



Facilities Planning & Construction

UNIVERSITY *of* ALASKA ANCHORAGE

INVITATION FOR BID

UAA ANSEP ULA RENOVATION

Anchorage, Alaska

**VOLUME II
TECHNICAL SPECIFICATIONS**

PROJECT NO.: 17-0103

BID NUMBER: 17-09

Building Name: University Lake Annex

Building Number: AO107

ISSUED: April 13, 2017

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SECTION 03 30 53

MISCELLANEOUS CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each concrete mixture.

1.4 QUALITY ASSURANCE

- A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. Comply with the following sections of **ACI 301 (ACI 301M)** unless modified by requirements in the Contract Documents:
 - 1. "General Requirements."
 - 2. "Reinforcement and Reinforcement Supports."
 - 3. "Concrete Mixtures."
 - 4. "Handling, Placing, and Constructing."

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2.3 CONCRETE MATERIALS

- A. Cementitious Materials:

- 1. Portland Cement: ASTM C 150/C 150M, Type I.

- B. Normal-Weight Aggregate: ASTM C 33/C 33M.

- C. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

- 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.

- D. Water: ASTM C 94/C 94M.

2.4 RELATED MATERIALS

- A. Vapor Retarder: Plastic sheet, ASTM E 1745, Class A or B.

2.5 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

- B. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth or cotton mats.

- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

- D. Water: Potable.

2.6 CONCRETE MIXTURES

- A. Comply with ACI 301 (ACI 301M).

- B. Normal-Weight Concrete:

- 1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 - 2. Maximum W/C Ratio: 0.45.
 - 3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
 - 4. Air Content: Maintain within range permitted by ACI 301 (ACI 301M). Do not allow air content of trowel-finished floor slabs to exceed 3 percent.

2.7 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.
 - 1. When air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EMBEDDED ITEM INSTALLATION

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.2 VAPOR-RETARDER INSTALLATION

- A. Install, protect, and repair vapor retarders according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.
 - 1. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended adhesive or joint tape.

3.3 STEEL REINFORCEMENT INSTALLATION

- A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
 - 1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.4 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete to align with existing joints. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch (3.2 mm)**. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch- (3.2-mm-)** wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.5 CONCRETE PLACEMENT

- A. Comply with **ACI 301 (ACI 301M)** for placing concrete.
- B. Do not add water to concrete during delivery, at Project site, or during placement.
- C. Consolidate concrete with mechanical vibrating equipment according to **ACI 301 (ACI 301M)**.

3.6 FINISHING UNFORMED SURFACES

- A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on surface.
 - 1. Do not further disturb surfaces before starting finishing operations.
- C. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, fluid-applied or direct-to-deck-applied membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system.

3.7 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with **ACI 301 (ACI 301M)** for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching **0.2 lb/sq. ft. x h (1 kg/sq. m x h)** before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- D. Curing Methods: Cure formed and unformed concrete for at least seven days by one or a combination of the following methods:
 - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with **12-inch (300-mm)** lap over adjacent absorptive covers.
 - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches (300 mm)**, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Contractor will engage a qualified testing agency to perform tests and inspections.
- B. Tests: Perform according to **ACI 301 (ACI 301M)**.
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding **5 cu. yd. (4 cu. m)**, but less than **25 cu. yd. (19 cu. m)**, plus one set for each additional **50 cu. yd. (38 cu. m)** or fraction thereof.

END OF SECTION 03 30 53

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SECTION 06 10 53

MISCELLANEOUS ROUGH CARPENTRY

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. Wood framing with dimension lumber
 - 2. Wall sheathing.
 - 3. Wood blocking, cants, and nailers.
 - 4. Wood furring
 - 5. Plywood backing panels.
- B. Related Requirements:
 - 1. Division 09 Section "Gypsum Board."

1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NLGA: National Lumber Grades Authority.
 - 2. WCLIB: West Coast Lumber Inspection Bureau.
 - 3. WWPA: Western Wood Products Association.

1.4 ACTION 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. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
 - 1. Preservative-treated wood.
 - 2. Power-driven fasteners.
 - 3. Expansion anchors.
 - 4. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

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.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less, 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2.
 - 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.
- D. Application: Treat items indicated on Drawings, and the following:
 - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - 2. Wood sills, sleepers, blocking, furring, and similar concealed members in contact with masonry or concrete.

2.3 DIMENSION LUMBER FRAMING

- A. Load-Bearing Partitions: No. 2 grade.
 - 1. Application: Exterior walls.
 - 2. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.
- B. Roof Joists: No. 2 grade.
 - 1. Species:
 - a. Douglas fir-larch; WCLIB or WWPA.
 - b. Hem-fir; WCLIB or WWPA.
- C. Other Framing: Construction or No. 2 grade and any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Douglas fir-larch; WCLIB or WWPA.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Douglas fir-south; WWPA.
 - 5. Hem-fir; WCLIB or WWPA.
 - 6. Douglas fir-larch (north); NLGA.
 - 7. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

2.4 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.
 4. Cants.
 5. Furring.
 6. Grounds.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber and any of the following species:
1. Hem-fir (north); NLGA.
 2. Spruce-pine-fir; NLGA.
 3. Hem-fir; WCLIB or WWPA.
 4. Western woods; WCLIB or WWPA.
 5. Northern species; NLGA.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
1. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 2. Northern species, No. 2 Common grade; NLGA.
 3. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.
- D. 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.
- E. 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.

2.5 WALL SHEATHING

- A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2, Exposure 1 sheathing.
1. Span Rating: Not less than 32/16.
 2. Nominal Thickness: Not less than 1/2 inch (13 mm).
- B. Oriented-Strand-Board Sheathing: DOC PS 2, Exposure 1 sheathing.
1. Span Rating: Not less than 32/16.
 2. Nominal Thickness: Not less than 1/2 inch (13 mm).

2.6 PLYWOOD BACKING PANELS

- A. 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 (13-mm) nominal thickness.

2.7 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 Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) 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. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.8 METAL FRAMING ANCHORS

- A. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.
- B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 (Z180) coating designation.
 1. Use for interior locations unless otherwise indicated.
- C. Hot-Dip Heavy-Galvanized Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 (Z550) coating designation; and not less than 0.036 inch (0.9 mm) thick.
 1. Use for wood-preservative-treated lumber and where 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, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- C. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Metal Framing Anchors: Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- F. Do not splice structural members between supports unless otherwise indicated.
- G. 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 (406 mm) o.c.
- H. 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 (2438 mm) 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 (2438 mm) 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 (38-mm actual) thickness.
- I. 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.
- J. Comply with AWP A 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.

- K. 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.
 - 3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
- L. Use steel common 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 WOOD GROUND, BLOCKING, AND NAILER INSTALLATION

- A. Install where indicated and where required for 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.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches (38 mm) wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 ROOF JOIST FRAMING REPAIR INSTALLATION

- A. Roof Joist Repair: Install with crown edge up and complying with requirements specified above for floor joists. Face nail to damaged joist with 10d nails at 6" on center, staggered, and six 10d nails at each end.

3.4 SHEATHING INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. 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. Install fasteners without splitting wood.
- D. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.5 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- B. Fastening Methods: Fasten panels as indicated below:
 - 1. Wall Sheathing:
 - a. Nail to wood framing.
 - b. Space panels $\frac{1}{8}$ inch (3 mm) apart at edges and ends.

3.6 PROTECTION

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

END OF SECTION 06 10 53

SECTION 06 20 13

EXTERIOR FINISH CARPENTRY

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. Lumber siding.
- 2. Panel siding.

- B. Related Requirements:

- 1. Section 09 90 00 "Painting" for priming, backpriming, and painting of exterior finish carpentry.

1.3 DEFINITIONS

- A. MDO: Plywood with a medium-density overlay on the face.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Compliance Certificates:

- 1. For lumber that is not marked with grade stamp.

- B. Sample Warranties: For manufacturer's warranties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

1.7 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecast weather conditions permit work to be performed and at least one coat of specified finish can be applied without exposure to rain, snow, or dampness.
- B. Do not install finish carpentry materials that are wet, moisture damaged, or mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

1.8 WARRANTY

- A. Manufacturer's Warranty for Hardboard Siding: Manufacturer agrees to repair or replace siding that fails in materials or workmanship within specified warranty period. Failures include, but are not limited to, deformation or deterioration beyond normal weathering.
 - 1. Warranty Period for Siding (Excluding Finish): 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated.
- B. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
 - 1. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.

2.2 LUMBER SIDING

- A. Provide kiln-dried lumber siding complying with DOC PS 20.
- B. Species and Grade: Grade B western red cedar; NLGA, WCLIB, or WWPA.

- C. Pattern: Square edge, rough-sawn tongue and groove, actual face width (coverage) and thickness of 1 by 6 inch nominal.

2.3 PANEL PRODUCTS

- A. MDO softwood plywood with solid-wood edge, 1/2 inch thick, conforming to PS 1 standard, with exterior glued veneers.

2.4 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails, in sufficient length to penetrate not less than 1-1/2 inches into wood substrate.
 - 1. For face-fastening siding, provide ringed-shank siding nails or hot-dip galvanized-steel siding nails.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 09 90 00 "Painting."

3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
 - 1. Do not use manufactured units with defective surfaces, sizes, or patterns.
- B. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining exterior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.4 SIDING INSTALLATION

- A. Install siding to comply with manufacturer's written instructions and warranty requirements.
- B. Horizontal Lumber Siding: Align coursing with adjacent siding. Install with tongues up. Face nail into stud backing.
 1. Leave 1/8-inch gap at trim and corners unless otherwise recommended by manufacturer, and apply sealant.
 2. Butt joints only over framing or blocking, nailing top and bottom on each side and staggering joints in subsequent courses.
- C. Finish: Apply finish within two weeks of installation.
- D. Panel Siding: Install MDO panels over firm bearing edges and face nail.

3.5 ADJUSTING

- A. Replace exterior finish carpentry that is damaged or does not comply with requirements. Exterior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.

3.6 CLEANING

- A. Clean exterior finish carpentry on exposed and semiexposed surfaces.

3.7 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

END OF SECTION 06 20 13

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

1.1 RELATED DOCUMENTS

- ## 1.2 SUMMARY

- ### B. Related Requirements:

- ### 1.3 COORDINATION

- ## 1.4 ACTION SUBMITTALS

- B. Samples for Verification: For the following:

- Page 1 of 6

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
 - 1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed/concealed by construction, and indicate measurements on Shop Drawings.
- C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of cabinets indicated for construction, finishes, installation, and other requirements.
 - 1. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Door and Drawer-Front Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.
 - 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. Formica Corporation.
 - b. Pionite; a Panolam Industries International, Inc. brand.
 - c. Wilsonart.
- F. Laminate Cladding for Exposed Surfaces:
 - 1. Horizontal Surfaces: Grade HGS.
 - 2. Vertical Surfaces: Grade VGS.
 - 3. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - 4. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
- G. Materials for Semiexposed Surfaces:
 - 1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
 - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
 - 2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
 - 3. Drawer Bottoms: Thermoset decorative panels.
- H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners.

- J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 percent.
2. Particleboard: ANSI A208.1, Grade M-2.
3. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for Test Methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

- A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
- B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.
- C. Wire Pulls: Back mounted, solid aluminum, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.
- D. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- E. Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted.
 - a. Type: Full extension.
 - b. Material: Zinc-plated steel with polymer rollers.
 2. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
 3. For drawers more than 3 inches high, but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
 4. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
- F. Door Locks: BHMA A156.11, E07121.
- G. Drawer Locks: BHMA A156.11, E07041.
- H. Door and Drawer Silencers: BHMA A156.16, L03011.

- I. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
 - 1. Match satin stainless steel: BHMA 630.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 - 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 - 1. Trial fit assemblies at 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 before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition cabinets to humidity conditions in installation areas for not less than 72 hours.
- B. Verify mechanical, electrical and building items affecting work are placed and ready to receive work.

3.2 INSTALLATION

- A. Grade: Install cabinets to comply with quality standard grade of item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.
- C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.
- D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
 1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
 2. Install cabinets without distortion so doors and drawers fit openings and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
 3. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

3.3 ADJUSTING AND CLEANING

- A. Adjust for maximum offset of true alignment with different adjacent materials to 1/32 inch.
- B. Adjust for true alignment of same materials to flush.
- C. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.
- D. Clean, lubricate, and adjust hardware.
- E. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 41 16

SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Glass-fiber blanket.

- B. Related Requirements:

- 1. Section 09 29 00 "Gypsum Board" for sound attenuation blanket used as acoustic insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

PART 2 - PRODUCTS

2.1 GLASS-FIBER BLANKET (BATT INSULATION)

- A. Glass-Fiber Blanket, Unfaced: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation, including removing projections capable of puncturing insulation or vapor retarders, or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.
- E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.
- F. Fill all joints greater than 1/4-inch with same material.
- G. Do not compress insulation.
- H. Fit insulation tightly on cavities and tightly to exterior side of mechanical and electrical services within plane of insulation.

3.3 INSTALLATION OF INSULATION IN FRAMED CONSTRUCTION

- A. Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. For wood-framed construction, install blankets according to ASTM C.
- B. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:
 - 1. Glass-Fiber Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft..

3.4 PROTECTION

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

END OF SECTION 07 21 00

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SECTION 07 25 00

WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Building wrap.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For water-resistive barrier from ICC-ES.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

- A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. DuPont Building Innovations: E. I. du Pont de Nemours and Company.
 - 2. Allowable UV Exposure Time: Not less than three months.

3. Flame Propagation Test: Materials and construction shall be as tested according to NFPA 285.
 4. Below are Tyvek Commercial Wrap Specs.
 5. Air Penetration: 0.001 cfm/ft² maximum at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677.
 6. Water Vapor Transmission: 40 perms minimum, when tested in accordance with ASTM E96, Method B.
 7. Water Penetration Resistance: No leakage when tested in accordance with AATCC Test Method 127 with a 550 mm hydrostatic head.
 8. Basis Weight: Minimum 5.0 oz/yd².
 9. Tensile Strength: Minimum 38 lbs/in., when tested in accordance with ASTM D828, Method A.
 10. Surface Burning Characteristics: Class A, when tested in accordance with ASTM E84.
- B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

- A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.
- B. Cover sheathing with water-resistive barrier as follows:
1. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.
- C. Building Wrap: Comply with manufacturer's written instructions and warranty requirements.
1. Seal seams, edges, fasteners, and penetrations with tape.
 2. Extend into jambs of openings and seal corners with tape.

END OF SECTION 07 25 00

SECTION 07 26 00

VAPOR RETARDERS

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. Polyethylene vapor retarders.

- B. Related Requirements:

- 1. Section 07 21 00 "Thermal Insulation" for vapor retarders integral with insulation products.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D 4397, [~~6-mil-~~] [**10-mil-**] thick sheet, with maximum permeance rating of 0.1 perm.

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on warm side of insulation.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates.
- C. Install without joints in new sheets. Tie into adjacent vapor retarders.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 07 26 00

SECTION 07 92 00

JOINT SEALANTS

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. Silicone joint sealants.
 - 2. Mildew-resistant joint sealants.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Installation Instructions: Indicate special procedures, surface preparations, and perimeter conditions requiring special attention.
- B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials in compliance with manufacturer's written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 FIELD 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. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period indicated below:
1. Warranty Period: 20 years from date of Substantial Completion for silicone sealants.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from 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 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

- A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning; 791,
 - b. Pecora Corp.; 895
 - c. Tremco, Inc.; Spectrum 2.
 - 2. Applications: Applications as follows:
 - a. Interior horizontal and vertical joints from metal to metal.
 - b. Wood to metal joints.
 - c. Wood to gypsum board joints.
 - d. Wood to wood joints.
 - e. Metal to gypsum board joints.

2.3 URETHANE JOINT SEALANTS

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
- B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing or neutral curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dow Corning; 786
 - b. Pecora Corp.; 898
 - c. Tremco, Inc.; Tremsil 200
 - 2. Applications: Applications as follows:
 - a. Ceramic tile joints.
 - b. Plastic laminate to ceramic tile joints.
 - c. Plastic laminate to gypsum board joints.
 - d. Plumbing fixtures to wall joints.
 - e. Joints in plastic wall panels.

2.5 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, O (open-cell material), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. 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. 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 performance of the Work.
- 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, 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. Unglazed surfaces of ceramic tile.
 3. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glass.
 - c. Glazed surfaces of ceramic tile.
 - d. Plastic laminate.
 - e. Plastic wall panels.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by 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 or primer 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. Do not use solvent curing sealants in enclosed, occupied spaces.
- C. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Oversize backing 30 to 50 percent of joint width.
 2. Do not leave gaps between ends of sealant backings.
 3. Do not stretch, twist, puncture, or tear sealant backings.
 4. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

- F. 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.
- G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs 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 profile per Figure 8A in ASTM C 1193 unless otherwise indicated.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 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.
- B. Repair or replace defaced or disfigured finishes caused by work of this Section.

3.5 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 07 92 00

SECTION 08 11 15

PREFINISHED STEEL DOOR FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Non-rated, shop pre-finished, site assembled steel frames.

1.3 RELATED SECTIONS

- A. Section 08 80 00 - "Glazing" for glass in frames.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, label compliance, and finishes for each type of steel door and frame specified.
- B. Shop Drawings: In addition to requirements below, provide a schedule of frames using same reference numbers for details and openings as those on Drawings:
 - 1. Frame details for each frame type, including dimensioned profiles.
 - 2. Details and locations of reinforcement and preparations for hardware.
 - 3. Details of each different wall opening condition.
 - 4. Details of anchorages, accessories, joints, and connections.
 - 5. Details of glazing frames and stops showing glazing.
- C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.
- D. Samples: Submit two standard frame samples, illustrating factory finished frame colors and surface texture.
- E. Manufacturer's Installation Instructions: Indicate special installation instructions.
- F. Manufacturer's Certificate: Certify that Products meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain prefinished steel door frames through one source from a single manufacturer.
- C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
- B. Store frames under cover at Project site. Avoid using nonvented plastic or canvas shelters that could create a humidity chamber.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
- B. Coordinate frame installation with size, location, and installation of service utilities.
- C. Coordinate work with door opening construction, door frame, and door hardware installation.
- D. Sequence installation to ensure concealed electric wire connections are achieved in an orderly and expeditious manner.

1.8 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Timely Industries, A Division of SDS Industries, Inc.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- D. 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-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.
- E. Glazing: Comply with requirements in Division 08 Section "Glazing."

2.3 STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated.
- C. Frame Profile: Non-rated:
 - 1. "C" Series, 1.2 mm (18 gage) thick.
- D. Side Light Frames: 1.2 mm (18 gage).
- E. Frame Casings:
 - 1. Material: Steel casings with corner alignment clips.
 - 2. Type: Standard Steel, Model TA-8 with 6 mm (1/4 inch) reveal, on steel frames. Fit factory assembled units with MiterGard corner alignment clips.

2.4 ACCESSORIES

- A. Weatherstripping: Specified in Section 08 71 00 – Door Hardware.
- B. Silencers: Specified in Section 08 71 00 – Door Hardware.
- C. Glass Stops: Model TA-14 removable rolled steel, shape, butted ends, countersink style and screws.
- D. Fasteners: Drywall type.

2.5 FABRICATION

- A. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- B. Hardware Reinforcement: Fabricate reinforcement plates for hinges, closers, exit devices, door guards, and other surface mounted hardware.
- C. Silencers:
 - 1. Provide three single silencers for single doors on strike side.
 - 2. Provide two single silencers on frame head at double doors without mullions.

2.6 FINISH

- A. Frame Units: Prefinished with factory applied impact resistant, polyester baked enamel finish.
- B. Casing: Prefinished steel with factory applied impact resistant, polyester baked enamel finish.
- C. Primer: Primer Electro Galvanized.
- D. Colors: As indicated on Drawings.

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 standard steel doors and frames.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Provide frames of sizes, thicknesses, and designs indicated. Install steel frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Steel Frames: Install standard steel frames for doors and sidelights of size and profile indicated.

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. Install frames with removable glazing stops located on secure side of opening.
 - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - c. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
- C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with standard steel door and frame 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.

3.3 ADJUSTING AND CLEANING

- A. Final Adjustments: Remove and replace defective work, including steel frames that are warped, bowed, or otherwise unacceptable.
- B. Touch-up blemishes on finished frames.

END OF SECTION 08 11 13

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SECTION 08 14 16

FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer faces.
 - 2. Factory finishing flush wood doors.
 - 3. Factory fitting flush wood doors to frames and factory machining for hardware.
- B. Related Requirements:
 - 1. Section 08 80 00 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction 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; and the following:
 - 1. Dimensions and locations of blocking.
 - 2. Dimensions and locations of mortises and holes for hardware.
 - 3. Dimensions and locations of cutouts.
 - 4. Undercuts.
 - 5. Requirements for veneer matching.
 - 6. Doors to be factory finished and finish requirements.
- C. Samples for Initial Selection: For factory-finished doors.
- D. Samples for Verification:
 - 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches (200 by 250 mm), 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 finished Work.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.
- B. Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.5 QUALITY ASSURANCE

- A. Do not store doors in damp or wet areas or in areas where sun may bleach veneers. Break seal on site to permit ventilation. Seal top and bottom of doors with tinted sealer.

1.6 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.

1.7 FIELD 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 remainder of construction period.

1.8 WARRANTY

- A. A. Special Warranty: 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 shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 - 3. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Eggers Industries.
 2. Graham Wood Doors; ASSA ABLOY Group company.
 3. Marshfield DoorSystems, Inc.
 4. Mohawk Flush Doors, Inc.
 5. Vancouver Door Company.
 6. VT Industries, Inc.
- B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with AWI's, AWMAC's, and WI's "Architectural Woodwork Standards."
1. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.
 2. Contract Documents contain selections chosen from options in quality standard and additional requirements beyond those of quality standard. Comply with those selections and requirements in addition to quality standard.
- B. WDMA I.S.1-A Performance Grade: Heavy Duty.
- C. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control, based on testing according to UL 1784.
- D. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-2.
 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
 3. Face Adhesive: Type 1 – Waterproof.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
1. Grade: Premium, with Grade AA faces.
 2. Species: Select white ash.
 3. Cut: Plain sliced (flat sliced).
 4. Match between Veneer Leaves: Book match.

5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening.
7. Exposed Vertical Edges: Same species as faces or a compatible species - edge Type A].
8. Core: Particleboard.
9. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.
10. Construction: Seven plies, either bonded or nonbonded construction.

2.4 LIGHT FRAMES

- A. Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish.

2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
 1. Comply with NFPA 80 requirements for fire-rated doors.
 2. Factory apply labels from testing agencies.
- 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, BHMA-156.115-W, and hardware templates.
 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Factory cut and trim openings through doors.
 1. Light Openings: Trim openings with moldings of material and profile indicated.
 2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."

2.6 SHOP PRIMING

- A. Doors for Transparent Finish: Shop prime faces and all four edges with stain (if required), other required pretreatments, and first coat of finish as specified in Section 09 93 00 "Staining and Transparent Finishing." Seal edges of cutouts and mortises with first coat of finish.

2.7 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.
- B. Factory finish doors.

C. Transparent Finish:

1. Grade: Premium.
2. Finish: AWT's, AWMAC's, and WT's "Architectural Woodwork Standards" System 5, conversion varnish.
3. Staining: None required.
4. Effect: Open-grain finish.
5. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
1. Verify that installed 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 Section 08 71 00 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
1. Install smoke- and draft-control doors according to NFPA 105.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. 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 08 14 16

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SECTION 08 42 13

ALUMINUM-FRAMED ENTRANCES

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-swing entrance doors.
- B. Related Requirements:

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.
- B. Shop Drawings: For aluminum-framed entrances. Include plans, elevations, sections, full-size details, and attachments to other work.
 - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
 - 2. Include isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances, showing the following:
 - a. Joinery, including concealed welds.
 - b. Anchorage.
 - c. Glazing.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For aluminum-framed entrances.
- B. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. CMI Architectural.
 - 2. Kawneer North America; an Alcoa company.
 - 3. U.S. Aluminum; a brand of C.R. Laurence.
- B. Entrance Framing: Provide manufacturers standard 1-3/4 inch aluminum profile consisting of one-piece extruded aluminum. Provide with an interior vinyl flashing system to exterior weep holes. System shall provide a 1/2-inch minimum glazing channel where adjacent glazing is indicated.
 - 1. Products: Including, but not limited to the following:
 - a. CMI 452.
 - b. Kawneer 425.
 - c. U.S. Aluminum.
- C. Source Limitations: Obtain all components of aluminum-framed entrance, including framing and accessories, from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

2.3 ENTRANCE DOOR SYSTEMS

- A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing or automatic operation.
 - 1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch- thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - 2. Door Design: Wide stile; 5-inch nominal width.
 - 3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
 - a. Provide nonremovable glazing stops on outside of door.
- B. Framing Members: Manufacturer's standard extruded aluminum, minimum 0.125 inch thick and reinforced as required to support imposed loads.
 - 1. Nominal Size: 1-3/4 by 4-1/2 inches.
- C. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.
- D. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Materials:
 - 1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 - a. Sheet and Plate: ASTM B 209.
 - b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
 - c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
 - d. Structural Profiles: ASTM B 308/B 308M.

2.4 ENTRANCE DOOR HARDWARE

- A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 08 71 00 "Door Hardware."

