceed the limit value determined in the above-mentioned standard.
 - 4. Category 6A (Augmented Category 6)
 - a. In order to pass the test, measurements at each frequency in the range from 1 MHz through 500 MHz must meet or exceed the limit value determined in the above-mentioned standard.

P. Optical Fiber Cable Testing

1. Expectations
 - a. Testing Tiers requirements are as described below, unless indicated otherwise or otherwise required by the Owner.
 - b. Every fiber optic cabling link in the installation shall be tested in accordance with the field test specifications defined in ANSI/TIA/EIA-568-C.0, Generic Telecommunications Cabling for Customer Premises.
 - c. One hundred percent of the installed cabling links must be tested and must pass the requirements as specified within this document.
 - 1) Any failing link must be diagnosed and corrected.
 - 2) The corrective action shall be followed with a new test to prove that the corrected link meets the performance requirements.
 - d. The final and passing result of the tests for links shall be provided in the test results documentation (below).
 - e. The Pass or Fail condition for the link-under-test is determined by the results of the required individual tests.
 - f. A Pass or Fail result for each parameter is determined by comparing the measured values with the specified test limits for that parameter.
 - 1) Loss shall not exceed calculated link loss.
 - g. Tests shall be documented, including OLTS dual wavelength attenuation measurements for multimode and SingleMode links and channels and OTDR traces and event tables for multimode and SingleMode links and channels.
 - h. Tests performed on optical fiber cabling that use a laser or LED in a test set shall be carried out with safety precautions in accordance with ANSI Z136.2.
 - i. Field-test instruments shall have the latest software and firmware installed.
 - j. Link and channel test results from the OLTS and OTDR shall be recorded in the test instrument upon completion of each test for subsequent insertion into the administrative documentation (reports) to be provided to Owner.
 - k. Fiber end faces shall be inspected at 200X or 400X magnification.
 - 1) 200X magnification is ^[1]_{SEP} suitable for inspecting multimode and singlemode fibers.
 - 2) 400X magnification may be used for detailed examination of singlemode fiber.
 - l. l. Scratched, pitted or dirty connectors shall be diagnosed and corrected.
 - 1) End face images shall be recorded in the memory of the test instrument for subsequent insertion into the administrative documentation (reports) to be provided to Owner.
 - m. Testing shall be performed on each cabling segment (connector to connector).
 - n. Testing shall be performed on each cabling channel (equipment to equipment) that is planned for use per Owner instructions.
 - o. Testing of the cabling shall be performed using high-quality test cords of the same fiber type as the cabling under test.
 - 1) The test cords for OLTS testing shall be between 1 m and 5 m in length.
 - 2) The test cords for OTDR testing shall be approximately 100 m for the launch cable and at least 25 m for the receive cable.
2. Performance Test Parameters
 - a. Three tiers of certification are available that vary in thoroughness of infrastructure analysis.
 - 1) Tier 1: optical loss testing (TIA-568.3-D)

- 2) Tier 2: optical loss and OTDR testing
- 3) Tier 3: optical loss and OTDR testing and magnified endface inspection
- 3. Optical Loss Testing (Tiers 1, 2 and 3)
 - a. Backbone link
 - 1) Multimode backbone links shall be tested at 850 nm and 1300 nm in accordance with ANSI/EIA/TIA-526-14A, Method B, One Reference Jumper or the equivalent method.
 - 2) Singlemode backbone links shall be tested at 1310 nm and 1550 nm in accordance with ANSI/TIA/EIA-526-7, Method A.1, One Reference Jumper or the equivalent method.
 - 3) Link attenuation does not include any active devices or passive devices other than cable, connectors, and splices, i.e. link attenuation does not include such devices as optical bypass switches, couplers, repeaters, or optical amplifiers.
 - 4) Use the One Reference Jumper Method specified by ANSI/TIA/EIA-526-14A, Method B and ANSI/TIA/EIA-526-7, Method A.1 or the equivalent method. Follow the procedures established by these standards or application notes to accurately conduct performance testing.
 - 5) Fiber tests from the same cable between the same 2 points shall not vary over .25db from each other.
- 4. OTDR Testing (Tiers 2 and 3)
 - a. Fiber links shall be tested at the appropriate operating wavelengths for anomalies and to ensure uniformity of cable attenuation and connector insertion loss:
 - 1) Multimode: 850nm and 1300nm
 - 2) Singlemode: 1310nm and 1550nm
 - b. Each fiber link and channel shall be tested in both directions.
 - c. A launch cable shall be installed between the OTDR and the first link connection.
 - d. A receive cable shall be installed after the last link connection.
- 5. Magnified Endface Inspection (Tier 3)
 - a. Fibers shall be inspected at 200X or 400X magnification.
 - 1) 200X magnification is suitable for inspecting multimode and singlemode fibers.
 - 2) 400X magnification may be used for detailed examination of singlemode fibers.
- 6. Length Measurement
 - a. The length of each fiber shall be recorded.
 - b. It is preferable that the optical length be measured using an OLTS or OTDR.
- 7. Polarity Testing
 - a. Paired duplex fibers in multi-fiber cables shall be tested to verify polarity in accordance with Clause E.5.3 of ANSI/TIA-568-C.0.
 - 1) The polarity of the paired duplex fibers shall be verified using an OLTS.
- 8. Fiber Optic Cable Test Result Documentation:
 - a. The OLTS and OTDR test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
 - b. The test result records saved by the tester shall be transferred into a database utility that allows for the maintenance, inspection and archiving of these test records.

- c. A guarantee shall be made that these results are transferred to the electronic record unaltered (i.e., as saved in the tester at the end of each test).
- d. The popular 'csv' format (comma separated value format) does not provide adequate protection and shall not be acceptable unless specified by Owner.
- e. The electronic report for the completed job shall be stored and delivered via electronic transfer. The method of electronic transfer shall be specified by Owner at the time of transfer.
- f. Circuit IDs reported by the test instrument shall match the specified label ID.
- g. Summary Test Reports: A copy of the test results shall be provided listing links that have been tested, including the following summary information.
 - 1) The identification of the link in accordance with the naming convention defined in the overall system documentation.
 - 2) The overall Pass/Fail evaluation of the link-under-test.
 - 3) The date and time the test results were saved in the memory of the tester.
- h. General Information to be provided in the electronic data base containing the test result information for each link.
 - 1) The identification of the customer site as identified by Owner.
 - 2) The operator responsible for testing.
 - 3) The overall Pass/Fail evaluation of the link-under-test.
 - 4) The name of the standard selected to execute the stored test results.
 - 5) The value of the NVP of the cable installed (used for length calculations).
 - 6) The date and time the test results were saved in the memory of the tester.
 - 7) The brand name, model and serial number of the tester.
 - 8) The tester software version and the revision of the test standards database in the tester.
- i. Detailed Test results data to be provided in the electronic report for each tested optical fiber must contain the following information.
 - 1) The identification of the link/fiber in accordance with the naming convention defined in the overall system documentation.
 - 2) Tier 1
 - a) The insertion loss (attenuation) measured at each wavelength, the test limit calculated for the corresponding wavelength and the margin (difference between the measured attenuation and the test limit value).
 - b) The link length shall be reported for each optical fiber for which the test limit was calculated based on the formulas above.
 - 3) Tier 2:
 - a) Tier 1 test results.
 - b) The overall OTDR loss (attenuation) and length.
 - c) The OTDR event loss at each wavelength and event location.
 - d) The OTDR trace at each wavelength.
 - 4) Tier 3:
 - a) Tier 1 and 2 test results.
 - b) A picture of the magnified connector endface.
 - c) The pass status based upon visual inspection.

3.03 ACCEPTANCE OF TEST RESULTS

- A. Owner or their designee may, at their discretion, select a random sample of five percent of the installed links.
 - 1. Owner or their designee shall test these randomly selected links, and the results shall be stored in accordance with this document.
 - 2. The results obtained shall be compared to the data provided by the installation contractor.
 - 3. If more than two percent of the sample results differ in terms of the pass/fail determination, the installation contractor under supervision of Owner shall repeat 100-percent testing at no cost to Owner.
- B. Installed cabling links and channels shall be field-tested and pass the test requirements and analysis as described in herein.
 - 1. Any link or channel that fails these requirements shall be diagnosed and corrected (at the expense of the GC and with no delay to the project timeline).
 - 2. Any corrective action shall be documented and followed with a new test to prove that the corrected link or channel meets performance requirements.
 - 3. The final and passing result of the tests for links and channels shall be provided in the test results documentation in accordance with this Section.
- C. Acceptance of the test results shall be provided electronically after the project is fully completed and tested in accordance with Contract Documents and to the satisfaction of the Owner.