2.5 GLAZING

- A. Glazing: Comply with Section 08 80 00 "Glazing."
- B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

2.6 ACCESSORIES

- A. Automatic Door Operators: Section 08 71 13 "Automatic Door Operators."
- B. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
 - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
 - 2. Reinforce members as required to receive fastener threads.
 - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- C. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
 - 1. Profiles that are sharp, straight, and free of defects or deformations.
 - 2. Accurately fitted joints with ends coped or mitered.
 - 3. Physical and thermal isolation of glazing from framing members.
 - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
 - 5. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.
- D. Entrance Door Frames: Fabricate components for assembly using shear-block and welded system. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
 - 1. At interior and exterior doors, provide compression weather stripping at fixed stops.
- E. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
- F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

- G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
 - 1. All office and recitation room entrances scheduled as aluminum.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
 - 1. Color: Medium bronze.
 - 2. Interior vestibule entrance.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 - 1. Comply with manufacturer's written instructions.
 - 2. Do not install damaged components.
 - 3. Fit joints to produce hairline joints free of burrs and distortion.
 - 4. Rigidly secure nonmovement joints.
 - 5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
 - 6. Seal perimeter and other joints watertight unless otherwise indicated.
- B. Metal Protection:
 - 1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or installing nonconductive spacers.
 - 2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- C. Install components plumb and true in alignment with established lines and grades.
- D. Install glazing as specified in Section 08 80 00 "Glazing."

- E. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.
 - 1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.
- F. Fill perimeter shim spaces with batt insulation.
- G. Install perimeter joint sealants as specified in Section 07 92 00 "Joint Sealants" to produce weathertight installation. Do not seal over weep holes.

3.3 ADJUSTING AND CLEANING

- A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.
 - 1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch, measured to the leading door edge.
- B. Remove protective material from pre-finished aluminum surfaces.
- C. Wash surfaces with a solution of mild detergent in warm water applied with a soft, clean cloth. Wipe surfaces clean.
- D. Touch up scratched surfaces so no natural aluminum is visible in completed assembly.

3.4 MAINTENANCE SERVICE

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

END OF SECTION 08 42 13

SECTION 08 71 00

DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
 - a. Swinging doors.
2. Cylinders for door hardware specified in other Sections.
3. Electrified door hardware.

B. Related Requirements:

1. Section 08 31 13 "Access Doors and Frames" for access door hardware, except cylinders.
2. Section 08 71 13 "Automatic Door Operators" for low-energy power operators and low-energy power-assist operators.

- C. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.

1. Permanent cores to be installed by Owner.

1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory 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 Representative.
- 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 hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 PREINSTALLATION MEETINGS

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 - 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Door and frame sizes and materials.
 - e. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - f. Fastenings and other installation information.
 - g. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - h. Mounting locations for door hardware.
 - i. List of related door devices specified in other Sections for each door and frame.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of electrified door hardware.
- B. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- C. Affidavit of Coordination: Letter signed by Hardware Supplier stating they have reviewed the drawings and specifications and have coordinated the hardware for completeness, substrates, conditions and project. Submittals submitted without affidavit will be returned without review.
- D. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware schedule.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: Within 2-hour service call range of Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver cores to Owner for keying.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: Three years from date of Substantial Completion unless otherwise indicated below:
 - a. Exit Devices: Two years from date of Substantial Completion.
 - b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. at the tested pressure differential of 0.3-inch wg of water.
- B. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- D. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.3 SCHEDULED DOOR HARDWARE

- A. Provide products for each door that comply with requirements indicated in Part 2 and door hardware schedule.

1. Door hardware is scheduled in Part 3.

2.4 HINGES

- A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Allegion plc.
 - b. Lawrence Hardware Inc.
 - c. McKinney Products Company; an ASSA ABLOY Group company.

- B. Hinge Weight: Unless otherwise indicated, provide the following:

1. Entrance Doors: Heavy-weight hinges.
2. Doors with Closers: Antifriction-bearing hinges.
3. Interior Doors: Standard-weight hinges.

2.5 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 1. Mortise Locks: Minimum 3/4-inch latchbolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.

D. Lock Trim:

1. Description: Schlage Rhodes or similar.
2. Levers: Cast.
3. Escutcheons (Roses): Forged.

E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

F. Mortise Locks: BHMA A156.13; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

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. Allegion plc.
 - b. Best Access Systems; Stanley Security Solutions, Inc.
 - c. SARGENT an ASSA ABLOY Group company.

2.6 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

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. Allegion plc.
 - b. Stanley Security Solutions, Inc.
 - c. Rockwood Manufacturing; an ASSA ABLOY Group company.

2.7 EXIT DEVICES AND AUXILIARY ITEMS

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

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. Allegion plc.
 - b. Precision Hardware, Inc.; a Stanley company.
 - c. SARGENT Manufacturing Company; ASSA ABLOY.

2.8 LOCK CYLINDERS

- A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Best Access Systems; Stanley Security Solutions, Inc., no substitutions.
- B. Standard Lock Cylinders: BHMA A156.5; Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Interchangeable.
- C. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.9 KEYING

- A. Furnish permanent cores to Owner for keying and installation.
- B. Keys: Brass.

2.10 OPERATING TRIM

- A. Operating Trim: BHMA A156.6; stainless steel unless otherwise 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. Allegion plc.
 - b. Hiawatha, Inc; a division of the Activar Construction Products Group.
 - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.11 ACCESSORIES FOR PAIRS OF DOORS

- A. Astragals: BHMA A156.22.

2.12 SURFACE CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
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. Allegion plc.
 - b. Norton Door Controls; an ASSA ABLOY Group company.
 - c. Stanley Commercial Hardware; a division of Stanley Security Solutions.
 2. Construction: Metallic piston bodies and cold weather fluid.
 3. Provide special templates, drop plates, and other offset arms required to coordinate with other hardware.

2.13 MECHANICAL STOPS AND HOLDERS

- A. Wall- and Floor-Mounted Stops: BHMA A156.16.
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. Allegion plc.
 - b. Hager Companies.
 - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.14 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
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. Allegion plc.
 - b. Hager Companies.
 - c. Rixson Specialty Door Controls; an ASSA ABLOY Group company.

2.15 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
 - 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. National Guard Products, Inc.
 - b. Pemko Manufacturing Co.
 - c. Reese Enterprises, Inc.
 - d. Sealeze.
- B. Maximum Air Leakage: When tested according to ASTM E 283 with tested pressure differential of 0.3-inch wg, as follows:
 - 1. Smoke-Rated Gasketing: 0.3 cfm/sq. ft. of door opening.
 - 2. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
- C. Smoke-Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke-control ratings indicated, based on testing according to UL 1784.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

2.16 METAL PROTECTIVE TRIM UNITS

- A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.
 - 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. Allegion plc.
 - b. Hiawatha, Inc; a division of the Activar Construction Products Group.
 - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.

2.17 AUXILIARY DOOR HARDWARE

- A. Auxiliary Hardware: BHMA A156.16.
 - 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. Allegion plc.
 - b. Baldwin Hardware Corporation.
 - c. Rockwood Manufacturing Company; an ASSA ABLOY Group company.
- B. Key Storage Box: Single key storage box for emergency fire department access, surface mounted. Knox Box #3208 as required by Anchorage Fire Department.

2.18 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
 - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.19 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine 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 of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Frames: For surface-applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

- D. Lock Cylinders: Install construction cores to secure building and areas during construction period.
 - 1. Furnish permanent cores to Owner for keying and installation.
- E. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room. Verify location with Architect.
 - 1. Configuration: Provide least number of power supplies required to adequately serve doors with electrified door hardware.
- F. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.
- G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- H. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

3.4 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.

3.5 CLEANING AND PROTECTION

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

3.6 MAINTENANCE SERVICE

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

3.7 DOOR HARDWARE SCHEDULE

Door Hardware Set No. 01

Door No. BB100V2A (Exterior Vestibule Door); each to have the following:

No.	Item	Manufacturer	Description	Finish
1 EA.	AUTO DOOR OPENER	STH	MAGIC FORCE	MEDIUM BRONZE

REUSE BALANCE OF DOOR HARDWARE. PUSHING BUTTONS ON EITHER SIDE OF ROOM TO RETRACT LATCH AND OPEN DOOR.

Door Hardware Set No. 02

Door No. BB100V2B; each to have the following:

No.	Item	Manufacturer	Description	Finish
3 EA.	HINGE	IVES	5BB1HW	694
1 EA.	EXIT DEVICE	VD	EL99L	MEDIUM BRONZE/630
1 EA.	POWER TRANSFER HINGE	VD	ETH-2	MEDIUM BRONZE
1 EA.	AUTO OPERATOR	STH	MAGIC FORCE	MEDIUM BRONZE
1 EA.	KICK PLATE	IVES	8400CSx10"	630
1 EA.	WALL STOP	IVES	WS407CVX	710
1 SET	GASKET	PE	316DS	710

PUSHING BUTTONS ON EITHER SIDE OF ROOM TO RETRACT LATCH AND OPEN DOOR.

Door Hardware Set No. 03

Door No. BB101, BB142, BB143, BB144, BB145; each to have the following:

No.	Item	Manufacturer	Description	Finish
3 EA.	HINGE	IVES	5BB1	652
1 EA.	LATCHSET	SCH	L9010	630
1 EA.	WALL STOP	IVES	WS407CVX	626
1 EA.	KICK PLATE	IVES	8400CSx10"	630
1 SET	GASKET	BY ENTRANCE MANUFACTURER		

Door Hardware Set No. 04

Door No. BB103, BB131, BB141; each to have the following:

No.	Item	Manufacturer	Description	Finish
3 EA.	HINGE	IVES	5BB1	652
1 EA.	LOCKSET	SCH	L99453	630
1 EA.	WALL STOP	IVES	WS407CVX	626
1 EA.	KICK PLATE	IVES	8400CSx10"	630
1 SET	GASKET	BY ENTRANCE MANUFACTURER		

Door Hardware Set No. 05

Door No. BB100M1, BB100W1; each to have the following:

No.	Item	Manufacturer	Description	Finish
3 EA.	HINGE	IVES	5BB1	652
1 SET	PUSH/PULL	IVES	8200/8303 4X16 PLATE WITH 10" PULL	630
1 EA.	AUTO OPERATOR	STH	MAGIC FORCE	626
1 EA.	WALL STOP	IVES	WS407CVX	626
1 EA.	KICK PLATE	IVES	8400CSx10"	630
1 EA.	MOP PLATE	IVES	8400CSx4"	630
1 SET	GASKET	PE	316AS	626

Door Hardware Set No. 06

Door No. BB105, BB100D1, BB100T2A, BB100U1; each to have the following:

No.	Item	Manufacturer	Description	Finish
3 EA.	HINGE	IVES	5BB1	652
1 EA.	LOCKSET	SCH	L9080	630
1 EA.	CLOSER	LCN	4011	ALUM
1 EA.	KICK PLATE	IVES	8400CSx10"	630
1 EA.	WALL STOP	IVES	WS470CVX	626
3 EA.	SILENCER	IVES	SR64	GREY

Door Hardware Set No. 07

Door No. BB129A; each to have the following:

No.	Item	Manufacturer	Description	Finish
6 EA.	HINGE	IVES	5BB1	652
1 EA.	LOCKSET	SCH	L9080	630
1 PR.	FLUSH BOLTS	IVES	261/262	626
1 EA.	DUSTPROOF STRIKE	IVES	DP2	626
1 PR.	ASTRAGAL	PE	355CS	628
2 EA.	CLOSER	LCN	4111	ALUM
1 EA.	WALL STOP	IVES	WS470CVX	626
1 EA.	OVERHEAD STOP	GL	904S	626
2 EA.	ARMOR PLATE	IVES	8400CSX34"	630
1 SET	GASKET	PE	AM88	CLEAR

Door Hardware Set No. 08

Door No. BB100T1; each to have the following:

No.	Item	Manufacturer	Description	Finish
3 EA.	HINGE	IVES	5BB1	652
1 EA.	LOCKSET	SCH	L9440	630
1 EA.	CLOSER	LCN	4011	ALUM
1 EA.	KICK PLATE	IVES	8400CSx10"	630
1 EA.	MOP PLATE	IVES	8400CSX4"	630

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1 EA.	WALL STOP	IVES	WS470CVX	626
3 EA.	SILENCER	IVES	SR64	GREY

END OF SECTION 08 71 00

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SECTION 08 71 13

AUTOMATIC DOOR OPERATORS

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. Low-energy door operators for swinging doors.

1.3 DEFINITIONS

- A. AAADM: American Association of Automatic Door Manufacturers.
- B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
- C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
- D. For automatic door terminology, see BHMA A156.19 for definitions of terms.

1.4 COORDINATION

- A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.
- B. Templates: Distribute for doors, frames, and other work specified for installing automatic door operators.
- C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.
- D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies.

1.5 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 automatic door operators.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For automatic door operators.
 - 1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
 - 2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Indicate locations of activation and safety devices.
 - 4. Include diagrams for power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of automatic door operator.
- B. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer for installation and maintenance of units required for this Project.
 - 1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty or sporadic operation of automatic door operator, including controls.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

2. Warranty Period: One years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Stanley Access Technologies; Magic Force or a comparable product by one of the following:
 1. DORMA USA, Inc.
 2. Horton Automatics; a division of Overhead Door Corporation.
- B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

2.2 AUTOMATIC DOOR OPERATORS, GENERAL

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.
 1. Wind Load: Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load exerted by a 145 MPH, Exposure B wind.
- B. Electromechanical Operating System: Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.
- C. Cover for Surface-Mounted Operators: Fabricated from 0.125-inch-thick, extruded or formed aluminum; continuous over full width of operator-controlled door opening; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.
- D. Brackets and Reinforcements: Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 LOW-ENERGY DOOR OPERATORS

- A. Standard: BHMA A156.19.

B. Performance Requirements:

1. Opening Force if Power Fails: Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.
2. Entrapment-Prevention Force: Not more than 15 lbf required to prevent stopped door from closing or opening.

C. Configuration: Operator to control single swinging door.

1. Traffic Pattern: Two way.
2. Operator Mounting: Surface.

D. Operation: Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.

E. Operating System: Electromechanical.

F. Microprocessor Control Unit: Solid-state controller.

G. Features:

1. Adjustable opening and closing speed.
2. Adjustable opening force.
3. Adjustable backcheck.
4. Adjustable hold-open time from zero to 30 seconds.
5. Adjustable time delay.
6. Adjustable acceleration.
7. Obstruction recycle.
8. On-off/hold-open switch to control electric power to operator.

H. Activation Device: Push-plate switch on each side of door to activate door operator.

I. Exposed Finish: Class II, color anodic finish.

1. Color: Medium bronze.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Extrusions: ASTM B 221.
2. Sheet: ASTM B 209.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, stretcher-leveled standard of flatness, in manufacturer's standard thickness.

- C. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.5 CONTROLS

- A. General: Provide controls, including activation and safety devices, according to BHMA standards; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated. Coordinate activation and safety devices with door operation and door operator mechanisms.
- B. Push-Plate Switch: Momentary-contact door control switch with flat push-plate actuator with contrasting-colored, engraved message.
 - 1. Configuration: Square push plate with 4-by-4-inch junction box.
 - a. Mounting: Surface mounted on wall.
 - 2. Push-Plate Material: Stainless steel as selected by Architect from manufacturer's full range.
 - 3. Message: International symbol of accessibility and "Push to Open."
- C. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.6 FABRICATION

- A. Factory fabricate automatic door operators to comply with indicated standards.
- B. Form aluminum shapes before finishing.
- C. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.
- D. Provide metal cladding, completely covering visible surfaces before shipment to Project site. Fabricate cladding with concealed fasteners and connection devices, with accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion, and with allowance for thermal expansion at exterior doors.

2.7 ACCESSORIES

- A. Signage: As required by cited BHMA standard for type of door and its operation.
 - 1. Application Process: Decals.
 - 2. Provide sign materials with instructions for field application when operators are installed.

2.8 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
- B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.9 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
- B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install automatic door operators according to manufacturer's written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building's power supply.
 - 1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
 - 2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.
- B. Controls: Install activation and safety devices according to manufacturer's written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 ADJUSTING

- A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.
 - 1. Adjust operators on exterior doors for weathertight closure.
- B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.
- C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

END OF SECTION 08 71 13

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SECTION 08 80 00

GLAZING

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. Glass for doors, interior borrowed lites, and storefront framing.
 - 2. Glazing sealants and accessories.
- B. Related Requirements:
 - 1. Section 08 83 00 "Mirrors."

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. IBC: International Building Code.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

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

1.6 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For glass.

1.7 QUALITY ASSURANCE

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

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

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

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
- B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

- A. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
 - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum.[Provide glass that complies with performance requirements and is not less than the thickness indicated.]
 - 1. Minimum Glass Thickness for Exterior Lites: 6 mm.

2.4 GLASS PRODUCTS

- A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

2.5 LAMINATED GLASS

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

2.6 GLAZING TAPES

- A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM 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.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with 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, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of 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).

2.8 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to fit 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 publications, to comply with system performance requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, 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 systems.
 - 3. Minimum required face and 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. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.
- C. 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.
- D. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- E. Provide spacers for glass lites where length plus width is larger than 50 inches.
 - 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.
- F. 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.
- G. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

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. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.
- D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.
- E. Do not remove release paper from tape until right before each glazing unit is installed.
- F. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

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

3.7 LAMINATED GLASS SCHEDULE

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

END OF SECTION 08 80 00

SECTION 08 83 00

MIRRORS

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 the following types of silvered flat glass mirrors:
 - 1. Annealed monolithic glass mirrors.
- B. Related Requirements:
 - 1. Section 10 28 00 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect mirrors according to mirror manufacturer's written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.
- B. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

- 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.
- B. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

- A. Mirrors, General: ASTM C 1503.
- B. Annealed Monolithic Glass Mirrors: Mirror Select Quality, clear.
 - 1. Nominal Thickness: 5.0 mm.

2.3 MISCELLANEOUS MATERIALS

- A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.
- C. Mirror Mastic: An adhesive setting compound, asbestos-free, produced specifically for setting mirrors and certified by both mirror and mastic manufacturer as compatible with glass coating and substrates on which mirrors will be installed.

2.4 MIRROR HARDWARE

- A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.
 - 1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - 2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.
 - 3. Finish: Clear bright anodized.
- B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

2.5 FABRICATION

- A. Fabricate mirrors in the shop to greatest extent possible.
- B. Mirror Edge Treatment: Flat polished.
 - 1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
 - 2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.
- B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.
- C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

- A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
 - 1. GANA Publications: "Glazing Manual" and "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors."
- B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
- C. Install mirrors with mastic and mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.
 - 1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.
 - 2. Install mastic as follows:
 - a. Apply barrier coat to mirror backing where approved in writing by manufacturers of mirrors and backing material.
 - b. Apply mastic to comply with mastic manufacturer's written instructions for coverage and to allow air circulation between back of mirrors and face of mounting surface.
 - c. After mastic is applied, align mirrors and press into place while maintaining a minimum airspace of 1/8 inch between back of mirrors and mounting surface.

3.4 CLEANING AND PROTECTION

- A. Protect mirrors from breakage and contaminating substances resulting from construction operations.
- B. Do not permit edges of mirrors to be exposed to standing water.
- C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.
- D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 83 00

SECTION 09 22 16

NON-STRUCTURAL METAL FRAMING

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. Non-load-bearing steel framing systems for interior partitions.

1.3 DESIGN REQUIREMENTS

- A. Design in accordance with American Iron and Steel Institute Publication "Specification for the Design of Cold-Formed Steel Structural Members", except as otherwise shown or specified.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installing.
- 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 in AISI's "Code of Standard Practice".

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Horizontal Deflection: For wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft..

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
 - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C 645. Use either steel studs and tracks or embossed steel studs and tracks.
 - 1. Steel Studs and Tracks:
 - a. Minimum Base-Metal Thickness: 0.0219 inch minimum.
 - 1) Provide 0.0359 inch thick minimum at tile backer panels.
 - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
 - 1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing 1-1/2-inch minimum vertical movement.
 - 2. Double-Track System: ASTM C 645 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.
 - 3. 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.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thickness: 0.063 inch.
- E. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
 - 1. Depth: 1-1/2 inches.
 - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
 - 1. 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 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
 - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, door wall stops, 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.

3.3 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. 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. Diagonally brace each jamb above 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. Terminate partition framing at suspended ceilings where indicated. Brace partitions to structure or deck above with steel studs at plus or minus 45 degree angles at 8 feet on center maximum and at door strike and hinge jambs.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
 - 6. At interior walls and partitions containing acoustical batt insulation, set runners and perimeter studs in one continuous bead of acoustical sealant.
- E. 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.

END OF SECTION 09 22 16

SECTION 09 29 00

GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Interior gypsum board.
- 2. Tile backing panels.

B. Related Requirements:

- 1. Section 09 22 16 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Mark-up construction drawings to indicate proposed gypsum wallboard control joint locations.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

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

2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
 - 1. Thickness: 5/8 inch.
 - 2. Long Edges: Tapered.

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or ASTM C 1325, with manufacturer's standard edges.
 - 1. Thickness: 1/2 inch.
 - 2. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. L-Bead: L-shaped; exposed long flange receives joint compound.
 - d. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.

- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For leveling coat of textured finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Cementitious Backer Units: As recommended by backer unit manufacturer.
 - 2. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 - 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. Pecora Corporation.
 - b. Tremco Corporation.
 - c. USG Corporation.
- E. Thermal Insulation: As specified in Section 07 21 00 "Thermal Insulation."
- F. Acoustic Insulation: Unfaced glass-fiber blankets; ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
- G. Vapor Retarder: As specified in Section 07 26 00 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ACOUSTICAL INSULATION INSTALLATION:

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice and snow.
- C. Install batt insulation friction fit between framing members. Secure in place to prevent sag.
- D. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

- E. Extend insulation into profile of metal studs. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with panel placement.
- F. Until gypsum board is installed, hold insulation in place with 10 inch staples fabricated from 0.065 inch diameter tie wire and inserted through slot in web of stud.

3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install 5/8 inch Type "X" in all locations unless noted otherwise.
 - 1. Install 3/8 inch overlay to cover existing textured wall or skim coat as specified herein at Contractor's Option.
- C. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Form control and expansion joints with space between edges of adjoining gypsum panels.
- G. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.
- H. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- I. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

- J. STC-Rated Assemblies: Seal construction containing acoustic insulation at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.4 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Type X: Surfaces unless otherwise indicated.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
 - 3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.5 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at [showers, tubs, and where indicated] [locations indicated to receive tile].
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
 - 3. L-Bead: Use at exposed panel edges where an LC-Bead cannot be installed..

3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view.
 - 4. Level 5: Smoothing of textured walls.
- D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

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SECTION 09 30 13

CERAMIC TILING

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. Porcelain tile.
- 2. Metal edge strips.

B. Related Requirements:

- 1. Section 07 92 00 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
- 2. Section 09 29 00 "Gypsum Board" for cementitious backer units.

1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in its "Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Verification:
 - 1. Full-size units of each type and composition of tile and for each color and finish required.

1.5 INFORMATIONAL SUBMITTALS

- A. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- B. Product Certificates: For each type of product.
- C. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
 - 2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 QUALITY ASSURANCE

- A. Maintain one copy of Tile Council of America's TCA Handbook and ANSI A 108 Series/A118 Series on site.

1.8 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 in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
 - 1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
 - 1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
 - 1. Metal edge strips.

2.2 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
 - 1. Provide tile complying with Standard grade requirements.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

- A. Basis of Design Product: Named below or a comparable product.

B. Glazed Paver Tile PT-1: Flat tile as follows:

1. Basis of Design: Crossville; Gotham.
2. Composition: Porcelain.
3. Facial Dimensions PT-1: 24 by 12 inch nominal.
4. Wearing Surface: Nonabrasive.
5. Face: Plain with beveled edges.
6. Finish: Matte opaque.

C. Unglazed Paver Tile PT-2 and PT-3: Flat tile as follows:

1. Basis of Design: Olympia Tile, Colour & Dimension.
2. Composition: Porcelain.
3. Facial Dimensions PT-2: 4 by 16 inch nominal.
4. Wearing Surface: Nonabrasive.
5. Face: Plain with cushioned edges.
6. Finish: Matte.
7. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
 - a. Wainscot Cap for Thinset Mortar Installations: Surface bullnose, module size 4 by 16 inch.

2.4 SETTING MATERIALS

A. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

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. Custom Building Products.
 - b. LATICRETE SUPERCAP, LLC.
 - c. MAPEI Corporation.
1. Mortar shall have a bond strength of not less than 400 psi.
2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. Standard Cement Grout: ANSI A118.6.

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. Custom Building Products.

2.6 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

2.7 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- 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 the Work.
 1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
 - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
 - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

- A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
 - a. Tile floors consisting of tiles 8 by 8 inches or larger.
 - b. Tile floors consisting of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. 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.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

- F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
 - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
 - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
 - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Porcelain Tile: 3/16 inch.
- H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, directly above joints in concrete substrates. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
- J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.
- K. Grout tile to comply with requirements of the following tile installation standards:
 - 1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.
- L. Sound tile after setting. Replace hollow sounding units.
- M. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
- N. Allow tile to set for a minimum of 48 hours prior to grouting.
- O. Grout tile joints. Use standard grout unless otherwise indicated.
- P. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.
- Q. Floor Sealer: Apply floor sealer to cementitious grout joints in tile floors according to floor-sealer manufacturer's written instructions. As soon as floor sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 ADJUSTING AND CLEANING

- A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

- B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
 - 1. Remove grout residue from tile as soon as possible.
 - 2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

- A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

- A. Interior Floor Installations, Concrete Subfloor:
 - 1. Ceramic Tile Installation: TCNA F113; thinset mortar.
 - a. Thinset Mortar: Modified dry-set mortar.
 - b. Grout: Standard unsanded cement grout.
- B. Interior Wall Installations, Wood or Metal Studs or Furring:
 - 1. Ceramic Tile Installation: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.
 - a. Thinset Mortar: Modified dry-set mortar.
 - b. Grout: Standard unsanded cement grout.

END OF SECTION 09 30 13

SECTION 09 51 13

ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- B. Evaluation Reports: For each acoustical panel ceiling suspension system, from ICC-ES.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site 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.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, 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. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Class A according to ASTM E 1264.
 - 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries; Cortega or a comparable product.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
 - 1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
 - 2. Pattern: CD (perforated, small holes and fissured).
- D. Color: White.

- E. Light Reflectance (LR): Not less than 0.80.
- F. Ceiling Attenuation Class (CAC): Not less than 35.
- G. Noise Reduction Coefficient (NRC): Not less than 0.55.
- H. CAC: Not less than 35.
- I. Edge/Joint Detail: Square.
- J. Thickness: 5/8 inch.
- K. Modular Size: 24 by 48 inches.