END OF SECTION

SECTION 27 41 16
INTEGRATED AUDIO/VIDEO SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.01 REQUIREMENTS

- A. Furnish and install a complete audio/video system in each meeting room, conference room, Crew room, Huddle room, Fitness Center, and Kitchen as shown on the Drawings and as specified herein. Provide all accessories and equipment as necessary for a complete system.
- B. Furnish and install digital signage hardware in locations and quantities indicated on Drawings. Provide all accessories and equipment as necessary for signage distributed throughout facility.
- C. Coordinate all A/V blocking, power, data, and pathway requirements with all impacted trades, including, but not limited to, carpentry, electrical, and structured cabling contractors.
- D. A/V Integrator shall also meet all Division 1 requirements.

1.02 QUALITY ASSURANCE

- A. All equipment shall be UL listed and labeled in accordance with applicable NEMA and ANSI Standards.
- B. Audio/video systems shall meet industry standards and professional practice.

1.03 CONTRACTOR QUALIFICATIONS

- A. Work in this section shall be performed by an Audio Visual Contractor who has at least five (5) years of verifiable direct experience with the devices, equipment and systems of the type and scope specified herein, who has fully staffed and equipped maintenance and repair facility, and who is licensed to perform work of this type in the project jurisdiction. The Audio Visual Contractor is to have a Crestron Certified Programmer on staff. The contractor will also have personnel with CTS, CTS-I and CTS-D designations applicable to their role in the project. Verification of certifications should be submitted with the bid documents.
- B. The Audio-Visual Contractor shall use a sufficient number of skilled workers who are thoroughly trained and experienced in the necessary crafts, who are completely familiar with the specified requirements, and the methods needed for proper performance of the work in this section. These personnel shall have at least three (3) years direct experience in similar work, evidence of which shall be verified in writing with appropriate references.
- C. The Audio-Visual Contractor shall appoint a designated supervisor who shall have at least five (5) years direct experience in similar work and/or a PMP certification. The supervisor shall be present and in responsible charge of all work in the

fabrication shop, on the job site during all phases of the installation, and testing of the system(s). This supervisor shall be the same individual throughout the execution of the work unless illness, loss of personnel, or other reasonable circumstances intervene.

- D. The Owner may request a prospective Audio-Visual Contractor to provide additional information as desired for review by the Owner and Architect to make a determination of the Audio-Visual Contractor's acceptability.
- E. Other contractors bidding this work who cannot meet the above qualifications must employ the services of a qualified Audio-Visual Contractor who meets the above qualifications. This Audio Visual Contractor shall supervise the installation and perform all wiring connections.

1.04 SUBMITTALS

- A. For Review: Completely detailed shop drawings shall be prepared prior to the procurement of equipment or commencement of work. Drawings shall be prepared and submitted on 30 inch x 42 inch paper. Equipment lists, data sheets, etc. shall be 8 1/2 inch x 11 inch size, properly bound into a single or multiple volumes. Include the following:
 - 1. A complete equipment list, with manufacturers' names, model numbers, and quantities of each item.
 - 2. Manufacturer's data sheets on all equipment items.
 - 3. System block diagram(s).
 - 4. Equipment rack layouts showing all rack mounted equipment items.
 - 5. Floor plans, prepared at a scale of not less than 1/8" = 1'-0", showing loudspeaker locations and orientation, wall plates, and all other related device locations.
 - 6. Proposed construction details for all custom fabricated items, including interface panels, patch panels, and wall plates. These details shall show dimensions, materials, finishes and color selection.
 - 7. Riser diagrams showing conduit requirements with pull boxes, outlet boxes, part numbers of cable types used, and number of circuits in each conduit.
 - 8. Electrical power requirements for head-end and ancillary equipment. Include diagrams for any remote control of electrical power, in sufficient detail.
- B. To be included in Record and Information Manuals:
 - 1. One (1) copy of each approved submittal.
 - 2. Certificate of System Completion.
 - 3. Certificate Equipment Receipt.
 - 4. One (1) copy (data and printed) of the complete uncompiled Crestron Program.
 - 5. As-Built System Diagrams

1.05 VENDORS

- A. The Owner reserves the right to approve specific audio-video vendors. The below Vendors have been pre-approved by Owner. Below information has been provided for convenience only and should be verified by Contractor.
 - 1. AVI Systems
 - a. 7139 East Kemper Road, Cincinnati, Ohio 45249

- b. Jason Sizemore, Account Manager
- c. P: (513) 399-8092
- d. M: (927) 818-3811
- e. jason.sizemore@avisystems.com
- 2. Solutionz Inc.
 - a. 901 Bringham Ave., Los Angeles, California 90049
 - b. Paul Mitnick, Sales Account Executive
 - c. P: (234) 303-2300
 - d. M: (216) 470-3783
 - e. pmitnick@solutionzinc.com
- 3. iVideo Technologies
 - a. 6779 Engle Road Suite G, Middleburg Heights, Ohio 44130
 - b. Matt Chorba, Account Manager
 - c. P: (614) 509-2376
 - d. M: (419) 202-8119
 - e. mchorba@ivideo.com

1.06 MANUFACTURERS

- A. See below for approved Manufacturers.
- B. All products shall be the most current model at time of installation.

1.07 WARRANTY

- A. Warranty against defects in material and workmanship in the mounting and the interconnection of permanently installed equipment. This workmanship integration warranty shall be valid for one (1) year. During this period, the integrator shall also provide equipment service and maintenance as needed by Owner. The warranty begins on the date of the Owner's acceptance of system completion. The integrator shall cover the expense of removing, shipping or re-installing serviced equipment. Warranty service provided by the manufacturer for parts and labor is typically performed at the manufacturer's facility. Damage proven to be caused by natural phenomenon, such as flooding, fire, tornado, earthquake, unstable atmospheric conditions, will not be required. This warranty shall not cover consumable items such as batteries or lamps; these are normal use items, which are to be replaced by the customer as needed.
- B. The integrator will honor all manufacturer's warranty terms extending beyond the duration of the first year. The integrator will provide all warranty service and pass the cost of shipping and handling, etc. directly through to the Owner. This additional labor beyond one (1) year will not be covered and will be negotiated between the Owner/Integrator.

PART 2 PRODUCTS

2.01 PROJECTOR/SCREEN

- A. Provide laser light projector sized appropriately for the space as indicated on Drawings.

1. Basis of Design: Sony VPLPHZ10 or Engineer-approved equivalent
- B. Provide electric, ceiling-recessed screen sized appropriately for the space as indicated on Drawings.
 1. Basis of Design: Da-Lite Tensioned Advantage Electrol, or Engineer-approved equivalent

2.02 DISPLAYS

- A. Provide 55" Digital Signage Display with the following features where indicated on the Drawings.
 1. Basis of Design: LG 55LV340C or Engineer-approved equivalent
 - a. Minimum 3-year warranty
 - b. TV Tuner (where applicable)
 - c. Resolution: 1920x1080p Full HD
 - d. Public display mode
 - e. RS-232C control
 - f. Wake On LAN mode
 - g. USB input
 - h. Signage management software
 - i. Average response time: 9ms grey to grey
 - j. Crestron connect certified
- B. Provide 60" Class Commercial Display with the following features where indicated on the Drawings.
 1. Basis of Design: Sony PN-LE601 or Engineer-approved equivalent
 - a. Minimum 3-year warranty
 - b. Resolution: 1920x1080p Full HD
 - c. LED backlight
 - d. Average response time: 4ms grey to grey
 - e. Compatible with Crestron control system
- C. Provide 70" Class Commercial Display with the following features where indicated on the Drawings.
 1. Basis of Design: Sony PN-LE701 or Engineer-approved equivalent
 - a. Minimum 3-year warranty
 - b. Resolution: 1920x1080p Full HD
 - c. LED backlight
 - d. Average response time: 4ms grey to grey
 - e. Compatible with Crestron control system
- D. Provide 80" Class Commercial Display with the following features where indicated on the Drawings.
 1. Basis of Design: Sony PN-LE801 or Engineer-approved equivalent
 - a. Minimum 3-year warranty
 - b. Resolution: 1920x1080p Full HD
 - c. LED backlight
 - d. Average response time: 4ms grey to grey
 - e. Compatible with Crestron control system