2.4 METAL SUSPENSION SYSTEM

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.; Prelude ML System.
 - 2. USG Interiors, Inc.; DX 26 System.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
 - 1. Structural Classification: Heavy-duty system.
 - 2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
 - 3. Face Design: Flat, flush.
 - 4. Cap Material: Cold-rolled steel.
 - 5. Cap Finish: Painted white.

2.5 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
 - 2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch-diameter wire.
- C. Hold-Down Clips: Manufacturer's standard hold-down.
- D. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

2.6 METAL EDGE MOLDINGS AND TRIM

- A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
 - 1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
- B. Provide manufacturer's standard perimeter seismic clips.

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.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. 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 unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M and **ASTM E 580**, and manufacturer's written instructions.
- 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, countersplaying, 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 to structure 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 roof deck. Fasten hangers to joists.
 6. 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.
 7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. 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 precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.
 2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.
 3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

3.5 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.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 13

SECTION 09 65 13

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Thermoset-rubber base.
 - 2. Vinyl molding accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Initial Selection: For each type of product indicated.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, 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.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type and color of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

1.6 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.

1.7 FIELD 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 periods:
 - 1. 48 hours before installation.
 - 2. During installation.
 - 3. 48 hours after installation.
- B. After installation and 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.

1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace resilient base and accessories that do not comply with requirements or that fail in materials within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 THERMOSET-RUBBER BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 2. Johnsonite; a Tarkett company.
 - 3. Roppe Corporation
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
 - a. Style: Style B, Cove.
- C. Thickness: 0.125 inch.
- D. Height: 4-1/2 inches.
- E. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.

- H. Colors: As indicated by manufacturer's designations.

2.2 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Armstrong World Industries, Inc.
 - 2. Burke Mercer Flooring Products; a division of Burke Industries Inc.
 - 3. Flexco.
 - 4. Johnsonite; a Tarkett company.
 - 5. Roppe Corporation
- B. Description: Vinyl joiner for tile and carpet.
- C. Profile and Dimensions: As indicated below.
 - 1. Carpet to Resilient Flooring; Roppe 177.
 - 2. Carpet to Ceramic Tile; Roppe 155/179.
- D. Colors and Patterns: Match resilient base color.

2.3 INSTALLATION MATERIALS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

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; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

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 practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends. Shave back of base vertically at fold point and at two diagonal additional stress relief gouges on the vertical surface, approximately 1/2-inch long, 1-inch from the center gouge.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

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 floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal 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 subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

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SECTION 09 68 13

TILE CARPETING

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 modular carpet tile.
- B. Related Requirements:
 - 1. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 DEFINITIONS

- A. Pile Thickness: Yarn Tuft heights above top surface of backing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
 - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Shop Drawings: For carpet tile installation, plans showing the following:
 - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
 - 2. Carpet tile type, color, and dye lot.
 - 3. Type of subfloor.
 - 4. Type of installation.
 - 5. Pattern of installation.
 - 6. Pattern type, location, and direction.
 - 7. Type, color, and location of insets and borders.
 - 8. Type, color, and location of edge, transition, and other accessory strips.
 - 9. 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.

- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles 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.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, 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..

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
 - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
 - 2. Failures include, but are not limited to, the following:
 - a. More than 10 percent edge raveling, snags, and runs.
 - b. Dimensional instability.
 - c. Excess static discharge.
 - d. Loss of tuft-bind strength.
 - e. Loss of face fiber.
 - f. Delamination.
 - 3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
 - 1. Basis-of-Design Product: The design for each carpet type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
 - a. Substitutions will be evaluated on overall performance, yarn performance, warranty, yarn colors, and size of pattern.

2.2 CARPET TILE CPT-1

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tandus; a Tarkett company or a comparable product.
- B. Color: As indicated by manufacturer's designations.
- C. Pattern: Ratio.
- D. Fiber Type: Antron Legacy nylon.
- E. Pile Characteristic: Patterned loop pile.
- F. Density: 3,850 oz./cu. yd. minimum based on pile thickness.
- G. Pile Thickness: 0.187 inches for finished carpet tile according to ASTM D 6859.

- H. Stitches: 9.8 stitches per inch.
- I. Gage: 5/64 ends per inch.
- J. Surface Pile Weight: 20 oz./sq. yd..
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Size: 24 by 24 inches.
- N. Applied Treatments:
 - 1. Soil-Resistance Treatment: Duratech.
- O. Performance Characteristics:
 - 1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
 - 2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.3 CARPET TILE CPT-2 and CPT-3

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tandus; a Tarkett company or a comparable product.
- B. Color: As indicated by manufacturer's designations.
- C. Pattern: Tenera.
- D. Fiber Type: Dynex Nylon nylon.
- E. Pile Characteristic: Textured loop pile.
- F. Density: 3,850 oz./cu. yd. minimum based on pile thickness.
- G. Pile Thickness: 0.187 inches for finished carpet tile according to ASTM D 6859.
- H. Stitches: 9.7 stitches per inch.
- I. Gage: 5/64 ends per inch.
- J. Surface Pile Weight: 20 oz./sq. yd..
- K. Primary Backing/Backcoating: Manufacturer's standard composite materials.
- L. Secondary Backing: Manufacturer's standard material.
- M. Size: 24 by 24 inches.

N. Applied Treatments:

1. Soil-Resistance Treatment: Duratech.

O. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.4 CARPET TILE WOM-1

A. Basis-of-Design Product: Subject to compliance with requirements, provide Interface or a comparable product.

B. Color: As indicated by manufacturer's designations.

C. Pattern: Entry Level.

D. Fiber Type: Type 6,6 nylon.

E. Pile Characteristic: Tufted textured loop pile.

F. Density: 6,720 oz./cu. yd. minimum based on pile thickness.

G. Pile Thickness: 0.150 inches for finished carpet tile according to ASTM D 6859.

H. Surface Pile Weight: 28 oz./sq. yd..

I. Backing System: GlasBak.

J. Size: 24 by 24 inches.

K. Applied Treatments:

1. Soil-Resistance Treatment: ProTekt2.

L. Performance Characteristics:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
2. Electrostatic Propensity: Less than 3.5 kV according to AATCC 134.

2.5 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Partial glue down; install periodic tiles with releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.

- D. Maintain pile-direction patterns indicated on Drawings.
- E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. 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 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's "Carpet Installation Standard," Section 20, "Protecting 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 09 68 13

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SECTION 09 90 00

PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.
 - 1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish, except in mechanical equipment rooms, and electrical rooms.
- C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, labels and exterior horizontal traffic surfaces.
 - 1. Prefinished items including, but not limited to, the following factory-finished components:
 - a. Architectural woodwork.
 - b. Plastic toilet enclosures.
 - c. Metal lockers.
 - d. Finished mechanical and electrical equipment.
 - e. Light fixtures.
 - 2. Concealed surfaces including, but not limited to, walls or ceilings in the following generally inaccessible spaces:
 - a. Furred areas.
 - b. Ceiling plenums.
 - c. Pipe spaces.

3. Finished metal surfaces including, but not limited to, the following:
 - a. Anodized aluminum.
 - b. Stainless steel.
 - c. Chromium plate.
 - d. Copper and copper alloys.
 - e. Bronze and brass.
4. Operating parts include, but not limited to, moving parts of operating equipment and the following:
 - a. Valve and damper operators.
 - b. Linkages.
 - c. Sensing devices.
 - d. Motor and fan shafts.
5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.
6. Exterior Horizontal Traffic Surfaces included, but are not limited to the following:
 - a. Sidewalks
 - b. Curbs not specifically scheduled for paint.
 - c. Asphalt concrete pavement.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 1. Submit four Samples on 8-by-10 inch cardstock for Architect's review of color and texture only:
 2. Step coats on Samples to show each coat required for system.
 3. Label each coat of each Sample.
 4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. VOC content.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.

B. Source Limitations: Obtain primers for each coating system from the same manufacturer as the finish coats.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.

B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. PPG Industries, Inc. (Pittsburgh Paints).
 - 2. Rhodda Paint Co.
 - 3. Sherwin-Williams Co. (Sherwin-Williams).
- B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
- A. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Primers, Sealers, and Undercoaters: 200 g/L.
- B. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Colors: As indicated in a color schedule.

2.3 INTERIOR PRIMERS

- A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
1. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil.
 2. Rodda; 50701 Roseal Gypsum Primer: Applied at a dry film thickness of not less than 1.5 mils
 3. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.
- B. Interior Wood Primer for Acrylic-Enamel and Semigloss Alkyd-Enamel Finishes: Factory-formulated alkyd- or acrylic-latex-based interior wood primer.
1. Pittsburgh Paints; 17-921 Seal Grip 100 Percent Acrylic Universal Primer: Applied at a dry film thickness of not less than 1.6 mil.
 2. Rodda; Unique II 100% Acrylic Enamel Undercoater: Applied at a dry film thickness of not less than 1.5 mils
 3. Sherwin-Williams; Multi-Purpose Latex Primer B51W00020: Applied at a dry film thickness of not less than 1.6 mils.
- C. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.
1. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 2.0 mils.
 2. Rodda; 508901 Metal Master 100% Acrylic Primer: Applied at a dry film thickness of not less than 1.5 mils
 3. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer B66W00310: Applied at a dry film thickness of not less than 3.0 mils.
- D. Interior Zinc-Coated Metal Primer: Factory-formulated galvanized metal primer.
1. Pittsburgh Paints; 90-712 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: Applied at a dry film thickness of not less than 2.0 mils.
 2. Rodda; 508901 Metal Master 100% Acrylic Primer: Applied at a dry film thickness of not less than 1.5 mils
 3. Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer B66W00310: Applied at a dry film thickness of not less than 3.0 mils.

2.4 EXTERIOR FINISH COATS

- A. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
1. Pittsburgh Paints; 6-900XI Series SpeedHide Exterior House & Trim Semi-Gloss Acrylic Latex Paint: Applied at a dry film thickness of not less than 1.5 mils.

2. Rodda; 542001 Unique II 100% Acrylic Semi-Gloss Enamel: Applied at a dry film thickness of not less than 1.5 mils
3. Sherwin-Williams; Solo 100% Acrylic Interior/Exterior Semi-Gloss A76 Series: Applied at a dry film thickness of not less than 4.0 mils.

2.5 INTERIOR FINISH COATS

A. Interior Flat Latex-Emulsion Size: Factory-formulated flat latex-based interior paint.

1. Pittsburgh Paints; 6-70 Line SpeedHide Interior Wall Flat-Latex Paint: Applied at a dry film thickness of not less than 1.0 mil.
2. Rodda; 513101 Master Painter Int. Latex Flat Wall Paint: Applied at a dry film thickness of not less than 1.5 mils
3. Sherwin-Williams; ProMar 200 Interior Latex Flat Wall Paint B30W200 Series: Applied at a dry film thickness of not less than 1.4 mils.

B. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.

1. Pittsburgh Paints; 6-411 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils.
2. Rodda; 533001 Lasyn Eggshell Finish Wall Paint: Applied at a dry film thickness of not less than 1.5 mils
3. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils.

2.6 EXTERIOR WOOD STAINS

A. Exterior Solid Body Acrylic Stain: Factory formulated penetrating solid color wood stain of exterior application applied at a spreading rate recommended by manufacturer.

1. Olympic Stain; 796XX Elite.
2. Rodda; 512601 Ultimate II.
3. Sherwin-Williams; a 15 Series WoodScapes

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Wood: 15 percent.
 2. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. General: Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- B. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Provide barrier coats over incompatible primers or remove and reprime.
- D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 4. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view in occupied spaces:
 - a. Uninsulated metal piping.
 - b. Pipe hangers and supports.
 - c. Metal conduit.
 - d. Duct, equipment, pipe, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - e. Mechanical and electrical equipment that is indicated to have a factory-primed finish for field painting.
 - 2. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
 - 3. Sand lightly between each succeeding enamel coat.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in rooms and occupied spaces, except in mechanical equipment rooms, and electrical rooms. Do not paint exposed wire raceways or exposed data cables.
- F. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- G. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- H. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Semi-Gloss Acrylic Enamel Finish: Two finish coat over shop primer.
 - a. Finish Coats: Exterior semi-gloss acrylic enamel.

3.6 INTERIOR PAINT SCHEDULE

- A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- B. Wood and Hardboard: Provide the following paint finish systems over interior wood surfaces:
 - 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior wood primer for acrylic-enamel and semigloss alkyd-enamel finishes.
 - b. Finish Coats: Interior low-luster acrylic enamel.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Semigloss Acrylic Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.
- D. Zinc-Coated Metal: Provide the following finish systems over interior zinc-coated metal surfaces:
 - 1. Semigloss Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior zinc-coated metal primer.
 - b. Finish Coats: Interior semi-gloss acrylic enamel.

- E. All-Service Jacket over Insulation: Provide the following finish system on cotton or canvas insulation covering:
 - 1. Flat Acrylic Finish: Two finish coats. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coats: Interior flat latex-emulsion size.

3.7 EXTERIOR STAIN SCHEDULE

- A. Smooth Wood: Provide the following finish systems over smooth wood siding, wood trim, and other smooth exterior wood surfaces:
 - 1. Flat Acrylic Finish: Two finish coats.
 - a. Finish Coats: Exterior solid body acrylic stain.

END OF SECTION 09 90 00

SECTION 10 11 00101100

VISUAL DISPLAY UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Visual display board 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, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
 - 1. Include plans, elevations, sections, details, and attachment to other work.
 - 2. Show locations of panel joints.
 - 3. Include sections of typical trim members.
- C. Product Schedule: For visual display units.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For visual display units to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display units by field measurements before fabrication.
 - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

1.8 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Surfaces lose original writing and erasing qualities.
 - b. Surfaces exhibit crazing, cracking, or flaking.
 - 2. Warranty Period: 50 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of visual display unit from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 25 or less.
 - 2. Smoke-Developed Index: 450 or less.

2.3 VISUAL DISPLAY BOARD ASSEMBLY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Architectural School Products Ltd.
 - 2. Claridge Products and Equipment, Inc.
 - 3. Egan Visual Inc.
 - 4. PolyVision Corporation, a Steelcase company.
- B. Visual Display Board Assembly: Factory fabricated.
 - 1. Assembly: Markerboard.
 - 2. Corners: Square.
 - 3. Width: As indicated on Drawings.
 - 4. Height: As indicated on Drawings.
 - 5. Mounting Method: Direct to wall.
- C. Markerboard Panel: Porcelain-enamel-faced markerboard panel on core indicated.
 - 1. Color: White.
- D. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch-thick, extruded aluminum; standard size and shape.
 - 1. Aluminum Finish: Clear anodic finish.
- E. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
- F. Chalktray: Manufacturer's standard; continuous.
 - 1. Solid Type: Extruded aluminum with ribbed section and smoothly curved exposed ends.

2.4 MARKERBOARD PANELS

- A. Porcelain-Enamel Markerboard Panels: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction, consisting of moisture-barrier backing, core material, and porcelain-enamel face sheet with low-gloss finish. Laminate panels under heat and pressure with manufacturer's standard, flexible waterproof adhesive.
 - 1. Face Sheet Thickness: 0.013 inch uncoated base metal thickness.
 - 2. Manufacturer's Standard Core: Minimum 1/4 inch thick, with manufacturer's standard moisture-barrier backing.
 - 3. Laminating Adhesive: Manufacturer's standard moisture-resistant thermoplastic type.

2.5 MATERIALS

- A. Porcelain-Enamel Face Sheet: PEI-1002, with face sheet manufacturer's standard two- or three-coat process.
- B. Extruded Aluminum: ASTM B 221, Alloy 6063.
- C. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.

2.6 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 from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.

- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive visual display units and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.

3.3 INSTALLATION

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Adhere to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.

3.4 CLEANING AND PROTECTION

- A. Clean visual display units according to manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 10 11 00101100

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SECTION 10 14 23

PANEL SIGNAGE

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. Panel signs.

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Panel Signs: Full-size Sample.
 - 2. Full-size Samples, if approved, will be returned to Contractor for use in Project.
- D. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.6 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1.

2.2 PANEL SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 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. ASI Sign Systems, Inc.
 - b. Best Sign Systems, Inc.
 - c. InPro Corporation (IPC).
 - d. Mohawk Sign Systems.
 - e. Southwell Company (The).
- B. Cast-Acrylic Sheet: Manufacturer's standard and as follows:
 - 1. Color: As indicated on Drawings.
- C. Frames: Fabricate frames to profile indicated; comply with the following requirements for materials and corner conditions:
 - 1. Material: Acrylic plastic.
 - 2. Corner Condition: Square.
 - 3. Mounting: Adhesive.

4. Surface Finish and Applied Graphics:
 - a. Integral Acrylic Sheet Color: As selected by Architect from full range of industry colors.
5. Text and Typeface: Accessible raised characters and Braille in Avant Garde font. Finish raised characters to contrast with background color, and finish Braille to match background color.
6. Flatness Tolerance: Sign shall remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.3 PANEL-SIGN MATERIALS

- A. Acrylic Sheet: ASTM D 4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.

2.5 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessible Signage: Install in locations on walls as indicated on Drawings and according to the accessibility standard.
- C. Mounting Methods:
 - 1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 23

SECTION 10 21 13.19

PLASTIC TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes solid-plastic toilet compartments configured as toilet enclosures.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachment details.
- C. Samples for each type of toilet compartment material indicated.

1.3 INFORMATIONAL SUBMITTALS

- A. Product certificates.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: 75 or less.
 - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for toilet compartments designated as accessible.

2.2 SOLID-PLASTIC TOILET COMPARTMENTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Accurate Partitions Corp.; ASI Group.
 - 2. Bobrick Corporation.
 - 3. Bradley Corporation.
 - 4. General Partitions Mfg. Corp.
 - 5. Global Partitions; ASI Group.
 - 6. Hadrian Manufacturing Inc.
 - 7. Knickerbocker Partition Corporation.
 - 8. Scranton Products.
- B. Toilet-Enclosure Style: Overhead braced.
- C. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
 - 1. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-plastic components to hinder malicious combustion.
 - 2. Color and Pattern: One color and pattern in each room as indicated by manufacturer's designations.
- D. Pilaster Shoes: Manufacturer's standard design; stainless steel.
- E. Brackets (Fittings):
 - 1. Stirrup Type: Ear or U-brackets, chrome-plated zamac, clear-anodized aluminum, or stainless steel.
- F. Overhead Cross Bracing for Ceiling-Hung Units: As recommended by manufacturer and fabricated from solid polymer.

2.3 HARDWARE AND ACCESSORIES

- A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.
 - 1. Material: Chrome-plated zamac.
 - 2. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
 - 3. Hinges: Manufacturer's standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees, allowing emergency access by lifting door.
 - 4. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.

5. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
 6. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
 7. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.
- B. Hardware and Accessories: Manufacturer's heavy-duty stainless-steel operating hardware and accessories.
1. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
- C. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
- D. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 FABRICATION

- A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.
- B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.
- C. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.
1. Verify that field measurements are as indicated.
 2. Confirm location and adequacy of blocking and supports required for installation.
 3. Verify correct spacing of and between plumbing fixtures.

3.2 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.
 - 1. Maximum Clearances:
 - a. Pilasters and Panels: 1/2 inch.
 - b. Panels and Walls: 1 inch.
 - 2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel.
 - a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
 - b. Align brackets at pilasters with brackets at walls.
- B. Mount door bumper on center of door at 48-inches above floor.

3.3 ERECTION TOLERANCES

- A. Maximum Variation from True Position: 1/4 inch.
- B. Maximum Variation from Plumb: 1/8 inch.

3.4 ADJUSTING AND CLEANING

- A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.
- B. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

END OF SECTION 10 21 13.19

SECTION 10 28 00

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Public-use washroom accessories.
 - 2. Custodial accessories.
- B. Related Requirements:
 - 1. Section 08 83 00 "Mirrors" for frameless mirrors.

1.3 COORDINATION

- A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
- B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
 - 1. Identify locations using room designations indicated.
 - 2. Identify accessories using designations indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For accessories to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Source Limitations: Obtain public-use washroom accessories from single source from single manufacturer.
- B. Toilet Tissue (Roll) Dispenser (TPD):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-4288 or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
 - 2. Description: Roll-in-reserve dispenser with hinged front secured with tumbler lockset.
 - 3. Mounting: Surface mounted.
 - 4. Operation: Noncontrol delivery with theft-resistant spindle.
 - 5. Capacity: Designed for 4-1/2- or 5-inch- diameter tissue rolls.
 - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
- C. Combination Towel (Folded) Dispenser/Waste Receptacle (PTD/R):
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-3944 or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
 - 2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
 - 3. Mounting: Recessed with projecting receptacle.
 - a. Designed for nominal 4-inch wall depth.
 - 4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
 - 5. Minimum Waste-Receptacle Capacity: 12 gal..
 - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - 7. Liner: Reusable, vinyl waste-receptacle liner.
 - 8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

D. Liquid-Soap Dispenser (SD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-4112 or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
2. Description: Designed for dispensing soap in liquid or lotion form.
3. Mounting: Horizontally oriented, surface mounted.
4. Adhesive: Two component epoxy type, waterproof.
5. Capacity: 40 oz..
6. Materials: Stainless steel body, push button valve.
7. Lockset: Tumbler type.
8. Refill Indicator: Window type.

E. Grab Bar (GB):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-6800 Series or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick.
 - a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

F. Sanitary Napkin Dispenser (SND):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-37063 25 or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
2. Type: Sanitary napkin and tampon.
3. Mounting: Fully recessed, designed for 4-inch wall depth.
4. Capacity: Not less than 15 napkins and 20 tampons.
5. Operation: Single coin (25 cents).
6. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
7. Lockset: Tumbler type with separate lock and key for coin box.

G. Sanitary-Napkin Receptacle (SNR):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-353 for recessed wall mounted units, B-354 for through partition mounted units or comparable products by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
2. Mounting: As indicated above.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

H. Seat-Cover Dispenser (SCD):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-221 or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
2. Mounting: Surface mounted.
3. Minimum Capacity: 250 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.

I. Mirror Unit (MI):

1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B290 Series or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
2. Frame: Stainless-steel angle, 0.05 inch thick.
 - a. Corners: Welded and ground smooth.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
 - a. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.

2.2 CUSTODIAL ACCESSORIES

- A. Source Limitations: Obtain custodial accessories from single source from single manufacturer.
- B. Mop and Broom Holder:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Bobrick Washroom Equipment, Inc; B-224 or a comparable product by one of the following:
 - a. AJW Architectural Products.
 - b. Bradley Corporation.
 - 2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
 - 3. Length: 36 inches.
 - 4. Hooks: Three.
 - 5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
 - 6. Material and Finish: Stainless steel, No. 4 finish (satin).
 - a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
 - b. Rod: Approximately 1/4-inch-diameter stainless steel.

2.3 MATERIALS

- A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.
- B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.
- C. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.
- D. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.
- F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
- G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.4 FABRICATION

- A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.
- B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

- A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.
- B. Remove temporary labels and protective coatings.
- C. Clean and polish exposed surfaces according to manufacturer's written instructions.

END OF SECTION 10 28 00

SECTION 11 30 13

RESIDENTIAL APPLIANCES

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. Refrigeration appliances.
 - 2. Cleaning appliances.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include installation details, material descriptions, dimensions of individual components, and finishes for each appliance.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranties: For manufacturers' special warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each residential appliance to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Maintains, within 2-hour service area of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

1.7 WARRANTY

- A. Special Warranties: Manufacturer agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
- B. Refrigerator/Freezer, Sealed System: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
 - 1. Warranty Period: One year from date of Substantial Completion.
- C. Dishwasher: Limited warranty, including parts and labor for first year and parts thereafter, for on-site service on the product.
 - 1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Appliances: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Accessibility: Where residential appliances are indicated to comply with accessibility requirements, comply with applicable provisions in the DOJ's 2010 ADA Standards for Accessible Design and ICC A117.1.

2.2 REFRIGERATOR/FREEZERS

- A. Refrigerator/Freezer: Two-door refrigerator/freezer with freezer on top and complying with AHAM HRF-1.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide General Electric Company (GE Appliances); Model GIE21GTHBB or a comparable product by one of the following:
 - a. General Electric Company (Hotpoint).
 - b. Maytag; a division of Whirlpool Corporation.
 - c. Sears Brands LLC (Kenmore).
 - 2. Type: Freestanding.
 - 3. Dimensions:
 - a. Width: 33 inches.
 - b. Depth: 32 inches.
 - c. Height: 67inches.

4. Storage Capacity:
 - a. Refrigeration Compartment Volume: 15.1 cu. ft..
 - b. Freezer Volume: 6.1 cu. ft..
 - c. Shelves: Two full width adjustable glass.
 - d. Door Storage: Three shelves, 1 minimum with 1 gal. capacity.
 5. General Features:
 - a. Dual refrigeration systems.
 - b. Separate temperature controls for each compartment.
 6. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Compartment Storage: Vegetable crisper and meat compartment.
 - c. Door Storage: Three bins, one with gallon-milk-container storage.
 7. Freezer Features: One freezer compartment(s) with door.
 - a. Automatic defrost.
 - b. Interior light in freezer compartment.
 - c. Automatic icemaker and storage bin.
 8. Appliance Color/Finish: Black.
- B. Refrigerator/Freezer: One-door refrigerator with freezer compartment inside and complying with AHAM HRF-1.
1. Basis-of-Design Product: Subject to compliance with requirements, provide General Electric Company (GE Appliances); Model GDE03GGKBB or a comparable product by one of the following:
 - a. General Electric Company (Hotpoint).
 - b. Maytag; a division of Whirlpool Corporation.
 - c. Sears Brands LLC (Kenmore).
 2. Type: Undercounter.
 3. Dimensions:
 - a. Width: 19 inches.
 - b. Depth: 24 inches.
 - c. Height: 32 inches.
 4. Storage Capacity:
 - a. Refrigeration Compartment Volume: 2.1 cu. ft..
 - b. Freezer Volume: 0.9 cu. ft..
 - c. Shelf Area: Two glass shelves.

5. Refrigerator Features:
 - a. Interior light in refrigeration compartment.
 - b. Compartment Storage: One pan with cover.
 - c. Door Storage: In door can rack.
6. Freezer Features: One freezer compartment(s) with door.
 - a. Manual defrost.
7. Appliance Color/Finish: Black.

2.3 DISHWASHERS

A. Dishwasher: Complying with AHAM DW-1.

1. Basis-of-Design Product: Subject to compliance with requirements, provide General Electric Company (GE Appliances); Model GLDT690JBB or a comparable product by one of the following:
 - a. General Electric Company (Hotpoint).
 - b. Maytag; a division of Whirlpool Corporation.
 - c. Sears Brands LLC (Kenmore).
2. Type: Built-in undercounter.
3. Dimensions:
 - a. Width: 24 inches.
 - b. Depth: 21 inches.
 - c. Height: 32-1/2 inches.
4. Capacity:
 - a. International Place Settings of China: 12.
 - b. Water Consumption for Full Load: 3.2 gal. per cycle.
5. Sound Level: Maximum 57 dB.
6. Tub and Door Liner: Stainless steel with sealed detergent and automatic rinsing-aid dispensers.
7. Rack System: Nylon-coated sliding dish racks, with removable cutlery basket.
8. Controls: Touch-pad controls with five wash cycles and hot-air and heat-off drying cycle options.
9. Features:
 - a. Waste food disposer.
 - b. Self-cleaning food-filter system.
 - c. Hot-water booster heater for 140 deg F wash water with incoming water at 100 deg F.
 - d. Lock-out feature.

- e. Half-load option.
 - f. Delay-wash option.
 - g. Digital display panel.
 - h. Soil-sensing water use control system.
10. ENERGY STAR: Provide appliances that qualify for the EPA/DOE ENERGY STAR product-labeling program.
11. Appliance Color/Finish: Black.

2.4 GENERAL FINISH REQUIREMENTS

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

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, power connections, and other conditions affecting installation and performance of residential appliances.
- B. Examine roughing-in for piping systems to verify actual locations of piping connections before appliance installation.
- C. 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 INSTALLATION

- A. Install appliances according to manufacturer's written instructions.
- B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and that rough openings are completely concealed.
- C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Perform visual, mechanical, and electrical inspection and testing for each appliance according to manufacturers' written recommendations. Certify compliance with each manufacturer's appliance-performance parameters.
 - 2. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After installation, start units to confirm proper operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and components.
- B. An appliance will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 DEMONSTRATION

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

END OF SECTION 11 30 13

SECTION 12 24 13

ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified, 10 inches long.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each type of shadeband material, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

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

1.8 WARRANTIES

- A. General Warranty: Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Special Warranties: Written warranties, executed by manufacturer agreeing to repair or replace shades or component that fail in materials or workmanship within specified warranty period.

- 1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Mecho/5 by Mechoshades, Inc.
- B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.
 - 1. Bead Chains: Nickel-plated metal.
 - a. Loop Length: Full length of roller shade.
 - b. Limit Stops: Provide upper and lower ball stops.
 - c. Chain-Retainer Type: Clip, jamb mount.

- C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
 - 1. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
 - 2. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.
- D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
- E. Roller-Coupling Assemblies: Coordinated with operating mechanism and designed to join up to three inline rollers into a multiband shade that is operated by one roller drive-end assembly.
- F. Shadebands:
 - 1. Shadeband Material: Light-filtering fabric.
 - 2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.
 - a. Type: Enclosed in sealed pocket of shadeband material.
 - b. Color and Finish: As indicated on Drawings.
- G. Installation Accessories:
 - 1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
 - a. Shape: L-shaped.
 - b. Height: Manufacturer's standard height required to conceal roller and shadeband assembly when shade is fully open, but not less than 3 inches.
 - 2. Installation Accessories Color and Finish: As selected from manufacturers' full range.

2.3 SHADEBAND MATERIALS

- A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. SheerWeeve 2390 by Phifer, Inc.
- C. Light-Filtering Fabric: Woven fabric, stain and fade resistant.
 - 1. Source: Roller shade manufacturer.
 - 2. Type: Vinyl-coated fiberglass.
 - 3. Weave: Basketweave.

4. Thickness: 0.030
5. Roll Width: 98 inches.
6. Openness Factor: 5 percent.
7. Color: As indicated on Drawings.

2.4 ROLLER SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:
 1. Outside of Jamb Installation: Width and length as indicated, with terminations between shades.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

- A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.
- B. Roller Shade Locations: At exterior windows.

3.3 ADJUSTING

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

3.4 CLEANING AND PROTECTION

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

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

END OF SECTION 12 24 13

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SECTION 12 36 23.13123623.13

PLASTIC-LAMINATE-CLAD COUNTERTOPS

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 plastic-laminate-clad countertops.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For plastic-laminate-clad countertops.
 - 1. Include plans, sections, details, and attachments to other work. Detail fabrication and installation, including field joints.
 - 2. Show locations and sizes of cutouts and holes for items installed in plastic-laminate-clad countertops.
- C. Samples for Verification: As follows:
 - 1. Plastic Laminates: For each type, color, pattern, and surface finish required, 8 by 10 inches in size.

1.4 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver countertops only after casework and supports on which they will be installed have been completed in installation areas.

- B. Store countertops in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.
- C. Keep surfaces of countertops covered with protective covering during handling and installation.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Established Dimensions: Where countertops are indicated to fit to other construction, establish dimensions for areas where countertops are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of plastic-laminate-clad countertops indicated for construction, finishes, installation, and other requirements.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
- D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
 - 1. As indicated by manufacturer's designations.
- E. Edge Treatment: 3-mm PVC edging.
- F. Core Material: Particleboard.
- G. Core Material at Sinks: Particleboard made with exterior glue.
- H. Core Thickness: 3/4 inch.
 - 1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

- I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.2 WOOD MATERIALS

- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
 1. Wood Moisture Content: 8 to 13 percent.

2.3 ACCESSORIES

- A. Wire-Management Grommets: Circular, molded-plastic grommets and matching plastic caps with slot for wire passage.
 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. Doug Mockett and Company.
 2. Outside Diameter: 2 inches.
 3. Color: Black,

2.4 MISCELLANEOUS MATERIALS

- A. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
 1. Adhesive for Bonding Edges: Hot-melt adhesive.

2.5 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:
 1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
 1. Trial fit assemblies at 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 before disassembling for shipment.

- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 1. Seal edges of cutouts by saturating with varnish.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
 - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately, and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
 - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.
 - 1. Secure field joints in countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

- E. Countertop Installation: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
 - 1. Install countertops level and true in line. Use concealed shims as required to maintain not more than a 1/8-inch-in-96-inches variation from a straight, level plane.
 - 2. Secure backsplashes to walls with adhesive.
 - 3. Seal joints between countertop and backsplash, if any, and joints where countertop and backsplash abut walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects. Where not possible to repair, replace countertops. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semiexposed surfaces.
- C. Protection: Provide Kraft paper or other suitable covering over countertop surfaces, taped to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION 12 36 23.13123623.13

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SECTION 12 36 61.16

SOLID SURFACING COUNTERTOPS

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. Solid surface material countertops.
 - 2. Solid surface material backsplashes.
 - 3. Solid surface material end splashes.
 - 4. Solid surface material apron fronts.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
 - 1. Show locations and details of joints.
- C. Samples for Verification: For the following products:
 - 1. Countertop material, 6 inches square.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

- B. Installer Qualifications: Fabricator of countertops.

1.6 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.7 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

- A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide [**product indicated on Drawings**] <insert manufacturer name, product name or designation> or comparable product by one of the following:
 - a. Avonite Surfaces.
 - b. E. I. du Pont de Nemours and Company.
 - c. Formica Corporation.
 - d. LG Chemical, Ltd.
 - e. Swan Corporation (The).
 - 2. Type: Provide Standard type unless Special Purpose type is indicated.
 - 3. Colors and Patterns: As indicated by manufacturer's designations.
- B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Custom.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top.
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops: 1/2-inch- thick, solid surface material with front edge built up with same material.

- D. Backsplashes: 1/2-inch- thick, solid surface material.
- E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- F. Joints: Fabricate countertops in sections for joining in field.
 - 1. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
 - 2. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
- G. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
 - 3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

- A. Ledgers and Blocking: Dimension lumber conforming to DOC PS 20.
- B. Adhesive: Product recommended by solid surface material manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
 - 1. Install metal splines in kerfs in countertop edges at joints. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 - 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
 - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 61.16

SECTION 20 00 00

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Supplemental requirements in addition to Division 1 - General Requirements applicable to all Divisions 20, 21, 22, 23, 25 - Mechanical specification sections.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 13 - Common Motor Requirements
3. 20 05 29 - Mechanical Hangers and Supports
4. 20 05 48 - Mechanical Vibration and Seismic Control
5. 20 05 53 - Mechanical Identification
6. 20 05 56 - Interior Trench Excavation and Backfill
7. 20 07 00 - Mechanical Insulation
8. 21 10 00 - Water Based Fire Suppression Systems
9. 22 11 00 - Domestic Water Piping and Specialties
10. 22 13 00 - Sanitary Waste and Vent Piping and Specialties
11. 22 40 00 - Plumbing Fixtures
12. 23 05 93 - Testing, Adjusting and Balancing
13. 23 11 23 - Fuel Gas Piping and Specialties
14. 23 31 00 - Ducts and Accessories
15. 23 34 00 - HVAC Fans
16. 23 37 00 - Air Outlets and Inlets
17. 23 74 23 - Packaged Makeup Air Units
18. 23 82 00 - Terminal Heating and Cooling Units

19. 25 90 00 - Sequence of Operations

1.2 REFERENCES

A. Codes and Standards:

1. Perform work in accordance with the legally enacted editions of applicable international, state and local codes with locally accepted amendments to include:
 - a. 2012 International Building Code (IBC).
 - b. 2012 International Mechanical Code (IMC).
 - c. 2012 International Fuel Gas Code (IFGC).
 - d. 2012 Uniform Plumbing Code (UPC).
 - e. 2012 International Fire Code (IFC).
 - f. 2014 NFPA 70, National Electric Code (NEC).
 - g. Standard for Accessible and Usable Buildings and Facilities (ANSI A117.1-2009).
2. Standards: Reference to the following standards infers that installation, equipment and material shall be within the limits for which it was designed, tested and approved, in conformance with the current publications and standards of the following organizations:
 - a. American Gas Association - AGA.
 - b. American National Standards Institute - ANSI.
 - c. American Society of Heating Refrigerating and Air Conditioning Engineers - ASHRAE.
 - d. American Society of Mechanical Engineers - ASME.
 - e. American Society for Testing and Materials - ASTM.
 - f. National Electrical Manufacturers' Association - NEMA.
 - g. National Fire Protection Association - NFPA.
 - h. Sheet Metal and Air Conditioning Contractors National Association, Inc. - SMACNA.

B. Definitions:

1. "Accessible" means arranged so that an appropriately dressed man 6'-2" tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended; and may then position himself to properly perform the task to be accomplished, without disassembly or damage to the surrounding installation.

2. “Authority Having Jurisdiction” is the individual official, board, department, or agency established and authorized by the political subdivision created by law to administer and enforce the provisions of the Code as adopted or amended.
3. “As Specified” denotes a product, system, or installation that:
 - a. Includes salient characteristics identified in the Drawings and Specifications.
 - b. Meets the requirements of the “Basis of Design”.
 - c. Is produced by a manufacturer listed as acceptable on the Drawings or in the Specifications.
4. “Basis of Design” refers to products around which the design was prepared. Some or all of the particular characteristics of Basis of Design products may be critical to the fit or performance of the completed installation. Such characteristics are often subtle. Where substitutions are made to products that are the Basis of Design, the Contractor is alerted that nominally acceptable substitutions may produce undesirable side effects such as products that no longer fit the space due to increased product dimensions. The Contractor is responsible for resolving impacts of substitutions. Approval of a substitution request does not relieve the Contractor of complying with the design intent and applicable Codes. Reference to a specific manufacturer’s product (even as “Basis of Design”) does not necessarily establish acceptability of that product without regard to compliance with other provisions of these specifications.
5. “Contracting Agency” is the Owner as defined in the General Conditions of the Contract.
6. “Demolish” means to permanently remove a component, equipment, or system and its appurtenances with no intent for reuse and to properly disposal of it.
7. “Furnish” means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere, as noted or agreed, to be installed by supporting crafts.
8. “Install” means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.
9. “Product” is a generic term that includes materials, equipment, fixtures and any physical item used on the project.
10. “Provide” means furnish products, labor, subcontracts, and appurtenances required and install to a complete and properly operating, finished condition.
11. “Remove” means to remove a component, equipment, or system and its appurtenances and either store it for re-installation/reuse, or turn it over to the Contracting Agency.
12. “Rough-in and Connect” means provide an appropriate system connection such as water services with stops, continuous wastes with traps, shutoff valves, and piping connections, testing, etc., for proper operation, ready for furnished products to be installed. Equipment

furnished is received, uncrated, assembled and set in place by supporting crafts unless prior arrangements are made to hire the rough-in installer for this work.

13. "Serviceable" means arranged so that the component or product in question may be properly removed and replaced without disassembly, destruction or damage to the surrounding installation. "Serviceable" components shall be "accessible".
14. "Shop Drawings" are dimensioned working construction drawings drawn to scale to show an entire area of work in sufficient detail to demonstrate service and maintenance clearances and coordination of all trades.
15. "Substitution" is a product, system or installation that is not by a listed manufacturer or does not conform to all salient characteristics identified in the Project Manual, but that the Contractor warrants meets specific requirements listed in the Project Manual.
16. "System Drawing" is a diagrammatic engineered drawing that shows the interconnection and relationship between products to demonstrate how the products interact to accomplish the function intended. Examples of system drawings include plumbing diagrams, control and instrumentation diagrams, and wiring diagrams. Some drawings, such as dimensioned and complete Fire Suppression Drawings may be both System Drawings and Shop Drawings.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Provide labor, products and services required for the complete installation, checkout, and startup of mechanical systems shown and specified. Coordinate related work, including the work of other crafts, to provide each system complete and in proper operating order.
2. Cooperate with others involved in the project; with due regard to their work, to promote rapid completion of the entire project.
3. Become thoroughly familiar with the local conditions under which the work is to be performed. Schedule work with regard to seasons, weather, climatic conditions, and other local conditions that may affect the progress and quality of the work.
4. Coordinate and perform demolition in support of the project whether or not such requirements are described on the Drawings. Restore systems that are to remain but that are affected in any way by demolition work. Conduct a site visit prior to bid to determine Scope.
5. In general, the mechanical, electrical and building automation systems are interrelated. Coordinate the interface and operation of systems so that interrelated systems operate in proper synchronization and balance.

1.4 PREINSTALLATION MEETINGS

- A. Meet with and coordinate Divisions 20, 21, 22, 23, 25 work with the interrelated work of other trades including Architectural, Civil, Structural, and Electrical to identify and resolve potential conflicts.

1.5 SUBMITTALS

- A. Refer to Division 1 for general submittal requirements for the items listed below, supplemented with the additional requirements listed. In addition, prepare Divisions 20, 21, 22, 23, 25 submittals in accordance with the following.
- B. General:
 - 1. The Contracting Agency's obligation to review submittals and to return them in a timely manner is conditioned upon the prior review and approval of the submittals by the Contractor as required by the Construction Contract.
 - 2. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Project Manual.
 - a. Submittals will not be checked for quantity, dimension, fit, or for proper technical design of manufactured equipment.
 - b. Provision of a complete and satisfactory working installation is the responsibility of the Contractor.
 - 3. Furnish suppliers with the applicable portions of the Project Manual and review and verify that the suppliers' submittals clearly represent products which comply with the Project Manual.
 - 4. Master Submittal Log
 - a. Create and maintain a master submittal log for items submitted in Divisions 20, 21, 22, 23, 25, including test results, certifications, record drawings, etc.
 - b. Submit master submittal log, independent of other submittals, as the first submittal for review and approval by the Contracting Agency.
 - c. Update submittal log with each submittal action.
 - d. Share an electronic copy with Contracting Agency and Engineer at two week intervals, or as requested by the Contracting Agency.
- C. Coordination:
 - 1. Prior to a submittal's submission for approval, hold a meeting of all construction trades to review shop drawings and submittals. Each trade shall cross-check shop drawings and submittals for conflicts, clearances, physical space allocation and routing, discrepancies,

dimensional errors, omissions, contradictions, departures from the Contract requirements, correct electrical/mechanical services and connections.

2. Review, revise, correct, and appropriately annotate submittals prior to submission for approval.
3. Keep a current copy of approved submittals and the submittal log at the job site.

D. Electronic Submittals:

1. Provide electronic submittals in PDF format in addition to hard copy submittal. Maximum file size to be coordinated with Contracting Agency.
2. Follow the organization and formatting required for paper submittals.
3. Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.
4. If individual PDF files are provided for a product or shop drawing sheet(s), organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
5. Create PDF documents without security, to be searchable, and to allow copy and paste. For scanned documents, run the optical character recognition (OCR) function to ensure the document is searchable and can be copied and pasted.
6. Reduce PDF file size by removing data and file creation elements not needed for final file presentation.

E. Product Data:

1. General:
 - a. This section describes in detail the preparation of mechanical product submittals. Submittals not provided as described shall be rejected without review. This procedure is designed to accelerate and improve the accuracy of the technical review process, as well as, simplify the preparation of the Installation, Operation, and Maintenance Manuals (IO&Ms).
 - b. Product data for each specification section shall be submitted in one complete package, except as noted in this section.
2. Submittal Organization:
 - a. Organize product submittal information in the same order as the products are specified. Provide a separate tabbed divider for each Divisions 20, 21, 22, 23, 25 specification section. Provide the typed section number on each tab.
 - b. Within each section, organize product information in the same order as products are specified in Part 2 of each applicable specification section. Provide sub-tabs

within each section for each separate product article. Provide the typed product article number on each tab.

- c. Provide product submittal information for each product specified in 8-1/2" x 11" format. Fold-out 11" x 17" format is also acceptable.
- d. If a particular specified product is being omitted from the product submittal or will not be used for the project, provide a single sheet within the article tab identifying the product and annotated with a brief reason why the product is not being submitted, for example: "NOT USED," "NO SUBMITTAL REQUIRED," "TO BE SUBMITTED BY (PROVIDE DATE)," etc. This will inform the reviewer that the product was not overlooked.
- e. Partial submittals from individual subcontractors may be provided which cover a particular sub-contractor's scope of work. In this case, arrange partial submittals by system classification such as: PLUMBING, HEATING, FIRE SUPPRESSION, VENTILATION, BUILDING AUTOMATION SYSTEM, etc. Within each system classification, arrange product submittals by specification section, as described, such that each specification section can easily be reorganized into a master set of Divisions 20, 21, 22, 23, 25 product submittals organized by specification section. This will greatly simplify the preparation of IO&M manuals as described below.
- f. Bind product submittal information in identical 3 inch wide, hard-backed, loose-leaf, 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes so that the pages in each binder rest naturally on one side of rings.
- g. Provide a master table of contents at the front of each volume which lists the Divisions 20, 21, 22, 23, 25 specification sections and indicates which sections are located within each volume.
- h. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
- i. Provide identical cover and spine inserts for each product submittal volume, to include the following typed information:
 - 1). The Contracting Agency Name.
 - 2). Project Name.
 - 3). Contractor Name.
 - 4). Subcontractor Name preparing the submittal.
 - 5). Date that the submittal or resubmittal was initiated.
 - 6). "Mechanical Product Submittals" or "Plumbing Product Submittals" etc. as appropriate.

7). "Volume 1 of X, Volume 2 of X," etc.

3. Product Information:

- a. Indicate manufacturer's name and address, and local supplier's name, address, phone number.
- b. Indicate each product as "Basis of Design", "Specified Equal" or "Proposed Substitution."
- c. Identify catalog designation and/or model number.
- d. Provide manufacturer's product literature. Neatly annotate to indicate specified salient features, appurtenances and performance criteria for each product specified to demonstrate compliance with the Project Manual to include scheduled information, drawing information and specified information.
- e. Indicate product deviations from the Project Manual and mark out non-applicable items on generic "cut-sheets."
- f. Include manufacturer provided dimensioned equipment drawings with rough-in mechanical and electrical connections.
- g. Include operation characteristics, performance curves and rated capacities.
- h. Include motor characteristics and wiring diagrams.
- i. Include weight of equipment. Including accessories.
- j. Provide basic manufacturer's installation instructions.

4. Product Substitutions:

- a. Clearly indicate both in the section table of contents and on the individual product submittal information each proposed substitution, deviation or change from the product as described in the Project Manual.
- b. Submittal approval does not include substitutions, deviations or changes from the requirements of the Project Manual unless they are specifically itemized and approved. The term "No Exceptions Taken" will not apply to substitutions, deviations or changes not clearly identified.
- c. Provision of a satisfactory working installation of equal quality to the system as described in the Project Manual shall be the responsibility of the Contractor.
- d. Correct unapproved deviations from the Project Manual discovered in the field as directed by and at no additional cost to the Contracting Agency.
- e. Cost of any design modifications as a result of proposed product substitutions shall be borne by the Contractor.

F. System Drawings:

1. Submit System Drawings for dynamic elements/systems of the project which are performance specified to include but not limited to: Fire Suppression Systems, Building Automation Systems and stand-alone packaged equipment.
2. Prepare system drawings on full sized sheets of the same size as the original construction drawings.
3. Include with each system a sequence of operation narrative which describes each mode of system operation in sufficient detail to demonstrate compliance with the Project Manual to the satisfaction of the Contracting Agency.

G. Shop Drawings:

1. General:
 - a. The Project Manual documents are not intended for nor are they suitable for use as shop drawings. Project Manual documents shall not be utilized for the actual fabrication or installation of products or equipment.
 - b. The Drawings are partly diagrammatic and do not show all offsets in piping or ducts, and may not show in minute detail all features of the installation; however, provide systems complete and in proper operating order.
 - c. Locations of products are approximate unless dimensioned.
 - d. Divisions 20, 21, 22, 23, 25 products and systems shall not be installed without shop drawings approved by the Contracting Agency.
 - e. Rework, changes or additional engineering support required as a result of the installation of products and systems prior to the approval of applicable shop drawings by the Contracting Agency shall be provided at the Contractor's expense.
 - f. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry. Special items are identified by a supplementary list of graphical illustrations, or identified on the drawings or specifications.
2. Preparation:
 - a. Review each Divisions 20, 21, 22, 23, 25 specification section and identify the shop drawing requirements.
 - b. Combine the shop drawing requirements first by system (i.e. ventilation system, heating system, plumbing system, etc.) and then by area (i.e. fan room, boiler room, etc.).
 - c. Prepare shop drawings on full sized sheets of the same size as the original construction drawings.

- d. Arrange shop drawings to scale, showing dimensions where accuracy of location is necessary for coordination or communication purposes.
 - e. Incorporate the actual dimensions and configurations of the products and systems approved through the product submittal process into the shop drawings.
 - f. Provide dimensioned maintenance clearance areas around each product as recommended by the manufacturer.
 - g. Coordinate Divisions 20, 21, 22, 23, 25 work with the interrelated work of other trades including Architectural, Civil, Structural, and Electrical.
 - h. Identify and provide recommendations to resolve major conflicts which may impact the design of the systems as shown. Such conflicts will be resolved during the shop drawing review process.
 - i. Identify locations where field coordination between various trades is necessary to avoid conflicts.
 - j. Indicate elevation of piping, ductwork and equipment above or below finished floor at various locations and in sufficient detail to demonstrate clearance from structural elements and the work of other trades.
 - k. Coordinate placement of openings and holes through structure, walls, floors, ceilings, and roof with Structural and Architectural.
3. Submittal:
- a. Submit dimensioned shop drawings as specified to demonstrate proper planning and sequencing of the applicable trades for the installation and arrangement of Divisions 20, 21, 22, 23, 25 with respect to other interrelated work.
 - b. Partial shop drawings submittals (i.e. heating system only) will be rejected without review, as the interrelationship with other related work and overall system fit cannot be evaluated.
 - 1). Underslab shop drawings may be submitted separately for review to accommodate the construction schedule.
 - c. It is assumed that shop drawings submitted for review have been thoroughly prepared and coordinated and that the products and systems can and shall be installed as shown. Conflicts which are not clearly identified and annotated on the submitted shop drawings are assumed not to exist.
 - d. Installation conflicts arising from the failure to properly coordinate the work of related trades shall be provided at the Contractor's expense.

H. Certificates:

1. Review the submittal requirements for Certificates for each Divisions 20, 21, 22, 23, 25 specification section.
 2. Submit copies of certificates as specified. This information may be included within the Installation, Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.
- I. Test and Evaluation Reports:
1. Review the submittal requirements for Test and Evaluation Reports for each Divisions 20, 21, 22, 23, 25 specification section.
 2. Submit copies of reports as specified. Also include these reports within the Installation, Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.
- J. Installation, Operations and Maintenance (IO&M) Manuals:
1. Review the submittal requirements for IO&M manuals for each Divisions 20, 21, 22, 23, 25 specification section.
 2. Begin the preparation of the mechanical IO&M manuals with a complete and fully approved set of mechanical product data submittals organized, annotated and with the product information as indicated within the "Product Data" submittals article above and in each Divisions 20, 21, 22, 23, 25 section.
 3. Next, augment each individual product submittal with the written installation, operations and maintenance information for each approved product. This type of information is not applicable (or available) for bulk commodity or simplistic products such as copper pipe, basic pipe hangers or equipment tags, etc.
 4. Annotate the installation, operations and maintenance information to indicate applicable information for the specific equipment model(s) installed.
 5. Maintenance information shall include:
 - a. Preventive maintenance requirements for each product, including the recommended frequency of performing each preventive maintenance task.
 - b. Instructions for troubleshooting, minor repair and adjustments required for preventive maintenance routines, limited to repairs and adjustments that may be performed without special tools or test equipment and that require no extensive special training or skills.
 - c. Information of a maintenance nature covering warranty items, etc., that have not been discussed in the manufacturers' literature.
 - d. Information on the spare and replacement parts for each product and system. Properly identify each part by part number and manufacturer.
 - e. Recommended spare parts list.