- E. Provide 90" Class Commercial Display with the following features where indicated on the Drawings.
 - 1. Basis of Design: Sony PN-LE901 or Engineer-approved equivalent
 - a. Minimum 3-year warranty
 - b. Resolution: 1920x1080p Full HD
 - c. LED backlight
 - d. Average response time: 4ms grey to grey
 - e. Compatible with Crestron control system
- F. Provide 55" Digital Signage displays with the following features where indicated on the Drawings.
 - 1. Basis of Design: LG 55LV340C or Engineer-approved equivalent
 - a. Minimum 3-year warranty
 - b. Resolution: 1920x1080p Full HD
 - c. Public display mode
 - d. RS-232C control
 - e. Wake On LAN mode
 - f. USB input,
 - g. Signage management software
 - h. Average response time: 9 ms grey to grey
 - i. Crestron connect certified
- G. Provide vertical tilt wall mount with above displays and all hardware to complete the installation.
 - 1. Basis of Design: Chief LTM1U
 - a. Display shall be level and professional.
 - b. Provide all mounting hardware to safely mount display to wall.
 - c. Care shall be taken to route and hide all cabling to meet best practices and shall be mechanically fastened into position without damaging of cables.
- H. Provide power strip to power monitor and all devices behind the monitor. Ensure power strip is easily accessible to restart all electric devices.
 - 1. Basis of Design: Tripp-Lite DG115-SI
 - a. (6) Outlets
 - b. 6 feet long cable
 - c. 2100 joule surge separation

2.03 VIDEOCONFERENCING CODEC

- A. For rooms where videoconferencing is required, provide Polycom RealPresence Group Series videoconferencing codec as shown on Drawings.
 - 1. Basis of Design: Polycom RealPresence Group Series 310 and 700 as indicated on Drawings and in the Hardware Schedule

2.04 CAMERA

- A. Provide Polycom Eagle Eye series webcam for video conferencing as indicated on Drawings.
 - 1. For Conference Rooms with videoconferencing, provide Polycom Eagle Eye IV 4x camera.
 - 2. For All-Hands Rooms, provide Polycom Eagle Eye IV 12x camera

2.05 VIDEO SIGNAL EXTENSION

- A. Provide HD Scaling Auto-Switcher and Extender as indicated on Drawings. Crestron scaler shall not be connected to Owner enterprise network.
 - 1. Product shall be Crestron HD-MD-400-C-E

2.06 VIDEO WALL PLATE

- A. Provide Crestron wall plate with input and output jacks in style and quantity indicated on Drawings.

2.07 WIRELESS SCREEN SHARE

- A. Provide Wireless Screen Share device as indicated on Drawings. Device shall not be connected to Owner enterprise network.
 - 1. For small conference rooms and Huddle rooms, product shall be Barco ClickShare CS-100
 - 2. For all other rooms where Wireless Screen Share is shown, product shall be Barco ClickShare CS-200

2.08 AUDIO/VIDEO EQUIPMENT STORAGE

- A. Provide shelf to support Videoconferencing Codec and Camera. Shelf shall be mounted underneath the monitor.
- B. Provide retractable storage panel to support Video Receiver and Wireless Screen Share device. Shelf shall be mounted behind the monitor and shall be easily accessible.
 - 1. Product shall be Chief CSSMP15x10 Sliding Component Storage Panel
- C. For large meeting spaces (All-Hands Rooms), provide in-room equipment rack for equipment storage and operation. Basis of Design: Middle Atlantic MFR Series Rack

2.09 TOUCHSCREEN CONTROL PANEL

- A. Provide Polycom RealPresence Touch panel for user videoconferencing operation where indicated on Drawings.
- B. Provide wired Crestron TSW-1060 10" touch panel for intuitive user room control in rooms with a Crestron Control Processor as indicated on Drawings.

2.10 CONTROL PROCESSOR

- A. Provide Crestron Control system that is compatible with specified wired touch panel. Control system shall be adequately sized to accommodate all inputs and outputs as shown on Drawings.

2.11 CEILING MICROPHONE

- A. Provide ceiling microphone in quantities and locations indicated on Drawings
 - 1. Product shall be Polycom Ceiling Microphone

2.12 CEILING SPEAKERS

- A. Provide Ceiling Loudspeakers for distributed audio coverage over listener areas as shown on Drawings.
 - 1. Basis of Design: JBL Control 26CT 6.5" Loudspeaker Transducer Assemblies

2.13 AUDIO AMPLIFIER

- A. Wherever speakers are called for, provide Audio Amplifier with sufficient power output and channel count to support system deployment as shown on Drawings.