6. Organize the IO&M manual information by specification section (not by sub-contractor) with a tabbed divider separating each section. Provide the typed section number on each tab.
7. Within each section, organize the product information in the same order as the products are specified in Part 2 of each applicable section. Provide sub-tabs within each section for each product. Provide the typed product article number on each tab.
8. Bind the information in identical 3 inch wide; hard-backed, loose-leaf, 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes so that the pages in each binder rest naturally on one side of rings.
9. Provide a master table of contents at the front of each volume which lists the Divisions 20, 21, 22, 23, 25 specification sections and indicates which sections are located within each volume.
10. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
11. Provide identical cover and spine inserts for each IO&M manual volume, to include the following typed information:
 - a. The Contracting Agency Name.
 - b. Project Name.
 - c. "Mechanical Installation, Operations and Maintenance Manual".
 - d. "Volume 1 of X, Volume 2 of X," etc.
12. Submit copies of Operation and Maintenance Manuals in electronic format (Adobe PDF).

1.6 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Review the manufacturer's warranty requirements for each Divisions 20, 21, 22, 23, 25 specification section.
2. Submit required warranty documentation to the applicable Manufacturer's Representative to validate standard manufacturer's warranty for each required product. Obtain written confirmation of receipt from each applicable Manufacturer's Representative.
3. Provide Contracting Agency one copy of submitted warranty documentation and written confirmation of receipt for each applicable Manufacturer's Representative. This information may be included within the Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.

4. Provide statement of Contractor's warranty of workmanship, labor, and materials, as described under Article 1.12 Warranty below.

B. Record Documentation:

1. General: As the Work progresses, neatly annotate a designated and otherwise unused set of Divisions 20, 21, 22, 23, 25 Contract Drawings to show the actual locations and routing of Divisions 20, 21, 22, 23, 25 Work and the terminal connection points to related Work. As a minimum, include the following:
 - a. Annotate record drawings to incorporate each applicable addendum.
 - b. Annotate record drawings as directed by each applicable Request for Information (RFI) and accepted Change Order Proposal.
 - c. Modify record drawings to show actual equipment sizes and locations and pipe and duct routing. Revise pipe and duct sizes as appropriate.
 - d. Provide dimensioned locations for permanently concealed piping and ductwork (i.e. piping cast in concrete or buried underground/underslab).
 - e. Show the actual locations of system isolation valves, especially valves which are concealed above ceilings and behind access panels.
2. Preparation:
 - a. Neatly annotate record drawings to provide clear interpretation to support electronic drafting by a third party.
 - b. Tape electronic sketches from addendums and/or RFIs directly to the record drawings as overlays.
 - c. Annotate the record drawings in colored pencil using the same symbols and abbreviations as indicated in the Divisions 20, 21, 22, 23, 25 legends and schedules of the Contract Drawings.
 - 1). Red to add information.
 - 2). Green to delete information.
 - 3). Blue to provide additional clarifying information which is not to be drafted.
 - d. After submittal to the Contracting Agency, provide additional clarification, information or rework as necessary to support the accurate interpretation and electronic drafting of the record drawings.

3. Submittals:

- a. Provide dimensioned underslab record drawings to the Contracting Agency prior to placing the slab. For slabs placed in multiple sections, provide record drawings for the applicable slab sections to the Contracting Agency prior to each pour.
- b. Provide complete record drawings for concealed areas (i.e. above lay-in and hard ceilings and inside walls) to the Contracting Agency prior to concealment.
- c. Provide the remaining portion of the record drawings for exposed areas to the Contracting Agency prior to the final completion of the project.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts:

1. Furnish spare parts for systems and equipment as listed in applicable sections of Divisions 20, 21, 22, 23, 25.
2. Clearly label each part with name, manufacturer's part number, system and/or equipment where used and location.
3. Deliver parts to location and person designated by the Contracting Agency, in durable storage boxes.
4. Group cartons containing smaller items by system or application and deliver in an appropriate number of storage boxes.

- B. Tools: Provide three sets of special tools and testing and monitoring equipment as listed in applicable sections of Divisions 20, 21, 22, 23, 25.

1.8 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Companies specializing in manufacturing the Products specified in the Divisions 20, 21, 22, 23, 25 sections with documented experience.
2. Fabricators: Companies specializing in fabricating the Products specified in the Divisions 20, 21, 22, 23, 25 sections with documented experience.
3. Installers: Perform the Work using qualified workmen that are experienced and usually employed in the trade.
4. Testing Agencies: Products requiring electrical connection shall be listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and as indicated.

B. Product Testing and Certification:

1. Nationally Recognized Testing Laboratory (NRTL) Labeling: Electrical equipment and conductors shall be “Approved,” “Certified,” “Identified,” or “Listed” and “Labeled” to establish that the electrical equipment is safe, free of electrical shock and fire hazard, and suitable for the purpose for which it is intended to be used. The manufacturer shall have the specific authorization of one of the Occupational Safety and Health Administration (OSHA) approved Nationally Recognized Testing Laboratories (NRTLs) in accordance with the applicable national standards to label the equipment as suitable.
2. Where the words Listed, UL Listed, UL Labeled, Underwriters Laboratories, Inc., UL, or variations of this terminology, appear under this Division of the Specifications or the associated drawings, it is understood that a comparable testing agency as defined by NRTL above is acceptable.
3. Such testing and certification is generally applicable to products within the following categories:
 - a. Life safety and fire suppression.
 - b. Fuel burning equipment, except certain classes of power or industrial equipment for which other recognized certification applies as well.
 - c. Factory fabricated and wired electrical control panels and packaged equipment with factory installed electrical controls or panels.
 - d. Components for life safety systems, fuel systems and medical gas systems.
4. The listing under Paragraph ‘3’ above is provided for illustration of requirements and is not exclusive. Provide products that have been tested and listed for the intended application when such products are available unless the Contracting Agency has provided written exemption on an itemized basis.
5. Provide electrical products listed and labeled by UL, FM, ETL or other approved NRTL. If listing and labeling is not available, stamp the submittal for these products by an Alaska Registered Professional Engineer approved by the Authority Having Jurisdiction, at no additional cost.
6. Where interpretation is required, the Contracting Agency will provide direction and will be the sole judge in cases of compliance with this subsection.

1.9 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Verify products are new and delivered in original factory packaging/crating and are free from damage and corrosion.
2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.

3. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.

B. Storage and Handling Requirements:

1. Store products in covered storage area protected from the elements, outside the general construction area until installed.
2. Store products in original factory packaging until actual installation.
3. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
4. Replace damaged items with same item in new condition.

1.10 WARRANTY

- A. See Division 1 for general warranty requirements.
- B. Warranty workmanship, labor, and materials for a period of one year from the date of final acceptance, without limitation, except where longer warranty periods are specified in a specific Section under this Division, or in the General Conditions of the Contract. Promptly coordinate and perform Warranty work at the Contractor's sole expense.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Cover and protect open ends and individual components of the ventilation and piping systems during construction when dust, dirt, debris, overspray, or other potential construction contaminants could enter the air distribution system or elements (ducts, fans, VAV boxes, silencers, etc.).
2. Provide temporary construction filters over return airshaft openings and at air handling unit return air dampers.

B. Demolition/Removal:

1. Examination:
 - a. Drawings involving existing conditions are based on building record drawings and limited field observation.

- b. Conduct a site inspection prior to submission of Bid to become thoroughly familiar with the Scope of Work.
 - c. Report discrepancies to the Contracting Agency before disturbing existing installation.
 - d. Verify field measurements, locations, sizes, and routing arrangements and site conditions.
 - e. Commencement of demolition implies Contractor accepts existing conditions.
2. Preparation:
- a. In buildings that will remain occupied during construction, coordinate with the Contracting Agency in advance before scheduling disruption of services.
 - b. Accommodate the Contracting Agency's normal business schedule to the maximum extent possible.
 - c. Provide temporary mechanical systems to maintain existing systems in service during construction. Submit plan for providing temporary services for approval.
 - d. Cover and protect open ends and individual components of the ventilation and piping systems during construction when dust, dirt, debris, overspray, or other potential construction contaminants could enter the air distribution system or elements (ducts, fans, VAV boxes, silencers, etc.).
 - e. Provide temporary construction filters over return air openings and at air handling unit return air dampers.
 - f. When work must be performed on operating equipment or systems, use personnel experienced in the operation of the specific equipment affected.
 - g. Notify the Contracting Agency and the Fire Department Agencies at least 24 hours before partially or completely disabling Fire Suppression, Alarm, or Notification Systems.
3. Execution:
- a. Remove, relocate, and extend existing installations to accommodate new construction as shown and as required for phasing or final systems operations.
 - b. Disconnect and remove abandoned fixtures, terminal units and other products. Remove abandoned controls and associated wiring to source of signal and supply.
 - c. Remove abandoned piping and ductwork back to source of supply or other point as shown, and cap tight to accept normal system test pressures.
 - d. Remove exposed abandoned or indicated for demolition controls, equipment, pipes and ducts, including abandoned items above ceiling finishes. Cut concealed pipes

and ducts flush with walls and floors. Remove brackets, stems, hangers and other accessories. Fill and repair surfaces to match surrounding finish work.

- e. Repair damaged surfaces, insulation, ceiling tiles, and fireproofing. Plug, patch, repair holes, and surfaces. Repair assemblies to match existing fire, temperature, and/or smoke ratings. Refinish surface to match surrounding finish work.
- f. Seal room penetrations to maintain pressure relationships to adjacent spaces.
- g. Maintain access to existing mechanical and electrical installations that remain active. Modify installation or provide access panels as appropriate; coordinate with the Contracting Agency.
- h. Turn salvaged items over to the Contracting Agency as noted on the Drawings. Dispose of items that the Contracting Agency does not desire to retain at a legal disposal site.
- i. Recover refrigerant charge from existing units to be demolished in accordance with EPA section 608 of the Clean Air Act of 1990. Remove recovered refrigerant from the premises.

3.2 INSTALLATION

A. Special Techniques:

- 1. Provide temporary heating to maintain the building at 65 degrees F.
- 2. Provide temporary ventilation with filtration during construction.

B. Interface with Other Work:

1. Electrical Work:

- a. Coordinate with Division 26, 27, and 28.
- b. See also specification section 20 05 13 - Common Motor Requirements.
- c. Suggested Coordination Schedule: The Contractor is responsible to provide heating, ventilating, and plumbing equipment motors and controls, including fire suppression controls. Unless otherwise indicated on the Drawings, it is recommended that motors and controls be furnished, set in place, and wired in accordance with the following schedule. "CC" applies to either a Control subcontractor working as a sub to the General Contractor or to the Divisions 20, 21, 22, 23, 25 Mechanical subcontractor. Coordinate work between subcontractors.

MC - Divisions 20, 21, 22, 23, 25-Mechanical CC - Divisions 20, 21, 22, 23, 25-Controls EC - Divisions 26, 27 and 28-Electrical	Furnished By	Set in Place By	Power By	Control By
Equipment Motors	MC	MC	EC	CC
*Magnetic motor starters:				
Automatic controlled, w/ or w/o HOA switches	EC	EC	EC	CC
Automatic controlled, w/ or w/o HOA switches, and that are furnished as part of factory wired equipment	MC	MC	EC	MC
*Manual Motor Starters:				
Manually controlled	EC	EC	EC	EC
Manually controlled, and that are furnished as part of factory wired equipment	MC	MC	EC	MC
Combination disconnect and motor starter	EC	EC	EC	CC
Motor Control Centers	EC	EC	EC	CC
Variable Speed Drives	MC	EC	EC	CC
Push-button stations, pilot lights, contactors, multi-speed switches	EC	EC	EC	EC
Disconnect switches, thermal overload switches, manual operating switches	EC	EC	EC	--
Multi-speed switches furnished as part of factory wired equipment	MC	MC	EC	MC
Temperature control relays, transformers, electric thermostats, time clocks, etc., that are not part of factory furnished equipment	CC	CC	CC	CC
Remote bulb thermostats, motor valves, controls, which are an integral part of factory furnished mechanical equipment.	MC	MC	EC	MC
Fire sprinkler suppression controls	MC	MC	EC	MC
Duct smoke detectors, including relays for fan shutdown	MC	MC	EC	EC
Fire/Smoke Dampers	MC	MC	EC	EC
Control Systems	CC	CC	CC	CC
Damper & Valve Actuators (120 v)	CC	CC	EC	CC
Damper & Valve Actuators (24 v)	CC	CC	CC	CC
Master Building Power quality monitors (loss/reversal)	EC	EC	EC	CC

* Provide starters in accordance with the Electrical Division of these Specifications. Note that a thermal overload relay in each phase is required for each starter (packaged equipment included).

2. Coordination with Room Numbering:

- a. Certain systems provided under this Division rely on identification systems that are based on room names or numbers.
- b. The numbering scheme indicated in this Project Manual is based on room numbers assigned during the design process.
- c. The Contracting Agency reserves the right to change the numbers prior to Substantial Completion, and the final names and numbers will not necessarily match those found in the Project Manual.
- d. Obtain from The Contracting Agency the final room numbers prior to commencing the numbering of Divisions 20, 21, 22, 23, 25 systems.
- e. Tag and label system equipment and devices in accordance with the final numbering scheme at no additional cost.

3.3 REPAIR/RESTORATION

- A. Touch-up, repair or replace product components broken during installation or startup with new replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.
- C. Clean and repair existing identification tags/labels, hangers, supports, insulation, materials, instrumentation, and equipment that remain or are to be reused or are affected by this work. Materials and equipment which require major repair may be replaced at the Contractor's option.
- D. Plug, patch and repair surfaces, adjacent construction, and finishes damaged during demolition and new work. Restore to original condition or better including fire, smoke or temperature ratings or listings. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish. Replace cracked or damaged ceiling tiles. Repair fire proofing, assembly fire ratings, and construction resistant to the passage of smoke.

3.4 SITE QUALITY CONTROL

A. Site Tests and Inspections:

1. The Contracting Agency may inspect and approve sample installation of systems and equipment prior to general installation of units.
2. Schedule, obtain, and pay for fees and/or services required by the local Authorities Having Jurisdiction and by these specifications, to test the mechanical systems.
3. Notify the Contracting Agency a minimum of 24 hours in advance of tests. Certify in writing that specified tests have been made in accordance with the specifications.

4. Immediately correct deficiencies that are discovered during the tests and repeat tests until system is approved. Do not cover or conceal piping, equipment or other portions of the mechanical installations until satisfactory tests are made and approved.
5. Under the direction of the Contractor and in the presence of the Contracting Agency, place the entire mechanical installation and/or any portion thereof in operation to demonstrate satisfactory operation.
6. Arrange for the Contracting Agency to witness tests. The Contracting Agency may waive witnessing any specific test at its discretion.

B. Non-Conforming Work:

1. Expediently remove and provide new for work not conforming to the Project Manual upon discovery; including warranty and discovery periods.
2. Warranty period shall start over for replaced equipment and installation from the date of accepted by the Contracting Agency.

C. Manufacturer Services:

1. Authorized manufacturer's representative shall be on-site for testing, start-up, functional check-out, and commissioning of equipment and systems.
2. Procurement, installation, start-up, and warranty services to be provided by manufacturer's authorized representative and service company.
3. Equipment, devices, hardware, and software to be approved for application, and of current production. Original manufacturer's parts, hardware, software, and support to be available for ten years after installation.

3.5 CLEANING

- A. Upon completion of installation and prior to initial operation, remove debris, and clean and wipe down equipment, piping, ductwork and floor to eliminate dust and dirt.

3.6 CLOSEOUT ACTIVITIES

- A. Demonstration: Provide demonstration, conducted by authorized factory start-up personnel, to the Contracting Agencies authorized personnel as listed in each individual specification section.
- B. Training: In addition to training specified in each individual specification section, provide 4 additional hours of operational instruction conducted by qualified personnel, covering any of the mechanical systems and installation requested by the Contracting Agency to its authorized maintenance personnel.

END OF SECTION 20 00 00

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SECTION 20 05 13

COMMON MOTOR REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: This section describes general requirements, products and methods of execution relating to electric motors in general and shall apply to motors furnished as integral parts of equipment specified in this and other Divisions.
- B. Related Sections:
 - 1. 20 00 00 - Mechanical General Requirements
 - 2. 23 34 00 - HVAC Fans
 - 3. 23 74 23 - Packaged Makeup Air Units
 - 4. 23 82 00 - Terminal Heating and Cooling Units

1.2 REFERENCES

- A. Codes and Standards: National Electrical Manufacturers Association, NEMA, Standards Publication Motors and Generators, MG-1.

1.3 SYSTEM DESCRIPTION

- A. Performance Requirements: Provide product performance characteristics as specified or scheduled on drawings.

1.4 PREINSTALLATION MEETINGS

- A. Coordinate installation of electrical motors with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

1.5 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum 3 years' experience.

- B. Certifications: Motors shall conform to governing NEMA Standards and ASA Form C-50 for rotating machinery.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Delivery and Acceptance Requirements:

1. Verify motors are new and delivered in original product/factory packaging/crating and are free from damage and corrosion.
2. Replace products delivered to job site that does not comply with above requirements at no expense to Owner.

- B. Storage and Handling Requirements:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Replace damaged items with same item in new condition.

1.7 WARRANTY

- A. Manufacturer Warranty: See Section 20 00 00 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 MOTORS IN ELECTRICAL CLASSIFIED LOCATIONS

- A. Motors used in environments indicated to be NEC Class I, Division I shall be built and labeled as explosion-proof for the Group and autoignition temperature, NEC T-code.
- B. Motors used in environments indicated to be NEC Class I, Division II:
 1. Listed for Class I Division I environments.
 2. Listed for Class I Division II environments.
 3. Does not have arc-producing brushes or switching mechanisms which could act as ignition sources.
 4. Motors that include a space heater, its surface temperature may not exceed 80% of the autoignition temperature of the hazard.

2.2 SUPPLY VOLTAGE

- A. Supply voltage shall be determined from the electrical plans where nominal utility voltage will be indicated.
- B. Motor voltage shall be stamped on the nameplate and relate to the nominal voltage as follows:

THREE PHASE MOTORS	
Nominal Volts	Motor Ratings
208 volts	200V, 208V, or 208/220V
240 volts	220V or 208/220V
480 volts	460V
SINGLE PHASE MOTORS	
Nominal Volts	Motor Ratings
120 volts	115V or 115/230V
240 volts	230V or 115/230V
208 volts	200V or 208V

Note: Provide nameplate indicating that voltage for a motor operating at 208 VAC is suitable.

- C. Voltage variation: Motors shall be designed to operate within the parameters of these requirements at rated load and with a voltage variation from the name plate voltage of plus or minus ten percent.
- D. Motors shall operate successfully at rated load and at rated voltage with a maximum frequency variation of five percent above or below rated frequency.
- E. Motors shall operate successfully at rated load with a combined maximum variation in the voltage and frequency of five percent above or below rated voltage and rated frequency.

2.3 MOTOR INSULATION

- A. Unless otherwise specified, motor insulation shall be NEMA Class "B" (or better). Based on 40 degrees C. maximum ambient, and 90 degrees C. maximum rise, total maximum operating temperature shall not exceed 130 degrees C.

2.4 MOTOR LOADING

- A. No motors shall be subjected to loads exceeding the motor nameplate rating, under any normal operating condition.

2.5 MOTOR RATING

- A. Motors are sized in conformity with the manufacturer's published information and shall not be interpreted as the final requirement. Check each motor for adequacy in relation to the specific application.

2.6 HIGH EFFICIENCY AC MOTORS

- A. Furnished high efficiency electric motors for equipment that:
1. Require a three horsepower or larger drive motor.
 2. Have duty cycles classified as continuous.
- B. Efficiency of the motors shall be determined by NEMA Standard MG 1 - 12.536 and shall have efficiencies equal to or better than:

Motor Size	Nominal Efficiency
Through 3 HP	89 percent
Over 3 HP through 10 HP	91 percent
Over 10 HP through 30 HP	93 percent
Over 30 HP through 60 HP	94 percent
Over 60 HP through 100 HP	95 percent
Over 100 HP	95 percent

2.7 MOTOR HOUSING FEATURES

- A. Open drip-proof, totally enclosed fan cooled (TEFC), or explosion-proof, as appropriate for the use intended and the environment where installed, or as noted. Provide totally enclosed fan cooled motors for equipment below grade, located outdoors, or operating in damp or dust-laden locations. Provide a continuous moisture drain that is screened against insect entry for totally enclosed motors.
- B. Oversized external conduit boxes at least one size larger than NEMA standard.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions: Cover motors to protect them from construction dirt and debris.

3.2 INSTALLATION

A. Special Techniques:

1. Installation of motors shall be as required by the driven equipment. Make sure motor design and characteristics are suitable for the application.
2. Electrical connections for motors shall conform to NEC Articles 430 and 440 as applicable, and to any state and local code having jurisdiction.
3. Unless furnished as part of a complete package including disconnects and control, and/or motor fuse protection, protect motors by Bussmann Fusetron Dual-Element Time Delay fuses, or approved equal.
4. Megger motor windings prior to starting. Include log of megger readings in the Operations and Maintenance manuals.
5. Verify correct rotation of motors.
6. Comply with Article 460 of the National Electrical Code for installation of power factor correction capacitors.
7. Motor sizes shown on the Drawings are estimates based upon the mechanical design. Where motors actually furnished are of a different size than those shown, motor circuit components (starters, disconnects, overcurrent devices, and conductors) shall be revised to suit the motors actually furnished, without increase in the Contract amount. Similarly, motor overcurrent device sizes shown on the Drawings or specified are based upon estimated motor code letters, overcurrent device manufacturers' recommendations, and full-load currents from the NEC Tables. Where the motors actually furnished require different sizing, the sizes of the overcurrent devices shall be adjusted to conform to the NEC, without increase in the Contract amount.

3.3 REPAIR/RESTORATION

- A. Repair any components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

END OF SECTION 20 05 13

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SECTION 20 05 29

MECHANICAL HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General hanger and support requirements for building service piping and mechanical equipment not required to be vibration and/or seismically controlled.
2. Penetrations, sleeves and seals.

B. Related Sections:

1. 09 91 00 - Painting
2. 20 00 00 - Mechanical General Requirements
3. 20 05 13 - Common Motor Requirements
4. 20 05 48 - Mechanical Vibration and Seismic Control
5. 20 05 53 - Mechanical Identification
6. 20 07 00 - Mechanical Insulation
7. 22 11 00 - Domestic Water Piping and Specialties
8. 22 13 00 - Sanitary Waste and Vent Piping and Specialties
9. 22 40 00 - Plumbing Fixtures
10. 23 11 23 - Fuel Gas Piping and Specialties
11. 23 31 00 - Ducts and Accessories
12. 23 34 00 - HVAC Fans
13. 23 37 00 - Air Outlets and Inlets
14. 23 74 23 - Packaged Makeup Air Units
15. 23 82 00 - Terminal Heating and Cooling Units

1.2 REFERENCES

A. Codes and Standards:

1. International Building Code (IBC).
2. International Mechanical Code (IMC).
3. Uniform Plumbing Code (UPC).
4. MSS SP69 - Pipe Hangers and Supports - Selection and Application.
5. MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
6. SMACNA HVAC Duct Construction Standards - Metal and Flexible (current edition).

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

1.3 DESCRIPTION

A. Design Requirements:

1. Equipment and piping system support:
 - a. Select and apply pipe hangers and supports per MSS SP69 using stock or production parts whenever possible.
 - b. Design support spacing such that free span of piping does not exceed Code or MSS SP69 criteria (whichever is most restrictive).
 - c. Calculate required supporting force at each hanger location to confirm hanger type and hanger rod diameter selection.
 - d. Provide hangers such that equipment connection points do not carry connected piping load.

B. Performance Requirements:

1. Provide hangers and supports which allow for the free expansion and contraction of system piping without transferring tensile and compressive stresses to adjacent supports or connected equipment. Provide additional expansion loops, pipe anchor and pipe guide assemblies as required.

2. Coordinate hanger and support anchor locations and embedment depth requirements with structural.
3. Provide flexible connectors for piping systems which pass through seismic building joints. Design flexible connects for design building offset plus 100 percent safety factor.
4. Support fire suppression system piping and equipment accordance with the provisions of Section 21 10 00 - Water Based Fire Suppression Systems.
5. Support plumbing piping in accordance with this section and Uniform Plumbing Code requirements; whichever is more restrictive. In case of conflicts, follow UPC guidance.
6. Support ductwork in accordance with Section 23 31 00 - Ducts and Accessories.
7. Special Performance Requirements for Open Ceiling Spaces:
 - a. Coordinate the support of piping, ductwork, lighting and electrical cabling in open ceiling spaces (utilizing the shop drawing review process) to provide a uniform and symmetrical appearance.
 - b. In general, utilize trapeze hanger style support systems with hangers equally spaced based on the limiting component being supported. Provide hanger rods vertical and straight. Trim hanger rod ends to provide a “finished” appearance.

1.4 PRE-INSTALLATION MEETINGS

- A. Coordinate installation of equipment and associated piping or ductwork with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any components.

1.5 SUBMITTALS

- A. See Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
 1. Provide manufacturers catalog data, including load capacity, embedment depth.
 2. Manufacturer’s Installation Instructions: Indicate special procedures and assembly of components.
- C. Shop Drawings:
 1. Provide shop drawings for housekeeping pads and roof curbs (with dimensioned penetrations) and field fabricated support systems.
 2. Provide shop drawings to show system layout with location and detail of hangers, anchors, dimensioned expansion loops and guides.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance (IO&M) Manuals:
 - 1. Refer to Section 20 00 00 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
 - 2. Include the following:
 - a. Copies of approved submittal information.
 - b. Manufacturer's installation, operating and maintenance/repair instructions, parts listings, and spare parts list for each product. Clearly annotate the manual to indicate applicable information for the specific equipment model(s) installed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 00 00.
- C. Record Documentation:
 - 1. Indicate installed locations of hangers, supports and expansion control assemblies on record drawings on associated piping record drawings.
 - 2. Provide Operating and Maintenance Data (installation and adjustment instructions) for non-commodity products.