2.14 AUDIO DSP

- A. Provide VOIP Audio DSP where indicated on Drawings. Include connected Biamp phone interface in quantities indicated on Drawings.
 - 1. Product shall be in the Biamp TesiraFORTÉ family
 - a. Supports all inputs and outputs indicated on Drawings
 - b. Supports VOIP phone system
 - c. Compatible with Crestron control system
 - d. Available DSP components shall include (but not be limited to) various forms of: mixers, equalizers, filters, crossovers, dynamics/gain controls, routers, delays, remote controls, meters, generators, onboard logic, and diagnostics.
 - e. Include required power supply (if not included with device)

2.15 DIGITAL SIGNAGE PLAYER

- A. Provide Digital Signage Player mounted behind display in locations and quantities indicated on Drawings.
 - 1. Approved Manufacturers: Scala
 - a. Includes PC Player License and Support
 - b. Dual HD channel player

2.16 CABLE

- A. SPKR - Speaker cable shall be plenum 18 AWG UTP single pair cable as required on Drawings. WestPenn 25224B.
- B. CTRL - Low voltage control cable shall be plenum 4 conductor 22 AWG shielded twisted pair as required on Drawings. Basis of Design: WestPenn 25357B.
- C. HDMI - Provide HDMI patch cables which meet the latest standards and support of 1080p, 3D, 4Kx2K, Deep Color, Dolby TrueHD, DTS HD-Master, Audio Return Channel and Ethernet.
- D. VGA - Provide VGA patch cables which meet requirements for reliable transport of minimum 1920x1200 pixels at 60 Hertz. Patch cables shall include an auxiliary 3.5mm audio connection.
- E. CATEGORY - Provide factory terminated Cat 6 and Cat 6A patch cables with lengths as required.

- F. COAX - Provide RG6 and RG58 as required on Drawings. Basis of Design: West Penn 25806 and West Penn 25812.
- G. Provide minimum 10 foot patch cables for all input plates to connect Owner's equipment.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install audio/video equipment and cable as shown on the Drawings in accordance with manufacturer's written instructions.
- B. Mount displays, speakers, and other equipment in accordance with manufacturer's written instructions. Projector screens and projector mounts shall be installed approximately 2 months before the rest of the A/V installation.
- C. In all conference rooms, all audio-video equipment shall be mounted in a professional and aesthetically pleasing manner. The Auto-Switching Scaler and the Wireless Screen Share device shall be stored behind the in-room display on a sliding component storage panel with a power strip for power distribution. The Video Transmitter shall be mounted underneath the conference room table as indicated on Drawings. For Videoconferencing rooms, the Camera and Video Codec shall be mounted on a shelf directly below the in-room display. In All-Hands rooms, this shelf shall be on the side of the display instead of beneath. Auto-Switching Scaler shall be connected to display via HDMI. Video Transmitter shall be connected to Owner-provided Hayworth cable cubby.
- D. Consult Owner to configure Polycom Codecs per network standards.
- E. Consult Owner for VOIP phone call manager configuration.
- F. Consult Owner for A/V device configuration requirements. Configure all devices to Owner standards.
- G. The audio-video contractor shall purchase, ship, and install monitors, video conference systems, peripheral equipment and control system.
- H. Provide, at no charge to the Owner, a sufficient number of hours of Crestron programming to ensure simple, intuitive, and efficient A/V system and control operation that matches existing owner standards for room control.
- I. Coordinate faceplate colors and finishes with Owner on a per room basis.
- J. The Contractor shall schedule a pre-installation/pre-mobilization meeting with the Owner to review the A/V scope of work and any questions Contractor has for Owner. This meeting shall occur a minimum of (10) days before work in this section is scheduled to start.