1.7 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum 3 years documented experience.
 - 2. Installers: Minimum 3 years' experience.
 - 3. Testing Agencies: Provide piping and support systems designed and manufactured per MSS SP58.
 - 4. Licensed Professionals: Provide piping and support systems designed per MSS SP58.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at Site:
 - 1. Verify products are delivered in original factory packaging and are free from damage and corrosion.
 - 2. Replace equipment delivered to job site that does not comply with above requirements at no expense to the Owner.

B. Storage and Protection:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items to avoid damage.
3. Replace damaged items with same item in new condition.

1.9 WARRANTY

A. Manufacturer Warranty:

1. See Section 20 00 00 - Mechanical General Requirements, for general mechanical warranty requirements.
2. Provide 1 year manufacturer's warranty.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. General:

1. Piping and support systems shall be malleable iron, steel or copper.
2. Ferrous hangers and supports installed outdoors or in unheated spaces shall be hot dipped galvanized.
3. Select and apply pipe hangers and supports per MSS SP69.
 - a. Use stock or production parts whenever possible.
 - b. Calculate weight balance to determine the required supporting force at each hanger location and to eliminate pipe weight load at each equipment connection.
4. Fabricate and install pipe hangers and supports per MSS SP89 recommended practices.
5. Hangers shall be designed to securely lock using a mechanical fastener. Hangers and supports using gravity type locking are not acceptable. For example, adjustable swivel ring Type 6 is not allowed.
6. Pre-engineered support systems such as Unistrut, Super-Strut, B-Line and K-Line may be used in accordance with manufacturers load limits.
7. Manufacturers: Grinnell, M-CO Michigan Hanger Company, Kin Line.

B. Plumbing Piping:

1. Conform to the Uniform Plumbing Code requirements.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Adjustable swivel ring; split ring.
3. Hangers for DWV and Cold Pipe Sizes two inch and over: Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe sizes two to four inch: Carbon steel, adjustable, clevis.
5. Multiple or Trapeze Hangers under six inches: Steel channels with welded spacers and hanger rods.
6. Wall Supports: Welded steel bracket and wrought steel clamp.
7. Wall Support for Hot Pipe Sizes six inches and over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
9. Floor Support for Hot Pipe Sizes up to four inches: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and steel support.
10. Vertical Support: Steel riser clamp.
11. Provide copper colored epoxy coated hangers and supports for copper piping. Copper Pipe Support: Carbon steel ring, adjustable, epoxy coated.

2.2 PIPING ROOF SUPPORTS (NON-PENETRATING)

- A. Manufacturers:
 1. Cooper Industries (Dura-Blok)
 2. Miro Industries, Inc.
 3. Pipe Pier.
- B. Resilient, non-abrasive, UV resistant base. Galvanized steel channel and clamps. Zinc plated, adjustable hardware. Compatible with roof system.
- C. Roof supports shall be provided to maintain piping a minimum of 3-1/2 inches above the roof surface.

2.3 ACCESSORIES

- A. Hanger Rods: Mild steel, threaded both ends, threaded one end, or continuous threaded.
- B. Escutcheons: Nickel or chrome plate with screws or springs for holding plate in position.

- C. Pipe Protection Saddles: Shop fabricates, or purchase specially manufactured saddles specifically designed for the intended use. Provide saddles where roller type support is used, or where the pipe hanger is installed outside the insulation for protection of insulating jacket.
- D. Outdoor applications: Metal components shall be galvanized.

2.4 INSERTS

- A. Provide inserts to match the load bearing capacity of hangers scheduled in Part 3.
- B. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over four inches.
- C. Concrete deck inserts: Galvanized rod, steel plate, similar to Kin-Line figure 293.
- D. Screw insert for concrete: Malleable iron similar to Grinnell figure 152.

2.5 PRE-ENGINEERED SUPPORT SYSTEMS

- A. Manufacturers:
 - 1. Unistrut.
 - 2. Super-Strut.
 - 3. B-Line.
 - 4. K-Line.
 - 5. Erico.
- B. Materials:
 - 1. Cold worked steel.
 - 2. Type 304 stainless steel: Use for PVC, liquid-tight flex, or plastic-coated conduit installed to wood construction in outdoor, damp, corrosive or marine environments.
- C. Finish:
 - 1. Heated indoor areas: Pre-galvanized zinc coating.
 - 2. Outdoor areas: Hot dipped galvanized finish. In addition, coat hot dipped galvanized finish channel field cuts with zinc rich paint provide by the support system manufacturer.
 - 3. Painted areas: Paintable galvanizing or phosphatized and primed.
 - 4. Surface metal raceways: U.L. Listed epoxy coating.
- D. Channel:

1. Standard Size: 1-5/8 inch x 1-5/8 inch. Gauge thickness as required for attached load.
2. Standard Hole Pattern: Slotted. Provide solid channel in exposed public areas.

E. Nuts and Hardware:

1. Channel nuts: Hardened steel (ASTM-A675 and ASTM A36).
2. Bolts, screws and nuts: Hardened steel (ASTM-A307, ASTM A563 and SAE J429).
3. Finish: Electroplated zinc.

F. Fittings: Plate steel (ASTM A635). Epoxy or electroplated zinc coating.

G. Mechanical Accessories: Provide accessories from the support system manufacturer designed for the specific equipment to be supported to include but not limited to:

1. Splice and gusset plates.
2. Corner angles.
3. Specialized support brackets.
4. Beam clamps with restraints.
5. Column supports.
6. Strut pipe clamps.
7. Straps.
8. Brackets.

2.6 SLEEVES, ACOUSTICAL SEALS AND FIRE-STOPPING

- A. See Part 3 - PENETRATIONS.
- B. Sleeves for pipes through fire rated and fire resistive floors and walls, and fire proofing: UL listed prefabricated fire rated sleeves and seals.

2.7 WALL/FLOOR PENETRATION WATER SEALS

- A. Mechanical seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and the wall opening.
- B. EPDM seals.
- C. 316 Stainless steel bolts and nuts.

- D. Hot-dipped galvanized or coated sleeve with full water stop flange with continuous weld on both sides.
- E. Manufacturer: Metraflex, Thunderline, Crouse-Hinds, or approved equal.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Installer: Perform work by experienced personnel previously engaged in construction and under the supervision of a qualified installation supervisor.

3.2 PREPARATION

- A. Prior to installation, prepare detailed shop drawings of the planned installation of hanger and support products specified by this section. Coordinate the location, type and size of hangers and supports, housekeeping pads (thickness/perimeter overhang dimensions) and roof curbs with Architectural and Structural elements utilizing the shop drawing review process.
- B. Do not install hangers and supports without approved shop drawings.

3.3 INSTALLATION

- A. Special Techniques:
 - 1. Install vibration isolators, seismic control and wind restraint systems in compliance with the manufacturer's written instructions and certified and approved application engineering installation drawings.
 - 2. Insert and Attachment Installation:
 - a. Inserts:
 - 1). Provide inserts or cast-in-place channels for placement in concrete formwork.
 - 2). Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3). Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 4). Use expansion type anchor bolts with pre-cast concrete including concrete masonry units within loading limits of the pre-cast material and anchor bolt manufacturer's recommendations.

- 5). Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
 - 6). Plastic screw inserts and caulked lead inserts are prohibited, except for mounting instructions and control diagrams.
 - b. Attach mechanical equipment to structure as follows:
 - 1). Hollow masonry: Toggle bolts.
 - 2). Solid masonry and concrete: Preset inserts or expansion bolts.
 - 3). Structural steel: Beam clamps which engage both sides of structural member or have retaining clips or other approved means for positive engagement.
 - 4). Metal surfaces: Machine screws, bolts or welding.
 - 5). Wood construction: Wood or sheet metal screws.
 - 6). Do not use powder-actuated fasteners for anchorage in tension applications. Obtain written permission from the Owner prior to using any type of powder powered studs.
3. Pipe Hanger and Support Installation:
 - a. Install hangers and supports in accordance with manufacturer's instructions, applicable Code requirements and approved shop drawings.
 - b. Support horizontal piping as scheduled.
 - c. Independently support piping at equipment, so that the equipment supports no weight.
 - d. Insulated piping shall have insulation saddles or 18 gauge steel insulation shields combined with sections of calcium silicate or cellular glass. Cold piping shall always be supported over the insulation and vapor barrier. Subject to approval, hot piping may be insulated around the supports.
 - e. Trapeze hangers shall be used when more than three pipes run parallel and at same elevation. Provide rollers for hot pipes. Design rods and cross members to support three times the weight of pipes and contents plus 250 pounds.
 - f. Install hangers to provide minimum 1/2-inch space between finished covering and adjacent work.
 - g. Place hangers within 12 inches of each horizontal elbow.
 - h. Use hangers with 1-1/2 inch minimum vertical adjustment.

- i. Support horizontal cast iron pipe adjacent to each hub, with five feet maximum spacing between hangers.
- j. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- k. Support riser piping independently of connected horizontal piping.
- l. Provide saddles where roller type support is used, or where the pipe hanger is installed outside insulation for protection of insulating jacket.
- m. Piping requiring Vibration Isolation:
 - 1). Support main risers less than 20 feet in height only at mid-level, with riser guides at other levels.
 - 2). Do not support vibration isolated piping along with non-isolated piping on a common trapeze.
 - 3). Rigidly mount steel spring hanger boxes to the supporting structure. Do not locate in the middle of the hanger rod.
 - 4). Rigid pipe anchors are not permitted in vibration isolated piping circuits. When pipe anchors are required.
- 4. Penetrations:
 - a. Coordinate mechanical penetrations with architectural and structural construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
 - b. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.
 - c. Provide penetrations through roof, exterior walls and floors (See floor penetration seals) to be weather and water tight.
 - d. Fire-Stopping: Provide UL rated fire-stopping assemblies for rated roof, wall and floor penetrations in accordance with Division 7.
 - e. Pipe and Duct Sleeves/Framed Openings:
 - 1). Provide sleeves for pipe and round ducts less than 16 inches diameter passing through floors, walls, ceilings, or roofs. Fabricate sleeves in non-load bearing walls from 20 gauge galvanized sheet steel conforming to ASTM A924 / A924M. Fabricate sleeves in load-bearing walls from standard-weight galvanized steel pipe conforming to ASTM A53 / A53M. Provide 1 inch clearance between the pipe or duct and sleeve opening. Oversize sleeves for cold piping to allow continuous insulation through sleeve.

- 2). Provide framed openings for round ducts 16 inch diameter and greater and rectangular ductwork passing through floors, walls, ceilings, or roofs. Provide structural steel members for framed openings conforming to ASTM A36 / A36M. Provide 1 inch clearance between the duct and framed opening.
- 3). Provide closure collars not less than 4 inches wide on each side of duct wall or floor penetration where sleeves or framed openings are provided. Fabricate collars for round and rectangular ducts with a minimum dimension less than 16 inches from 20 gauge galvanized steel. Fabricate collars for round and rectangular ducts with a minimum dimension of 16 inches or greater from 18 gauge galvanized steel.
- 4). Provide escutcheons for piping and conduit passing through walls, floors and ceilings in finished areas, below counters and inside closets and casework subject to view when doors are open. Size escutcheons to cover sleeves. Secure escutcheons in position.

f. Acoustical Seals:

- 1). Monolithic sound walls (i.e. poured concrete or masonry): Provide wall sleeve with approximately one-inch annular space around pipe. Pack annular space with backer rod or acoustical filler as specified in Division 7. Allow a 1 inch recess at each end of sleeve. Caulk sleeve flush with flexible sealant or firestopping material as specified in Division 7.
- 2). Where acoustical wall is a two component type, such as a staggered or double stud partition, treat each component as a separate wall. Pack and seal each half of penetration sleeve as previously specified, except that only the exposed end of each sleeve portion can be caulked with sealant or fire-stop. Provide adequate separation between each sleeve.

g. Wall Penetration Seals:

- 1). Provide pre-engineered wall penetration water seal systems for exterior wall penetrations.
- 2). Select appropriate wall penetration sealing systems based on pipe/conduit material and nominal pipe/conduit size in accordance with the manufacturer's selection charts.
- 3). Install piping/conduit and sealing system prior to waterproofing the wall. Grout void between water seal and outside face of foundation wall to provide continuous bearing surface for waterproofing fabric.

- B. Interface with Other Work: Coordinate and sequence installation of hangers and supports with trades responsible for portions of this and other related sections of the Project Manual.

3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 SITE QUALITY CONTROL

- A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.6 CLEANING

- A. Waste Management: After construction is completed, clean and wipe down exposed surfaces.

3.7 HANGAR SPACING

- A. Tables:
 - 1. Pipe Support: Provide pipe support spacing as indicated in the table below except where spacing more restrictive by Code.

PIPE SIZE (Inches)	HANGER SPACING MAX (Feet)			
	Steel		Copper	Polyethylene (1)
	Water Filled	Gas Filled		
1/2	7	9	5	
3/4	7	9	5	
1	7	9	6	
1-1/4	7	9	7	
1-1/2	9	12	8	4
2	10	13	8	4-1/2
2-1/2	11	14	9	
3	12	15	10	5
4	14	17	12	6
6	17	21	14	
8	19	24	16	

(Based on Table 3, MSS SP-69, except for PE piping)
(1)(Based on manufacturer's data)

END OF SECTION 20 05 29

SECTION 20 05 53

MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Equipment Nameplates.
2. Valve Tags.
3. Pipe Identification.

B. Related Sections:

1. 20 00 00 - MECHANICAL GENERAL REQUIREMENTS
2. 22 11 00 - Domestic Water Piping and Specialties
3. 22 13 00 - Sanitary Waste and Vent Piping and Specialties
4. 23 11 23 - Fuel Gas Piping and Specialties
5. 23 34 00 - HVAC Fans
6. 23 74 23 - Packaged Makeup Air Units
7. 23 82 00 - Terminal Heating and Cooling Units

1.2 REFERENCES

A. Codes and Standards:

1. ANSI/ASME A13.1-2007 (American Society of Mechanical Engineers) - Scheme for the Identification of Piping Systems.
2. ANSI Z535.1-2006 (R2011) - Safety Color Code.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. Provide equipment nameplates, valve tags and labels for the mechanical systems provided under this contract.
2. Provide equipment nameplates for existing equipment to remain.
3. Provide labels for piping. Paint exposed piping and pipe insulation in utility and mechanical rooms.

1.4 SUBMITTALS

A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.

B. Product Data:

1. Master Schedule of Equipment:
 - a. Submit master schedule of equipment, components, and systems that will be tagged and labeled for the project.
 - b. Include the proposed method of labeling to be implemented (nameplate, tag, label/marker, etc.), legend ("Domestic Cold Water," "PMP-1," etc.) and letter/background colors.
 - c. Match legend to Contract Document legend, abbreviations, and schedule symbols. Use standard mechanical identification products when available.
2. Equipment Directories: Submit separate proposed "Equipment Directories" (subset of the master schedule) for each mechanical room that includes the equipment located within the applicable space. Include system name, fluid or medium type, and normal operating properties and ranges.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Marking Services Incorporated (MSI).
- B. Seton Identification Products.
- C. Craftmark.
- D. Approved equal.

2.2 EQUIPMENT NAMEPLATES

A. Plastic Engraved Equipment Nameplates:

1. Minimum letter height: 3/4 inch.
2. Tag size: Minimum 2 inches high, length to fit equipment tag lettering requirements. Provide uniform size for similar types of equipment.
3. Plastic thickness: 1/16 inch minimum.
4. Fastening method:
 - a. Mounting holes.
 - b. Adhesive backing may be provided for labeling equipment where drilling holes is not feasible, with the pre-approval of the Contracting Agency.
5. Color coding: As designated by the Contracting Agency. If specific direction is not provided, select white letters on black background.
6. Legend: As designated by the Contracting Agency. If specific direction not provided, match scheduled equipment symbols.

2.3 VALVE TAGS

A. General:

1. Small equipment, such as in-line pumps may be identified with tags in lieu of nameplates if inadequate room is available.
2. Provide service indicator on top line of tag, using system abbreviations provided in Part 3 Pipe Identification Table.
3. Provide valve number on bottom line of tag. Start valve numbering with "001" for each legend series/service indicator. Assign valve numbers in a logical sequence from the source (i.e. service water entry point, gas meter service isolation) or heat source (boiler or water heater supply) and continue numbering outward to the most remote terminal connection point.

B. Plastic Engraved Tags:

1. Round, 1-1/2 inches diameter, engraved plastic.
2. Text stamped and filled black:
 - a. 1/4 inch service indicator on top.
 - b. 1/2 inch valve number below.

3. Beaded chain tag fasteners.
4. Provide tag color coding to match pipe marker coding or as designated by the Contracting Agency.
- C. Brass Stamped Tags:
 1. Round, 1-1/2 inches diameter, brass with smooth edges.
 2. Text stamped and filled black:
 - a. 1/4 inch service indicator on top.
 - b. 1/2 inch valve number below.
 3. Beaded chain tag fasteners.

2.4 PIPE IDENTIFICATION, MARKING

- A. Identify both service and flow direction.
- B. Colors and Lettering: Conform to ANSI/ASME A13.1; see tables under Article 3.2E below.
- C. Plastic Pipe Labels:
 1. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering.
 2. Larger sizes may have maximum sheet size with plastic nylon ties or straps.
- D. Plastic Tape Pipe Labels: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to directly receive adhesive labels.
- B. Install identifying devices after completion of coverings and painting.

3.2 INSTALLATION

- A. Do not install identifying devices over factory installed equipment labels.
- B. Locate identifying devices in clear view for simple identification.

- C. Tag automatic controls, instruments, and relays. Key these to control system schematic drawings.
- D. Frame and install approved equipment and valve directories in each mechanical room, at a location designated by the Contracting Agency.
- E. Pipe Identification:
 - 1. Identify piping, concealed or exposed, using ANSI A13.1 compliant pipe labels. Identify both service and flow direction in accordance with the following table.

Abbreviation	Legend	Color (Letters/Background)
CW	Domestic Cold Water	White/Green
HW	Domestic Hot Water	White/Green
HWC	Domestic Hot Water Circulation	White/Green
RL	Refrigeration - Liquid	Black/Orange
RS	Refrigeration - Suction	Black/Orange
NG	Natural Gas	Black/Yellow
W	Sanitary Drain	White/Green
V	Sanitary Vent	White/Green
RL, ORL	Rain Leader, Overflow Rain Leader	White/Green
FW	Fire Suppression Water	White/Red

- 2. Pipe label letters shall be a minimum of 1/2" high and increase with pipe diameter as follows:

3. Pipe Outside Diameter	4. Letter Height
5. 0.75" to 1.25"	6. 0.5"
7. 1.5" to 2"	8. 0.75"
9. 2.5" to 6"	10. 1.25"
11. 8" to 10"	12. 2.5"

- 13. Install labels in unobstructed view and aligned with horizontal or vertical axis of piping as appropriate. For piping located above the normal line of vision, place labels below the horizontal centerline of the pipe for clear unobstructed view from below.

14. Install labels not to exceed 20 foot intervals along straight piping runs (including risers and drops), close to valves, adjacent to changes in direction and branches, on each side of pipe penetrations through walls or floors, and at each access panel.

END OF SECTION 20 05 53

SECTION 20 05 56

INTERIOR TRENCH EXCAVATION AND BACKFILL

PART 1 - GENERAL

1.1 SUMMARY

- A. This section describes general requirements, products, and methods of execution relating to excavation, back-fill, and compaction of inside trenches for mechanical work. Inside trenches are those which occur within an arbitrary, imaginary boundary five feet beyond the outside perimeter of the structure.
- B. Related Sections:
 - 1. 20 00 00 - Mechanical General Requirements
 - 2. 22 11 00 - Domestic Water Piping and Specialties
 - 3. 22 13 00 - Sanitary Waste and Vent Piping and Specialties

1.2 SYSTEM DESCRIPTION

- A. Provide trench work for mechanical work of every description and of whatever substance encountered to the depth indicated, or to provide pipe slopes and elevations shown on the Drawings. Excavate and backfill utility trenches. Place and compact bedding material. Compact backfill material.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TRENCH BACKFILL

- A. Obtain trench backfill material from trench excavation. If sufficient suitable trench backfill material is not available from trench excavation, import it from sources approved by the Contracting Agency.
- B. Use granular material, free from large stones, boulders debris, and frozen material, and in accordance with the MASS specification. Maintain moisture content within a range that will allow specified compaction.

3.2 EXCAVATION

- A. Place excavated material suitable for backfill in an orderly manner, and in conformance with safety codes.
- B. Dispose of material not suitable for back filling.
- C. Form bell holes so pipelines rest on continuous undisturbed soil. If larger rocks or boulders are encountered, remove them. If trenches are below specified grade, backfill to required depth with select granular materials free from debris, rock, or frozen material, and compact to proper grade before installing piping.

3.3 LOCATION

- A. Locate trenches to accommodate utilities shown on the drawings.
- B. Excavate trench with adequate width to allow compaction equipment to be used at the sides of pipes.
- C. Make trench side slopes conform to prevailing safety code requirements.

3.4 DEWATERING

- A. Perform whatever work is necessary to prevent the flow and accumulation of surface or ground water in the excavation.

3.5 TIMING

- A. Do not backfill until underground mechanical system has been properly tested, inspected and approved.
- B. Coordinate with the work of others, and complete trench work in a timely manner.

3.6 BEDDING MATERIAL

- A. Select bedding material from trench excavation using care to separate it from unsuitable material. If suitable bedding material is not available from trench excavation, import it from sources approved by the Contracting Agency.
- B. Use granular material, free from large stones, boulders, debris, and frozen material. Maximum aggregate size in accordance with the MASS specification. Maintain moisture content within a range that will allow specified compaction.
- C. Do not use any frost susceptible materials.

3.7 BEDDING

- A. Place bedding material under, around, and over the pipe in lifts not exceeding six inch in depth.
- B. Work material around pipe by hand methods, taking care to keep any oversize or sharp stones out of contact with the pipe, and to provide uniform support for the pipe.
- C. Cover pipe with bedding material to building sub-grade or to a minimum 12-inch depth before adding other backfill.

3.8 BACKFILLING

- A. Continue placing backfill material until trench is completely filled to building sub-grade, or as shown on the Drawings.
- B. Place backfill material in lifts not to exceed 6-inches in depth.

3.9 COMPACTION

- A. Compact bedding material to at least 95 percent of maximum density, taking care not to damage the pipe.
- B. Compact backfill under footings, slabs, and other structures to 95 percent of maximum density or more, if required by the Contracting Agency. Where 95 percent compaction cannot be achieved, fill remaining voids with concrete. Provide compaction tests every 100 feet, in accordance with the MASS specification.
- C. Compact other areas to preclude future settlement, or at least to 85 percent of maximum density.

3.10 FINISHING

- A. After completion of backfilling, dispose of excess material and smooth the surface to grade.
- B. Do not allow heavy equipment to be used over backfilled work that does not have sufficient cover to prevent pipe damage.

3.11 SPECIAL PRECAUTIONS

- A. Avoid unauthorized and unnecessary excavations.
- B. Minimize number and size of excavations under footings or bearing walls.
- C. Support footings, foundations, and walls with timbers and jacks if there appears to be any possible chance of damage, and keep such precautions in place until work is completed and sufficient backfill is in place to eliminate possible damage.

- D. Avoid damage to existing underground services, cables, conduit lines or foundations. Repair any existing underground work damaged at no additional cost to the Owner.
- E. Protect excavated materials from moisture during the period prior to reinstallation.

END OF SECTION 20 05 56

SECTION 20 07 00

MECHANICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Specific requirements, products and methods of execution which relate to the insulation of ducts, fittings, equipment, pipes and other surfaces of the mechanical installation.
- B. Related Sections:
 - 1. 20 00 00 - Mechanical General Requirements
 - 2. 22 11 00 - Domestic Water Piping and Specialties
 - 3. 22 13 00 - Sanitary Waste and Vent Piping and Specialties
 - 4. 22 40 00 - Plumbing Fixtures and Equipment
 - 5. 23 31 00 - Ducts

1.2 DESCRIPTION

- A. Provide thermal insulation for ventilation system ductwork and building service piping.
- B. Provide insulation for exposed ADA plumbing fixture piping.

1.3 REFERENCES

- A. International Building Code (IBC).
- B. International Mechanical Code (IMC).
- C. International Energy Conservation Code (IECC)
- D. MSS Standard Practice SP-69 Pipe Hangers and Supports - Selection and Application.

1.4 SUBMITTALS

- A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

- B. Qualifications: Submit manufacturer and applicator qualifications, showing compliance with Article 1.5.

1.5 QUALITY ASSURANCE

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

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient conditions required by manufacturer of each product.

PART 2 - PRODUCTS

2.1 FIRE RATING OF MATERIALS

- A. Provide insulation products used aboveground in building with burning characteristics in compliance with NFPA Standards 90A and 90B: Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Tested according to UL 723, ASTM E84, or NFPA 255.
- B. Insulation specified for use underground and aboveground away from the building might have other burning characteristics. Use such products only where specifically required.

2.2 FIBERGLASS INSULATION

- A. Piping: Provide insulation products as follows:
 - 1. Thermal conductivity K equals 0.24 at 100 degrees F. mean temperature, ASTM C335.
 - 2. Factory applied vapor-barrier, flame retardant all service jacket and tape, with permeability rating equal to 0.02 perms, ASTM E 96.
 - 3. Temperature limits for fiberglass pipe insulation: 350 degrees F, unless otherwise indicated.
 - 4. Manufacturers: Johns Manville, Owens Corning, Knauf Fiber Glass, or approved equal.
- B. Ductwork: Provide insulation products as follows:
 - 1. Flexible insulation: Average thermal conductivity K equals 0.24 at 75 degrees F. mean temperature at 1.5 pcf density, ASTM C335.

2. Rigid insulation: Average thermal conductivity K equals 0.24 at 75 degrees F. mean temperature at 3.0 pounds per cubic feet (pcf) density, ASTM C518.
3. Factory-applied vapor barrier flame-retardant Foil-Scrim-Kraft (FSK) or all-service jacket and tape, with permeability rating equal to 0.02 perms, ASTM E 96.
4. Temperature limits for fiberglass duct insulation: 250 degrees F. unless otherwise indicated.
5. Manufacturers: Johns Manville, Owens Corning, Certainteed, Knauf Fiber Glass, or approved equal.

2.3 FLEXIBLE FOAM PLASTIC

- A. Thermal Conductivity: 0.27.
- B. Water Vapor Transmission: 0.08.
- C. Flame-spread rating of 25 or less and a smoke-developed rating of 50 or less as tested by ASTM E 84.
- D. Manufacturer: Armaflex, Aerotube, Rubatex.

2.4 ADA PLUMBING FIXTURE PIPING INSULATION ASSEMBLY

- A. Manufacturer: Proflo PF200 Series, or approved equal.
- B. Description: Protective single piece cover manufactured specifically for plumbing fixture supplies and drains.
- C. Performance/Design Criteria:
 1. Burning characteristics: Self-extinguished zero seconds per ASTM D-635.
 2. Bacterial/Fungus Resistance: Zero growth per ASTM G21 and G22.
- D. Material: Molded vinyl with 1/8 inch wall, internal and reusable fasteners, and tool-less tear-to-fit trim feature.

2.5 CANVAS JACKETING

- A. Insulating Lagging Canvas: Eight ounces per square yard minimum, fire-retardant material complying with fire ratings specified above. Manufacturer: Chas Harmon "Osnaberg", Claremont Company Inc., "Claretex", or approved equal.
- B. Lagging Adhesive: Plastic synthetic resin emulsion adhesive; watertight, mildew resistant, fire retardant. Manufacturer: Childers Chil-Perm CP, Foster® Sealfas® coating 30-36, or approved equal.

2.6 METAL JACKETING

- A. 27 gauge (U.S. Standard) heavy corrugated aluminum.
- B. Preformed fitting covers.

2.7 COATINGS

- A. Coatings: UL labeled.
- B. On cold or dual service lines, use vapor barrier type coatings.

2.8 PREFORMED FITTING COVERS

- A. One piece premolded PVC jacketing and fitting covers specifically designed for the service intended.
- B. Install per manufacturer's instructions and secure with manufacturer's color matching PVC tape.
- C. Manufacturer: J-M "Zeston", TeeCee, Proto, Certainteed.

PART 3 - EXECUTION

3.1 GENERAL

- A. Do not apply insulation materials until surfaces to be covered are clean and dry and foreign material such as rust, dirt, etc. is removed. Keep insulation clean and dry during installation and during the application of any finish.
- B. Do not install the insulation on pipe fittings and pipe joints until the piping has been tested and approved.
- C. Do not install the insulation on ducts or fittings until the ductwork has been tested and approved.
- D. Do not apply under conditions of excessive humidity or at temperatures below 50 degrees F or above 100 degrees F.
- E. Provide insulation support blocks, shields, and transitions for hangers, supports, anchors, and guides. Coordinate insulation requirements through rated assemblies and Listing penetration's requirements.
- F. Adjust hangers, guides, anchors, and supports after insulation installation has been approved.

3.2 PIPE INSULATION

A. Cold Piping:

1. Includes rainwater piping, domestic cold water, plumbing, and other vents through roof, refrigeration, and other cold piping to zero degrees F.
 - a. Insulate aboveground rain leaders from the roof drain to the point pipe penetrates building skin or below grade. Cover underside of roof drain.
 - b. Insulate plumbing vents from three feet below the under deck of the roof to the termination above the roofline.
2. Insulate with sectional fiberglass and provide a completely sealed vapor barrier. Provide insulation thickness per Insulation Thickness Table.
3. Insulate valves, unions, flanges, fittings, tanks, vessels, air separators, heat exchanges, and similar components, except where indicated otherwise.

B. Hot Piping:

1. Includes domestic hot water supply and recirculation.
2. Insulate with sectional fiberglass. Provide insulation thickness per Insulation Thickness Table.
3. Insulate valves, unions, flanges, fittings, and similar components, except where indicated otherwise.

C. Buried Piping. Insulate with flexible foam plastic insulation; glue seams with manufacturers recommended cement.

D. In addition to specified jackets, provide heavy corrugated aluminum jacket on piping insulation anywhere piping is exposed below eight feet zero inches above floor in public areas.

E. Insulation Thickness Table (units are in inches):

Fluid Design Operating Temperature Range	Less than 1	1 to <1-1/2	1-1/2 to <4	4 to <8	8 and up
Domestic (Hot Water and Hot Water Circulation):					
105 °F to 140 °F	1.5	1.5	2	2	2
Cooling Systems (Refrigerant):					
40 °F to 60 °F	1.5	1.5	1.5	1.5	1.5
Below 40 °F	1.5	1.5	1.5	1.5	1.5
Domestic Cold Water:					
All	1	1	1.5	1.5	1.5

Fluid Design Operating Temperature Range	Less than 1	1 to <1-1/2	1-1/2 to <4	4 to <8	8 and up
Rain leaders, Plumbing vents through roof:					
All	1	1	1.5	1.5	1.5

3.3 TECHNIQUE FOR APPLICATION TO PIPES

- A. Close longitudinal joints of pipe insulation firmly and butt insulation sections firmly together. Neatly and smoothly adhere laps and butt strips.
- B. Clean the contact area on jacket for adhesive lap strips and butt strips so it is free from fingerprints, oil, construction dust and other contaminants. Clean surfaces with tack rags, methanol, or other suitable agent before attempting to adhere the strip. Apply pressure to adhesive strip with suitable tool immediately after adhering. Remove insulation with inadequately sealed joints and install new sections. Outwardly clinching staples may be used to reinforce joints.
- C. Continuously seal vapor barriers. If staples are used at laps, seal the entire length of stapled lap with adhesive jacket tape applied as specified above for laps and butts. Sectionalize vapor barrier by sealing ends of insulation sections at not more than 25 feet intervals, to prevent moisture migrating lengthwise. Apply butt strips over joint as above.
- D. Provide double insulation thickness on piping in outside walls and within five feet of vehicle doors or other large openings.
- E. Except as indicated, locate pipe hangers and rollers outside insulation. Provide insulation saddles or sheet metal shields around insulation. On pipes two inches and larger, within the area of each insulation shield, use calcium silicate or cellular glass on the lower half of the insulation, equal in thickness to adjacent insulation.
- F. Where piping is installed outdoors, provide two-layer glass cloth and four-layer weatherproof vapor barrier adhesive coating, in addition to jacket specified.

3.4 TECHNIQUE FOR APPLICATION TO PIPE FITTINGS, EQUIPMENT, AND VALVES

- A. Insulate fittings, valves, and flanges to the same thickness as the pipe insulation.
- B. Any of the following methods of insulation are acceptable:
 1. Blanket Wrap: Wrap the fitting with compressed glass fiber blanket. Wire the blanket securely in place and cover with a smooth layer of insulating/finishing cement. Cover with glass mesh tape, adhering it with an adhesive coating.
 2. Fabricated Segments: Cut mitered segments from pipe insulation that has the same wall thickness as adjacent pipe insulation to form a cover which will fit snugly around the fitting. Wire the segments firmly in place and seal the joints with insulating/finishing

cement. Apply adhesive coating and wrap with glass mesh tape, then apply another layer of the same coating over the whole assembly.

3. Cement: Apply insulating or insulating/finishing cement, molding it to the contour of the fitting. When area is large, apply an under layer of cement, wrap this with glass mesh tape, then apply an outer layer of cement. If the insulation is not concealed the exposed surface of insulating/finishing cement shall have a final glass mesh tape wrap embedded in adhesive.
- C. In each of the listed methods, to protect the insulation against contact damage, apply an adhesive coating when the cement is completely dry and hard, then wrap with glass mesh tape. Apply another coating of adhesive over the whole assembly.
- D. In each of the listed methods, pre-formed fitting covers may be substituted for the tape and adhesive covering specified. Cement and tape fitting covers on cold piping to provide a positive vapor barrier.
- E. Removable insulation blankets of comparable insulation value for valves and where equipment require frequent adjustments or maintenance shall be provided; identify and coordinate during submittal process.
- F. After insulation has been installed adjust hangers for proper fit, maintain pipe grade and support.

3.5 DUCT THERMAL INSULATION REQUIREMENTS

- A. Insulate ductwork as follows:
 1. Insulate outside air intake ducts from air intake louver connection to equipment connections (including insulated isolation damper frame) with 2-inch rigid or semi-rigid board insulation.
 2. Insulate exhaust and relief ducts from point of discharge to and including back draft damper support frame with 2-inch rigid or semi-rigid board insulation.
 3. Supply air ductwork: When mechanical cooling is provided, insulate associated ventilation system supply ductwork from AHU connections to VAV terminal unit inlet connections with 1-1/2" inch thick fiberglass insulation.
 4. Return air ductwork: Insulate return air ductwork passing through unheated spaces, within in mechanical rooms and as indicated with 1-1/2" inch fiberglass insulation.
 5. Lined ductwork: Provide external duct insulation only when indicated in addition to duct lining.
- B. Insulation Type and Finish:
 1. Rigid or semi-rigid board where canvas or metal jacket is specified. May also be used in place of blanket insulation where practical.

2. Blanket insulation where rigid board is not specified or indicated. Proper installation is critical. Loose joints and sagging insulation shall require reinsulation of entire branch or main duct before acceptance and during warranty period.
3. Fiberglass or canvas jacket over board insulation in mechanical and boiler rooms less than 10 feet above finish floor, where exposed in finished rooms and where indicated. Seal jacket with vapor barrier lagging adhesive.
4. Ductwork insulation to have a completely sealed vapor barrier, except segmental insulation on medium/high velocity trunk ducts and warm air ducts in concealed spaces, where approved.

3.6 DUCT SOUND INSULATION REQUIREMENTS

- A. Refer to Section 23 31 00 - Ducts.
- B. Install where shown.
- C. Install in accordance with manufacturers installation instructions. Completed installation shall be fastened tightly to ductwork and free of sags.

3.7 TECHNIQUE FOR APPLICATION TO DUCTWORK

- A. Rigid and Semi-rigid Insulation:
 1. Impaling Over Pins: Install insulation with edges tightly butted using adhesive and metal pins. Impale insulation on pins welded to the duct and secure with speed clips. Trim off pins close to speed clip. Space pins as required to hold insulation firmly against duct surface but not less than one pin per square foot.
 2. Other Method of Securement: If the welded pin method is not feasible, secure the insulation to the duct with adhesive. Cover the entire surface of the metal with adhesive when applying to the underside of horizontal ducts. Application to top and sides may be in strips with a minimum of 50 percent coverage. Additionally, secure insulation with No. 16 galvanized wire on not more than 12 inches on center. Provide metal angle at corners to protect edges of insulation.
 3. Vapor Barrier: Seal joints and speed clips with adhesive tape of similar construction to insulation jacket. Thoroughly clean contact surfaces for adhesive as specified under pipe insulation technique. Glass cloth tape set in adhesive may be used. Provide metal or plastic corner angles within eight feet of floor, walkway, or stairs.
 4. Provide fiberglass or canvas jacket where specified. Completely cover with minimum 1/8" lagging adhesive. Cover canvas with two heavy coats of same adhesive and completely fill the weave. Inspect when dry for complete vapor barrier throughout and refinish as required.
- B. Blanket Insulation:

1. Position insulation so that longitudinal seam will be underneath and not supporting weight of sheet. Remove a uniform strip of insulation from backing to provide a lap strip. Butt insulation and secure lap strip with outwardly clinching staples.
2. Use pins to secure blanket on large flat areas as specified for rigid insulation. Reinforce jacket at pin penetration where required.
3. Seal laps, staples and butt joints with adhesive tape of similar construction to insulation jacket. Seal speed clips if used. Thoroughly clean contact surfaces for adhesive as specified under pipe insulation technique.
4. When system is under pressure, inspect insulation for inflation caused by improperly sealed ducts. Repair duct seal and reinsulate as necessary.
5. The Contracting Agency may inspect completed insulation and test taped joints for adhesion. Seal laps and butt tapes that can be removed with reasonable force shall require that entire branch or trunk duct be reinsulated.

3.8 FIXTURE INSULATION ASSEMBLY

- A. Insulate hot water supply and waste piping exposed beneath sink and lavatory fixtures designated on drawings or specified in Section 22 40 00 - Plumbing Fixtures, as intended for use by the handicapped. Install in accordance with ANSI A117.1. - 2009.

3.9 LIMP MASS SOUND INSULATION

- A. Install in accordance with the manufacturers' instructions.

3.10 REPAIR/RESTORATION

- A. Examine existing duct and pipe installations to remain and condition of insulation installed.
- B. Existing damaged insulation:
 1. Insulation damage: Sections of insulation with damage to fiberglass material resulting in loss of insulating quality (e.g. water soaked) or thickness (e.g. missing sections of insulation) shall be removed and replaced with new.
 2. Insulation jacket damage: Damage to insulation jacket shall be repaired or section of insulation removed and replaced with new.
 3. Existing insulation for cold surfaces where condensation may form shall be repaired to maintain a vapor tight barrier.
- C. Uninsulated Pipes and Ducts:
 1. Existing pipes and ducts shall be insulated as required by this section.

3.11 PAINTING

- A. Paint exposed insulation in utility areas, service areas and mechanical rooms in accordance with Division 9 - Finishes.
- B. Color shall be white or light gray.

END OF SECTION 20 07 00

SECTION 21 10 00

WATER BASED FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes performance requirements, products, and methods of execution relating to fire suppression for the project. The contract documents have required performance, materials, and installation requirements which exceed code minimums. This Section is substantially a “performance” specification.
- B. Related Sections:
 - 1. 20 00 00 - Mechanical General Requirements
 - 2. 28 31 00 - Addressable Fire Alarm

1.2 REFERENCES

- A. Provide fire suppression in accordance with the provisions of the following codes and standards:
 - 1. International Fire Code - 2012, IFC.
 - 2. International Mechanical Code - 2012, IMC.
 - 3. International Building Code - 2012, IBC.
 - 4. Uniform Plumbing Code - 2012, UPC.
 - 5. NFPA 13 – 2013, Installation of Sprinkler Systems.
 - 6. NFPA 24 - 2016, Installation of Private Fire Service Mains and Their Appurtenances.
 - 7. NFPA 25 - 2014, Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems.
 - 8. NFPA 70 - 2014, National Electric Code, NEC.
 - 9. NFPA 72 – 2013, National Fire Alarm and Signaling Code.
 - 10. NFPA 101 – 2012, Life Safety Code.
 - 11. ASCE 7 - 10, Minimum Design Loads for Buildings and Other Structures.

12. Foundation for Cross-Connection Control and Hydraulic Research, 9th edition, University of Southern California.
13. Underwriters Laboratories, UL, Fire Protection Equipment Directory.
14. Municipality of Anchorage Fire Department, Fire Prevention, Policy #08-014 Permitting Requirements for Fire Systems.
15. Municipality of Anchorage Standard Specifications, MASS.

1.3 SYSTEM DESCRIPTION

- A. Provide complete wet pipe automatic fire sprinkler systems, hydraulically calculated using density/area method to protect the entire facility and fully operational. Comply with the Contract Documents requirements, applicable codes and standards, as well as the Authority Having Jurisdiction (AHJ) requirements. The contract documents have performance, materials, and installation requirements which exceed code minimums.
- B. Provide fire suppression system, complete and fully operational, in accordance with the contract documents and the applicable codes and standards to protect the areas noted. Work includes installation of heads in finished ceilings.
- C. Provide seismic anchoring, bracing, supports, and clearance for equipment, pipes and sprinkler heads per NFPA 13, International Building Code, and ASCE 7; most conservative criteria shall govern.
- D. Provide listed sprinkler flex hose for sprinkler heads in suspended ceiling assemblies. Other methods to maintain required clearances are not allowed.
- E. Provide a test valve at the hydraulic remote area to equal the required flow of one or more sprinklers head.
- F. Work includes concealment of pipes in walls and possible routing of pipes through structural elements. Coordinate with architectural and structural drawings and requirements.

1.4 SUBMITTALS

- A. Submittals shall be complete for review. Drawings, calculations, and product cutsheets shall be complete and submitted together in one package. See Section 20 00 00 - General Mechanical Requirements for additional requirements not covered below.
- B. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents.
 1. Submittals will not be checked for quantity, dimension, fit, or for proper technical design of manufactured equipment.

2. Providing a complete and satisfactory working installation is the responsibility of the Contractor.

C. Electronic Submittals:

1. Provide electronic submittal in PDF format in addition to hard copy submittal.
2. Electronic submittals shall follow the organization and formatting required for paper submittals.
3. Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.
4. If individual PDF files are provided for each product or shop drawing sheet, organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
5. PDF documents to be without security and be searchable, and copied and pasted. For scanned documents, run the optical character recognition (OCR) function to ensure the document is searchable and can be copied and pasted.
6. Reduce PDF file size by removing data and file creation elements not needed for final file presentation.

D. Product Data:

1. Submit product data for items specified in Part 2 and those products required by the performance standards of this Section. Identify catalog designation and/or model number and neatly annotate each salient characteristic and design option of the product. Identify operation characteristics, performance curves and rated capacities of products and devices to show compliance with shop drawings and calculations.
2. Provide exterior and interior signage with placement locations indicated on shop drawings.
3. Provide data on firestopped penetrations, including product being submitted, the rating of the assembly it will be used for, and the applicable Through Penetration Firestop System drawing(s) from the UL Fire Resistance Directory.

E. Shop Drawings:

1. Submit Authority Having Jurisdiction approved sets of shop drawings and calculations. Drawings and calculations shall include the NICET certification and State of Alaska Permit IIC or IIC-DO number and signature, or signed seal of a licensed professional engineer, and the fire suppression Contractor's Alaska specialty license number.
2. Shop drawings shall be submitted with information in compliance with NFPA 13 and other performance standards of this Section. Shop drawings shall include but not limited to the following:
 - a. Name of Contracting Agency, Occupant and Building Permit number.

- b. Location, including street address and legal description.
- c. Point of compass.
- d. Fire Department connections.
- e. Necessary controlling equipment.
- f. Location of water source, type, routing, depth of bury, and size of supply pipes. Identify location and size of city main and whether it is dead-end or circulating loop and distance to the flow data test hydrant.
- g. Distribution system pipes and outlets. Include pipe and fitting types.
- h. Sprinkler connection, drop, details including supports required for flex pipe.
- i. Supports, brackets, restraints, and seismic attachments details and schedules.
- j. Reflected ceiling plan showing ceiling heights, construction type, proposed location and type of sprinkler heads, and other ceiling devices such as HVAC diffusers, loud speakers, type and location of light fixtures, etc.
- k. Interference control between sprinkler system and other trades.
- l. Full height cross section, indicating basic building construction system, sprinkler piping arrangement, and elevation of the highest sprinkler head.
- m. Location of partitions. Identification of full height walls and draft stops.
- n. Location and size of unprotected concealed spaces.
- o. Identification of unheated areas and areas that cannot be reliably maintained above 40 deg. F.
- p. Water flow test results, include testing agency, time, date, and location of test.
- q. Make, model, type, orifice, finish, color, and temperature rating of sprinklers and their respective locations.
- r. Sprinklers with sprinkler guards.
- s. Extended coverage sprinklers.
- t. Corrosion resistant sprinklers.
- u. Ceiling slopes greater than 2 to 12 shall be identified.
- v. Clearly identify each hydraulic remote area and associated calculations with hazard type and density.
- w. Hydraulic node points.

- x. The square footage area protected by each system.
- y. Make, model, and size of valves and equipment, including: control valves, pre-action, deluge, alarm valves, check valves, hose valves, and related appurtenances.
- z. Identify drum drip drains, main drain, low point drains, drain receptors, and inspector test stations.
- aa. Indicate the type and location of pipe hangers, equipment supports, seismic movement, and seismic restraints.
- bb. Make, model, size, and locations of pipe couplings, fittings, and flanges.
- cc. Make, model, size, power requirement, and location of alarm bells, buzzers, detectors, switches, air compressors, and panels.
- dd. Provisions for flushing and backflow device system demand forward flow test and test discharge to safe location.
- ee. Name, address, and telephone number of the fire protection specialty Contractor. If design is by a separate firm, include the name address, telephone and fax numbers, and email of the design firm.
- ff. Complete legend of abbreviations and symbols indicated.
- gg. Complete schedule of room occupancies.
- hh. Location of structural penetrations and verification that structural penetrations have been coordinated and approved.
- ii. Note the size, location, and extent of “exposed” pipes.
- jj. Location of fire rated assemblies.

F. Design Data:

1. Submit Authority Having Jurisdiction approved sets of calculations. Drawings and calculations shall include the NICET certification and State of Alaska Permit IIC or IIC-DO number and signature or stamp of a licensed professional engineer and the fire suppression Contractor’s Alaska specialty license number. Submit complete hydraulic calculations which were used to prepare the final design drawings. One set will be retained by the Engineer.
2. Product data, shop drawings, and calculations shall be submitted together for review. Partial submittals will not be reviewed.
3. Systems shall be limited to a maximum of 175 psig, unless otherwise approved. Systems requiring pressures 175 psig and higher shall have pressure reducing valves, controls, and related equipment incorporated.

4. Submit water flow information used for hydraulic calculations:
 - a. For the Municipality of Anchorage service area, contact AWWU and obtain hydraulic model information nearest hydrant flow for maximum day demand of year, or provide hydrant flow test and use 10% flow safety factor as minimum requirement, or as approved by the AHJ and the engineer.
 - b. If the Contractor conducts the flow test, a representative of the AHJ and Contracting Agency shall witness the test. Submit a written procedure and certification for the test, which shall be in compliance with NFPA 13 and NFPA 291 for flow testing water supplies and approved by the AHJ. Provide a minimum of 48 hours advance notice of test to the Contracting Agency.
 - c. Hydraulic calculations shall be accomplished in compliance with the procedures established in NFPA 13. In addition to minimum NFPA 13 standard, a minimum 10 percent pressure and flow buffers are required to be designed into the system. Where local authorities require additional buffer, comply with the more demanding requirement.
 - d. Hydraulic calculations accomplished by computer program for submittal shall be accompanied by a complete legend of the abbreviations, nodes, and symbols utilized on the computer printout.
 - e. Hydraulic calculations shall follow NFPA 13 requirements and shall clearly identify the following:
 - 1). Sprinkler type and “K” factor.
 - 2). Pipe and fittings type, size, and inside diameter.
 - 3). Fitting equivalent length chart that complies with the “C” factor and pipe type.
 - 4). NFPA hazard designation, design density, and size of the design remote area.
 - 5). The elevation of the “highest” sprinkler.
 - 6). Extended coverage sprinklers shall include design pressure and coverage identified on the drawings and manufacturer's product information to confirm usage. Hydraulic calculations shall identify extended coverage sprinklers and operating pressure.
 - 7). The available water supply and system demand at the point of connection to the water supply, indicated on a logarithmic graph and required safety factors. Include hose demands.
 - f. Equipment, pipe, fittings, and sprinklers used in calculations shall match installed system. Variances shall require redesign and installation by contractor.

G. Quality Assurance/Control Submittals:

1. Design Data: Provide hydrant flow test reports or other information used for design.
2. Certificates Initial Submittal:
 - a. Submit Contractor's qualifications, proof of three years' experience under this Contractor's firm name, and references for at least five projects in Alaska of similar type, size, or complexity.
 - b. Submit a copy of designer's NICET certification and resume', Alaska Permit number and level or Alaska P.E. license number.
 - c. Submit a copy of backflow assembly tester qualifications and certificate.
 - d. Submit a copy of Contractor's State of Alaska Fire Protection Permit and Administrator's License for the appropriate type of systems provided.
3. Certificates Post Construction:
 - a. Submit a letter of certification for backflow assembly installation and testing, signed by the installer/tester.
 - b. Provide copy completed of the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Above Ground Piping.
 - c. Provide test report for hydrostatic test of piping, to include a test of piping between the fire department connection and the check valve.
 - d. Provide test report confirming proper operation of tamper, supervisory, and flow, switches and system alarms.
 - e. Provide a letter of certification stating that testing and flushing has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.
4. Provide Manufacturer's Installation Instructions, and Manufacturer's field reports.
5. Fire suppression system shall be installed, tested, as-builts completed and installation approved by the Authority Having Jurisdiction, AHJ, before substantial completion request or notification is made.
6. Structural tests and special inspections required by IBC or ASCE-07 shall be identified on the shop drawings, products submitted and coordinated during installation. Reports shall be submitted. Secure required services and pay for tests and inspections.
7. Significant changes in piping due to on site coordination with other trades and existing conditions shall require hydraulic recalculation to confirm adequate pipe sizing and be resubmitted to AHJ and Contracting Agency's Insurance agency.

H. Review, Approvals, and Permits Required

1. Obtain written review and/or approval of the entire fire suppression system design and arrangement from the following authorities:
 - a. Contracting Agency - (Approval).
 - b. Authority Having Jurisdiction, AHJ - (Approval).
 - c. Architect - (Review).
 - d. Mechanical Engineer - (Review).
 - e. Contracting Agency's Insurance Agency – (Review)
2. Comply with the above review comments, revising the system design as required, and resubmitting in a timely manner, so as not to hinder the construction schedule.
3. Obtain and pay for required permits, inspections, tests, and approvals as required by Authority Having Jurisdiction.

I. Operation and Maintenance Manual Submittal:

1. Include manufacturers' descriptive literature, operating instructions, installation instructions, testing certificates, maintenance and repair data, parts listings, and spare parts list.
2. Electronic copy of the Authority Having Jurisdiction approved hydraulic calculations, drawings, and their review letter.
3. Table showing NFPA 25 maintenance requirements.
4. Provide an electronic copy of operations and maintenance manual in PDF format with bookmarks matching table of contents, including as-built shop drawings with each required paper copy.