3.02 HARDWARE SCHEDULE

- A. Hardware Set 1 – Small Room
 - 1. (1) 60" Class Display
 - 2. (1) Tilt Wall Mount Bracket for Display
 - 3. (1) Surge-protected power strip
 - 4. (1) Crestron HD Scaling Auto-Switcher and Extender
 - 5. (1) Barco Clickshare CSE-100
 - 6. (1) VGA Cable for connection at table
 - 7. (1) HDMI Cable for connection at table
 - 8. (1) Slide-out Component Storage panel, behind display
- B. Hardware Set 2 – Medium Room
 - 1. (1) 70" Class Display
 - 2. (1) Tilt Wall Mount Bracket for Display
 - 3. (1) Surge-protected power strip
 - 4. (1) Crestron HD Scaling Auto-Switcher and Extender
 - 5. (1) Barco Clickshare CSE-200
 - 6. (1) VGA Cable for connection at table
 - 7. (1) HDMI Cable for connection at table
 - 8. (1) Slide-out Component Storage panel, behind display
- C. Hardware Set 3 – Medium Room with Video Conferencing
 - 1. (1) 70" Class Display
 - 2. (1) Tilt Wall Mount Bracket for Display
 - 3. (1) Surge-protected power strip
 - 4. (1) Crestron HD Scaling Auto-Switcher and Extender
 - 5. (1) Barco Clickshare CSE-200
 - 6. (1) VGA Cable for connection at table
 - 7. (1) HDMI Cable for connection at table
 - 8. (1) Slide-out Component Storage panel, behind display
 - 9. (1) Polycom RP Group 310 codec
 - 10. (1) Polycom Eagle Eye IV 4x camera
 - 11. (1) Polycom ceiling microphone
 - 12. (1) Polycom RealPresence Touch Control
 - 13. Ceiling speakers – sized for room
 - 14. Amplifier, sized for room per plans
- D. Hardware Set 4 – Large Room
 - 1. (1) 80" Class Display
 - 2. (1) Tilt Wall Mount Bracket for Display
 - 3. (1) Surge-protected power strip
 - 4. (1) Crestron HD Scaling Auto-Switcher and Extender
 - 5. (1) Barco Clickshare CSE-200
 - 6. (1) VGA Cable for connection at table
 - 7. (1) HDMI Cable for connection at table
 - 8. (1) Slide-out Component Storage panel, behind display
 - 9. Ceiling speakers, sized for room per plans
 - 10. Amplifier, sized for room per plans
 - 11. (1) Coaxial Cable connection at wall box for display

- E. Hardware Set 5 – Large Room with Video Conferencing
 - 1. (1) 80" Class Display
 - 2. (1) Tilt Wall Mount Bracket for Display
 - 3. (1) Surge-protected power strip
 - 4. (1) Crestron HD Scaling Auto-Switcher and Extender
 - 5. (1) Barco Clickshare CSE-200
 - 6. (1) VGA Cable for connection at table
 - 7. (1) HDMI Cable for connection at table
 - 8. (1) Slide-out Component Storage panel, behind display
 - 9. (1) Polycom RP Group 310 codec
 - 10. (1) Polycom Eagle Eye IV 4x camera
 - 11. (2) Polycom ceiling microphones
 - 12. (1) Polycom RealPresence Touch Control
 - 13. Ceiling speakers, sized for room per plans
 - 14. Amplifier, sized for room per plans
 - 15. (1) Coaxial Cable connection at wall box for display

- F. Hardware Set 6 – All Hands Room, Single Space
 - 1. (1) Laser Projector, ceiling mounted, sized for room per plans
 - 2. (1) Tilt Wall Mount Bracket for Display
 - 3. (1) Electrified Projection Screen, ceiling recessed
 - 4. (1) 80" Class Display
 - 5. (1) Surge-protected power strip
 - 6. (1) Slide-out Component Storage panel, behind display
 - 7. (1) Mobile Electronics Cabinet
 - 8. (1) Polycom RP Group 310 with 12x camera
 - 9. (1) Crestron Wall jack, VGA/HDMI, for PC display
 - 10. (1) Barco ClickShare CSE-200
 - 11. (1) Crestron Control system – 10" wired Touch panel
 - 12. (1) Cable TV Input – Crestron Control (input select and channel number, and channel up/down)
 - 13. (1) Biamp Tesira VOIP phone Interface
 - 14. Ceiling microphones, sized for room per plans
 - 15. Ceiling speakers, sized for room per plans
 - 16. Amplifier, sized for room per plans
 - 17. (1) Coaxial Cable connection at wall box for display

- G. Hardware Set 7 – All Hands Room, Divisible Into Two Spaces
 - 1. (2) Laser Projectors, ceiling mounted, sized for room per plans, one per space
 - 2. (2) Tilt Wall Mount Bracket for Display
 - 3. (2) Electrified Projection Screen, ceiling recessed, one per space
 - 4. (2) 80" Class Displays, one per space
 - 5. (2) Surge-protected power strip
 - 6. (2) Slide-out Component Storage panel, behind display
 - 7. (1) Mobile Electronics Cabinet
 - 8. (1) Polycom RP Group 310 with 12x camera, only installed on one side of room
 - 9. (2) Crestron Wall jack, VGA/HDMI, for PC display, one per space
 - 10. (2) Barco ClickShare CSE-200, one per space
 - 11. (2) Crestron Control system – 10" wired Touch panel, , one per space
 - 12. (2) Cable TV Input – Crestron Control (input select and channel number, and channel up/down), one per space

13. (1) Biamp Tesira VOIP phone Interface, with (2) extensions, one per space
 14. Ceiling microphones, sized for room per plans
 15. Ceiling speakers, sized for room per plans
 16. Amplifier, sized for rooms per plans
 17. (1) Coaxial Cable connection at wall box for display
- H. Hardware Set 8 – Crew Room
1. (1) 90" Class Display
 2. (1) Tilt Wall Mount Bracket for Display
 3. (1) Surge-protected power strip
 4. (1) Crestron HD Scaling Auto-Switcher and Extender
 5. (1) Barco Clickshare CSE-200
 6. (1) VGA Cable for connection at table
 7. (1) HDMI Cable for connection at table
 8. (1) Slide-out Component Storage panel, behind display
 9. (1) Coaxial Cable connection at wall box for display
 10. Ceiling speakers, sized for room per plans
 11. Amplifier, sized for room per plans
- I. Hardware Set 9 – Huddle Room
1. (1) 55" Class Display
 2. (1) Tilt Wall Mount Bracket for Display
 3. (1) Surge-protected power strip
 4. (1) Barco Clickshare CSE-100
 5. (1) Slide-out Component Storage panel, behind display
 6. (1) Coaxial Cable connection at wall box for display
- J. Hardware Set 10 – Fitness Room, or Break Room
1. (1) 70" Class Display
 2. (1) Tilt Wall Mount Bracket for Display
 3. (1) Surge-protected power strip
 4. (1) Slide-out Component Storage panel, behind display
 5. (1) Coaxial Cable connection at wall box for display
- K. Hardware Set 11 – Digital Signage
1. (1) 55" Class Display
 2. (1) Tilt Wall Mount Bracket for Display
 3. (1) Surge-protected power strip
 4. (1) Scala Fan Less Dual Channel Player – 2 output
 5. (1) HDMI Cable

3.03 TESTING

- A. Provide a complete functional test of all components in accordance with manufacturer's recommendations.
- B. Operate system for a minimum of seven (7) consecutive days with no problems before claiming contract completion.
- C. Provide, at no charge to the Owner, up to twenty (20) hours of Crestron program changes at any time during the first year after acceptance.

- D. For all projection systems, ensure minimum of 15:1 system contrast ration under normal operating conditions.
- E. Ensure that audio systems provide coverage at listener plane of within +/- 3 dB across entire listener area at 75 dB SPL with a pink noise signal generator and flat response microphone.
- F. Owner will perform a final system test to verify operating parameters.

3.04 EQUIPMENT DEMONSTRATION

- A. After all system tests have been completed, schedule an instruction period with the Owner. Instruction to be provided by manufacturer's authorized field technician. All training sessions shall be recorded and electronically turned over with O&M manuals.
- B. Eight (8) hours of training shall be for general users of the system and may be broken up into multiple sessions as coordinated throughout the construction team and Owner. Training shall include a detailed instruction booklet of basic usage of the system. This booklet shall include detailed instructions and photographs of actual touch panel screen shots and field mounted equipment. Provide enough documentation for all attendees and leave spare manuals in the rack storage drawer.
- C. Eight (8) hours of detailed training for technical staff which is dedicated to technical staff usage and cover common maintenance items and thorough explanation of the system functionality. At this time, a copy of half size Drawings shall be turned over to the Owner directly as well as an electronic copy of the O&M Manuals and PDF Drawings. Instruction shall include:
 - 1. Location of all components of the system and explanation of their function
 - 2. Demonstration of equipment
 - 3. Maintenance and repair procedures
 - 4. Programming procedures
 - 5. Review of documents in Record and Information Manuals
- D. Perform a one-year follow-up preventive maintenance call. At this time, the integrator will do the following:
 - 1. Full functional checkout of the entire system
 - 2. Recalibration of all audio levels
 - 3. Software and firmware upgrades as required by manufacture and then fully test all system components and controls
 - 4. Verify all touch panels controls are still working as originally installed.
 - 5. Assist with questions and provide up to a half day of additional training for new users.
- E. Provide additional programming changes as required by break/fix issues in the programming interacting with system components within two business days of service call. Provide one (1) additional follow up meeting with the Owner's Representative for cosmetic and flow changes to the programming as requested by the Owner.

END OF SECTION