J. Closeout Submittals:

1. Refer to Division 1 for general procedures for submittals.
2. Project Record Documents: Record actual locations of components and locations of access doors required for access or valving.
3. Warranty: Submit manufacturer warranty and ensure forms have been completed in Contracting Agency's name and registered with the manufacturer.
4. Submit a written affidavit at the completion of the system, stating that the fire suppression system as installed complies with referenced Codes and Standards, Authority Having Jurisdiction requirements.

5. Provide written warranty as specified in Division 1. Furnish written guarantee to the Contracting Agency, that materials installations are free from mechanical defects and guaranteeing to replace and repair any and all unsatisfactory and defective work and items, to the satisfaction of the Contracting Agency, in a timely manner for a period of one year after final acceptance of the Contracting Agency, and to be responsible for any damage caused to the premises for any such unsatisfactory work.
6. Issue a minimum one set of full size as-built drawings and maintenance data to the Contracting Agency's designated maintenance personnel, in addition to required submittals.
7. Train the Contracting Agency's designated maintenance personnel in the operation and maintenance of the fire suppression system. Minimum 4 hours of training is required.

K. Maintenance Information and Framed Building Plan:

1. Coordinate with Section 28 31 00 - Addressable Fire Alarm for fire alarm graphical displays and maps.
2. Orient the floor plan in a manner that is consistent with the building. Rotate graphic layout as required to show North, South, East, and West, as it applies to the building.
3. Enclose the plan in a professionally fabricated metal picture frame with 1/8 inch rigid clear plastic cover. Minimum 1 inch frame width. Locate the framed plan in the water service entry room on the wall with the spare sprinkler cabinet.
4. Include step by step instructions to place the fire suppression system in service as well as to take it out of service. Provide complete maintenance information of primary fire suppression equipment, valves, fittings, sprinklers. Identify equipment indicating whether devices are replacement items or repairable. Provide parts list and suppliers for repairable items.
5. Include step by step procedures for required operational weekly/monthly/annual service and testing as required by NFPA 25. Provide a complete report of field test operations and results prior to substantial completion.

L. Record Drawings:

1. Maintain current and up-to-date As-Built prints of the fire suppression system at the job site.
2. Approved full size As-Built drawings and electronic copy of as-built drawing files in PDF and DWG formats shall be submitted with IO&M manuals.

1.5 QUALITY ASSURANCE

- A. Furnish the services of a qualified and approved fire suppression subcontractor to provide the work of this specification section. Unless otherwise noted, this is substantially a "performance" specification.

B. Minimum qualifications of the Contractor/subcontractor shall include the following:

1. Specialist Firm: Company specializing in automatic fire suppression/sprinkler systems, possessing a minimum of three years of experience with systems similar in nature to the type specified herein. Demonstrate satisfactory completion of five projects of similar size and scope in the State of Alaska; provide references.
2. Backflow Prevention: Installation and testing by a certified backflow assembly tester, in accordance with the Uniform Plumbing Code and Foundation for Cross-Connection Control and Hydraulic Research. Provide a copy of the certification and test results.
3. Design Certification: Drawings and calculations shall be prepared by a Level III or IV Fire Sprinkler Designer, certified by the National Institute for Certification in Engineering Technologies (NICET), in Fire Protection Engineering Technology Automatic Fire Sprinkler System Layout who also have their State of Alaska Permit IIC or IIC-DO license, or an Alaskan Licensed Professional Engineer.
4. Maintain a complete stock of replacement parts.
5. Remain on 24 hour call for emergency service.
6. Maintain an office and telephone, with authorized representatives of the fire suppression contractor's firm, including the Designated Project Administrator, with a physical presence and address in Alaska.
7. Bids by wholesalers, contractors, or any firm whose principal business is not that of manufacturing and/or installing fire suppression systems are not acceptable.

C. Material:

1. Equipment and components: Bear the "UL" label or the "FM" approval marking.
2. Grooved joint couplings, fittings, valves, and specialties shall be from the same manufacturer, including grooving tools.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle products to the site under provisions of Division 1.
- B. Deliver and store valves in manufacturer's packaging with labeling in place.
- C. Prior to installation, pipes shall be wrapped with protective wrapping.

1.7 PROJECT/SITE CONDITIONS

- A. Temporary occupancy permits, or partial occupancy require alarm and life safety systems to be fully operational. Expedite installation and complete life safety requirements for temporary and phased occupancy.

- B. Check dimensions indicated on the Architectural and Structural Drawings, and verify dimensions at the site before fabricating any portion of the system. Any discrepancies in piping and head locations resulting from failure to do so shall be corrected expeditiously to provide proper coordination of trades.
- C. Coordinate work with that of other trades to make sure that adequate space is provided, including requirements for accessibility and serviceability. Locate sprinkler heads a minimum 6 inches distance from ceiling T-Bar, structural elements, devices, and other installed equipment. Adjust final location of piping and heads in field to accomplish these requirements for coordination.
- D. Identify structural penetrations for pipes, and submit details of those penetrations to the Structural Engineer for approval. Replace structural members that are damaged, cut, or penetrated without approval at no additional expense to the Contracting Agency.
- E. Design automatic fire suppression piping in this educational facility with full consideration given to the building occupants, minimizing inherent health risks caused by self-inflicted injury from the fire suppression system and/or damage to the system. This includes but is not limited to exposed pipes, security of system controls and service points, and sprinkler types specified for this application.

1.8 ANNUAL MAINTENANCE AGREEMENT PROPOSAL

- A. Provide upon request a cost proposal for performing annual maintenance recommended by NFPA 25.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide only products that are a standard product of a manufacturer regularly engaged in the manufacture of fire suppression equipment.
- B. Products and materials shall have a minimum working pressure of 175 psig and capable of withstanding a hydrostatic test pressure of 200 psig at 2 hours test pressure without damage, unless noted otherwise for higher pressure ratings or basis of design includes higher pressure ratings.
 - 1. Exception for approved ancillary devices that are normally isolated from the fire water and sprinkler lines shall have a minimum rated 150 psig working pressure.
- C. Submittals are required for all equipment, materials, and products.
- D. Glycol systems for fire suppression shall not be used.
- E. Exterior items shall be chrome finish or stainless steel.

2.2 LABELS, TAGS, AND APPROVALS FOR PRODUCTS

- A. Products UL or FM listed, labeled, and specifically approved for the fire suppression application where they are used.
- B. Label pipes, riser assemblies, pre-action systems, and alarm valves, including zone designation; enamel on metal for valves.
- C. Tag equipment for maintenance and operations. Include in shop drawings and O&M manual.

2.3 MANUFACTURERS

A. Sprinkler System and Components:

- 1. AGF.
- 2. Central.
- 3. Croker.
- 4. Gem Sprinkler.
- 5. Grinnell.
- 6. Kennedy.
- 7. Metraflex.
- 8. Milwaukee.
- 9. Notifier Company.
- 10. Potter-Roemer.
- 11. Potter Electric.
- 12. Reliable.
- 13. Star.
- 14. System-Sensor.
- 15. Tyco.
- 16. Tolco.
- 17. Victaulic.
- 18. Viking.

2.4 PIPE

- A. Plastic pipe is not allowed.
- B. The use of pipe nipples less than 1-inch in diameter is not allowed.
- C. Pipe shall be identified including manufacturer's name, model designation or schedule.
- D. Below Ground Pipe and Fittings, Municipality of Anchorage Standard Specifications, MASS:
 - 1. Ductile iron pressure pipe, Class 52, 150 psig working pressure, cement-mortar lining.
 - 2. Ductile iron cement-mortar line mechanical joint fittings.
 - 3. External zinc coating, anode bags, and bonding cables. Coordinate with civil requirements.
 - 4. Thrust restraint joints and concrete thrust blocks for horizontal and vertical bends.
- E. Wet Pipe Sprinkler Systems:
 - 1. Metallic pipes shall be listed for the intended service by UL or FM.
 - 2. Whenever pipes other than steel schedule 40 is utilized, submit a statement that the pipe complies with NFPA 13 standards, the pipe strength is adequate for the application, and the pipe corrosion resistance ratio (CRR) shall be equal or greater than 1.0, equivalent to schedule 40 pipe. Include this CRR data in product submittal.

2.5 FLEXIBLE SPRINKLER HOSE WITH THREADED END FITTINGS

- A. Flexible one-inch 304 stainless steel flexible sprinkler hose products shall be FM Global or UL tested and approved and submitted for the specific application. The drop system shall include required mounting brackets and appurtenances.
- B. Equivalent length of 1" schedule 40 steel pipe and pressure drop information shall be included in product submittal and hydraulic calculations.

2.6 FITTINGS, ABOVE GROUND

- A. Grooved Fittings, Couplings, and Mechanical Tees:
 - 1. Grooved Fittings: ductile iron fittings with flow equal to standard pattern. Fabricated or segmented fittings are not acceptable. Couplings and mechanical tees shall be standard painted, unless indicated otherwise.
 - 2. Grooved joint couplings shall consist of two ductile iron housing segments with pressure responsive gaskets and zinc plated, hot dipped galvanized or stainless steel hardware as required for application.

- a. Rigid type: Couplings shall provide joint rigidity, support and hanging in accordance with NFPA 13.
 - b. Flexible type: For use in locations where vibration attenuation and stress relief or flexible connectors are required.
- B. Threaded fittings shall be compatible with piping system and include cast iron Class 125 and 250 and malleable iron Class 150 and 300 steel.
- C. Pipe Flanges shall be compatible with piping system and include: Cast iron Class 125 and 250, and malleable iron Class 150 and 300 steel.
- D. Welded Pipe Fittings for Wet Pipe Sprinkler Only: Limited to Weld-o-lets, Thread-o-lets, Gruv-o-lets, Tees, and Welded Flanges. Welding limited to shop fabrication work with approved quality control process, welding procedures, and welders for specific application.
- E. Welded pipe joints and fittings shall not be used on galvanized pipe or on pipes with wall thickness less than schedule 10.
- F. Clamp-on, saddle type, or mechanical tee are not allowed for new work.
- G. Other means of joining pipe are not permitted.

2.7 VALVES AND ALARM ASSEMBLIES

- A. Valves: UL or FM listed and labeled and specifically approved for the fire suppression application where they are used. Minimum working pressure 175 psi non-shock cold water. Higher pressure rating as required.
 - 1. Control Valves: Fire suppression system control valves shall be supervised with switches compatible with the fire alarm system or other methods in compliance with NFPA 13.
 - a. OS&Y Gate Valves: Rated working pressure 250 psi non-shock cold water.
 - b. Butterfly Valves: Rated working pressure 300 psi non-shock cold water with pressure responsive seat, 360-degree circumferential seating. Weatherproof handwheel actuator housing and two integrated supervisory switches. Grooved, threaded, or wafer type acceptable.
 - c. NRS Gate Valves: Rated working pressure 250 psi non-shock cold water.
 - 2. Swing Check Valves, Spring-Assisted: Rated working pressure 250 psi non-shock grooved end, flanged, or wafer type, listed for vertical or horizontal installation.
- B. Test and Drain Valves:
 - 1. Test orifices shall be clearly identified and selected for smallest sprinkler orifice on system riser.
 - 2. Drain valve position clearly identified and valve accessible.

3. Sight glass for visual confirmation of water flow.
 4. Valve assembly shall be bronze body.
- C. Fire Department Valve:
1. Fire department valve shall be 2-1/2" angle valve, cast brass body, polished brass finish, and red hand wheel.
 2. Valve cap with chain. Cap and chain finish to match valve body.
 3. Threads shall match fire department standards.
 4. Provide a low point drain at connection to prevent freezing.
- D. Provide sprinkler alarm valve assemblies, appropriate to the system, complete with trimmings and accessories for proper alarm initiation and interface with fire alarm system. Alarm valve internal components shall be replaceable without removing the valve from the installed position. Include water flow detector, inlet and discharge pressure gauges, main drain, and inspectors test connection.
- E. Provide electrical alarm and control wiring in accordance with NFPA 72 and Division 26 requirements.
- F. Provide identification sign (enamel on metal) for valves per NFPA requirements.

2.8 SPRINKLER HEADS

- A. Provide sprinklers as required by NFPA 13 standards and in compliance with the IBC Chapter 9. Sprinkler heads using O-ring water seals are not allowed. Sprinkler finish and style as follows:
1. In areas with surface mounted light fixtures attached to finished suspended ceilings, provide standard spray pendant sprinklers, and escutcheons to position the sprinkler deflector below the light fixture. Sprinklers and escutcheons to be chrome finish.
 2. In areas with recessed lighting flush to the suspended ceiling finish, provide recessed standard spray pendant sprinklers. Sprinklers and escutcheons to be chrome finish.
 3. Sprinklers above ceilings and exposed ceiling areas shall be bronze finish, standard spray, upright or pendant type.
 4. Sidewall sprinklers shall be bronze finish in service areas, and chrome throughout public areas.
 5. Dry pendant and dry sidewall sprinklers protecting entry vestibules and other public areas susceptible to temperatures below 40 degrees F. shall be chrome finish recessed.
 6. Dry pendant and dry sidewall sprinklers protecting unheated areas and piped from wet pipe systems shall have an "A Length" dimension of not less than 18 inches.

7. Sprinklers with orifices less than K-4.2 shall be noted during submittal for specific application for approval and have an independent strainer with access for maintenance.
8. Guards are required on exposed piping sprinklers where subject to mechanical damage and sprinklers less than eight feet zero inches above finish floor. Provide the same brand sprinkler guard or escutcheon with the same finish as the sprinkler on which it is to be installed. Red guards are acceptable for bronze sprinklers only. Chrome finish guards are required for chrome sprinkler heads. Physically wire guards closed.
9. Sprinklers of correct temperature rating shall be installed according to NFPA 13.
10. Provide a minimum of 2 spare sprinkler heads of each type and temperature rating, minimum of 6 total, and a minimum of one sprinkler wrench for each type of installed sprinkler. Wrenches shall directly engage the wrench boss cast into the sprinkler. Provide plugs where dry type sprinklers are used. Spare sprinkler cabinet shall be red sheet steel manufactured by the sprinkler manufacturer. Mount cabinet on the wall within 60 inches of the main sprinkler control riser.
11. Provide additional sprinklers, as requested by Authority Having Jurisdiction, at no additional cost to the Contracting Agency.

2.9 FIRE DEPARTMENT CONNECTION, FDC

- A. Cast brass body and trim having individual double female snoots with rigid end three inches NPT by 2-1/2 inch pin lug hose thread swivels; plugs and chains; angle body outlet size as required; horizontal flush mounting with sillcock and flange plate; exposed parts polished brass finish.
- B. Provide number of snoots as required by NFPA 13.
- C. Connection to be complete with 1/2 inch automatic ball drip valve piped to exterior.
- D. Provide appropriate minimum 1" raised lettering on mounted metal signage to properly identify connection.
- E. Provide hose threads to match the threads of the local fire department.
- F. Provide knox stainless steel lockable caps, as approved by the Authority Having Jurisdiction.

2.10 BACKFLOW DEVICE

- A. Provide full line size double check valve backflow assembly and devices in accordance with the Uniform Plumbing Code requirements before FDC or sprinkler riser connections.
- B. Provide access to backflow device and gauges for conducting backflow device full flow test with provisions to record inlet and discharge pressures and discharge flow discharge to safe location.

- C. Backflow assemblies including approved orientations shall have successfully passed the laboratory and field evaluation tests conducted by the University of Southern California Foundation for Cross-Connection Control.

2.11 MAIN DRAIN

- A. Provide main drain exterior fitting with fire hose threads and wall plate with outlet adapter, cap and chain for exterior discharge. Chrome finish.

2.12 PIPE AND EQUIPMENT ANCHORS, BRACING, HANGERS, AND SUPPORTS

- A. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping and sprinkler heads per NFPA 13, International Building Code, and ASCE 7. Most conservative criteria shall govern.
- B. Provide flexible couplings, bracing, and other components required and compatible with the piping materials and fittings.
- C. Hangers, bracing, and seismic details and locations shall be included on the shop drawings.

2.13 INSPECTORS TEST CONNECTIONS

- A. Provide inspectors test connections for complete system testing, as indicated, and as required by Authority Having Jurisdiction.
- B. Polished brass plate pipe and fittings exposed outside building. Provide brass plated set screw escutcheon.

2.14 ELECTRICAL WORK

- A. Provide electrical components, equipment, wire, conduit, connections, devices, and services as required by NFPA 72 and Division 26 requirements.

2.15 VALVE SUPERVISION, TAMPER, SWITCHES

- A. Provided by Division 26. Refer to Section 28 31 00 - Addressable Fire Alarm.

2.16 WATER FLOW DETECTORS

- A. Provided by Divisions 26, 27 and 28. Refer to Section 28 31 00 - Addressable Fire Alarm.
- B. Provide vane-type water flow detectors installed at each system or zone control and for the main system header for multiple zone systems.
- C. Provide test connection at each flow detector.

- D. Provide water flow detectors compatible with fire alarm system in NEMA 4 enclosure.
- E. Coordinate with Division 26 requirements.

2.17 PRESSURE GAUGES

- A. Pressure gauges shall be 3-1/2" corrosion resistant moving parts, polycarbonate window with connection not smaller than 1/4" NPT, and maximum limit not less than twice the normal system working pressure at the point where installed.
- B. Provide 3-way globe shutoff valve with provisions for removal and draining on each pressure gauge.

PART 3 - EXECUTION

3.1 COORDINATION

- A. The fire suppression contractor shall coordinate their work with the work of other trades to assure timely installation and efficient use of mechanical areas including, but not limited to, boiler rooms, fan rooms, and ceiling spaces.
- B. Promptly remove any work installed without proper coordination and reinstall in a manner to allow for a good practical arrangement of items which need to be installed by other trades involved.
- C. In case of coordination dispute, consult the Contracting Agency and its decision shall be binding.
- D. Costs associated with coordination, arranging or rearranging of the fire suppression system shall be borne by the affected contractor, without causing any additional expense or delay to the Contracting Agency.
- E. Installation, testing, O&M manuals, record drawings, and AHJ approvals shall be completed, submitted, and approved by the Contracting Agency before beneficial occupancy.
- F. Coordinate with architectural requirements for prepping and painting of pipes, hangers, brackets, restraints, and appurtenances in public exposed areas.

3.2 PIPING INSTALLATION

- A. Install pipes, fittings, and appurtenances in accordance with codes and recommended practices. Follow manufacturers' installation instructions.
- B. Pipes and equipment not directly serving exit enclosures or exit passageways shall not be routed through them. Only pipes and equipment directly serving exit enclosures or exit passageways shall be allowed in these spaces. There shall be no penetrations whether protected or not between adjacent exit enclosures or exit passageways.

- C. Sprinkler pipe and fittings shall be installed to flush and drain system. Drains shall be accessible. Discharge test pipes, backflow system demand flow tests, and system main drain to safe location outside. Coordinate discharge point with Contracting Agency.
 - 1. Arrange pipes to drain to the main drain valve where practicable. Where connection to the main drain or other exterior drainage is impractical, as shown on shop drawings, install low point drain stations in accordance with NFPA 13.
 - 2. Identify the location of drain and test stations with signs on access panels, ceiling panels, or walls adjacent to the station, visible from the floor.
 - 3. Riser main drains and express drains shall have hose bibb connections for maintenance drainage where drainage to exterior safe location is not allowed or impractical.
 - 4. Coordinate routing of drain lines to waste receptors. Direct connection shall not be made between sprinkler drain lines and sewers.
- D. Seismic protection for the piping system shall be in accordance with NFPA 13 standards and ASCE 7. Include seismic restraint details with installation shop drawings.
- E. Provide clearance around pipes extending through walls, floors, ceilings, platforms, and foundations, including drains, fire department connections, and other auxiliary pipes. Holes shall be sized 2" larger than the pipe for pipe 1" to 3-1/2" and 4" larger for pipe 4" and larger, unless flexible couplings are located within 1 foot of each side of item penetrated, and excluding frangible construction that is not required to have a fire resistance rating.
- F. Install pipes to conserve building space and route pipes around roof hatches, electrical panels, access panels, and maintenance accesses.
- G. Minimum 2" clearance from structure not used to support pipes.
- H. Provide service access around equipment per manufacturer's requirements, minimum of 18".
- I. Provide flexible couplings as required per NFPA 13 and at the following locations:
 - 1. Penetrated fire and smoke rated assemblies.
 - 2. Within 24" of building's expansion joints.
- J. Sprinkler pipes shall be substantially supported from the building structure, which shall support the water loaded pipe plus a minimum 250 pounds temporary point load applied at the point of hanging. In addition pipe hangers shall include 5 time pipe filled with water.
- K. Pipes shall be concealed, except at ceilings exposed to structure, or as noted. Conceal pipes in areas with finished ceilings. Coordinate with the other trades to take timely advantage of available space above ceilings, below raised floor, in pipe and duct spaces and elsewhere.
- L. Piping to sprinklers below ceilings with minimum 1 inch outlets.

- M. Pipes in exposed ceiling areas shall be limited to branches serving heads in the area. Pipe routing shall be coordinated to minimize visual impact and approved prior to installation.
- N. Provide penetrations where pipes pass through walls, floors, or ceilings. Penetrations shall be in accordance with UL Fire Resistance Directory for "Through Penetration Firestop Systems (XHEZ)".
- O. Pipes supported from manufactured structural members shall comply with truss manufacturer's installation recommendations for hanger attachments and loading of pipe hangers.
- P. Pipes passing through pre-drilled structural elements to be shown on approved shop drawings.
- Q. Fasten trapeze members to truss chords or structural members.
- R. Install "beam clamp" type fasteners with retainer straps and locking nuts. Retainer strap shall be tight to beam.
- S. Pipe hangers: "rod and ring" type hangers throughout for dry pipe system. Minimum 1/2" of adjustment on each side of the hanger ring nut, to allow for piping grade adjustment in the future.
- T. Pipe size reductions by one-piece reducing fittings; bushing shall not be used.
- U. Provide test connection for each flow switch and supervisory switch on each shutoff valve.
- V. As a minimum, install pressure gauges at system entrance, forward flow test main drain, floor control valve main drains, and where indicated.
- W. Welded pipe shall be shop fabricated by certified welders and procedures. No field welding is allowed.
- X. Coat exposed threads with corrosion inhibitive paint per manufacturer's instructions.

3.3 GROOVED AND ROLLED FITTINGS

- A. Follow the manufacturer's suggested methods to prepare gaskets, pipes, and fittings to prevent leakage, system breakdown, and designed pipe and fitting movement.
- B. Cut grooved pipe shall be limited to schedule 40 pipe.
- C. Welding fittings shall not be used on galvanized pipe.
- D. Installers to have been trained by the coupling manufacturer in the use of grooving tools and installation of product. The manufacturer's representative shall periodically visit the job site to ensure best practices are being followed.

3.4 BONDING

- A. Provide underground ductile iron pipes with metallic bonding to produce electrical conductivity.

- B. Bond wire shall be type RHW-USE-2 for underground wet use, minimum size 1/0 neoprene-jacketed copper conductor shaped to stand clear of pipe joint.
- C. Coordinate with civil requirements and MASS requirements for installation and continuity of fire water service lines.

3.5 SPRINKLER HEAD INSTALLATION

- A. Sprinkler heads to be centered per approved shop drawings. Changes due to field conditions shall be pre-approved.
- B. Sprinkler heads to be centered on acoustical lay-in panels and symmetrically 4-way on architectural drawings laid out in each separate room or space with GWB type ceiling regardless of finishes and minimum Code requirements.
- C. Sprinkler heads shall be connected to system via minimum 1" diameter flexible stainless steel sprinkler hose in suspended ceiling areas, areas subject to tenant renovations, where indicated, and where required for seismic criteria. Ceiling systems with listed flex hose connections shall be identified on shop drawings.
- D. Escutcheons and cover plates shall be metallic and listed for the assembly.
- E. Provide guards where sprinklers may be subject to mechanical damage and in accordance with contract documents.
- F. Do not install sprinklers that have been dropped, damaged, show a visible loss of fluid, or a cracked bulb.
- G. The sprinkler bulb protector shall be removable by hand, without tools or devices that may damage the bulb.
- H. Sprinkler head temperature ratings shall be selected based upon installed distance from heat source.
- I. Provide clearance for removal of sprinkler heads and minimum 1" clearance from structure. Exclude concealed, recessed, and flush types, which have clearances above the ceiling.
- J. Identify sprinklers with less than 8 feet between them and include listing and NFPA 13 criteria.

3.6 DRY SPRINKLER HEADS

- A. Provide dry sprinkler heads in areas potentially subject to freezing including, but not limited to ceilings of entry vestibules, overhangs requiring fire suppression, rooms with combustion air openings, under over-head garage type doors, and other areas where temperatures may drop below 40 degrees F.
 - 1. Provide insulating boot for vapor tight and thermally insulated assembly. Coordinate with architectural requirements.

2. Coordinate "A Length" dimension with each assembly penetrated when piped from wet pipe system. Include information in submittals.
 - B. Review work of Divisions 26, 27 and 28 and determine which areas are not heated during times of primary power failure.
- 3.7 SPRINKLER PIPES AT ELECTRICAL, TRANSFORMER, TELECOM/DATA, AND COMPUTER ROOMS
- A. Provide complete interface with electrical/transformer rooms in compliance with the National Electrical Code and AHJ.
 - B. Route no pipes through rooms except branch piping supplying sprinklers protecting the room. Branch pipes shall not exit electrical room to supply additional sprinklers outside the room.
 - C. No pipes shall be routed above electrical panels or telecommunication racks.
 - D. Noncombustible hoods or shields, as described in NFPA 13, shall be provided to deflect direct sprinkler discharge away from electrical panels and equipment.
 - E. Maintain a minimum of 42" clear in front of electrical panels, coordinate with electrical requirements.
- 3.8 FIRE DEPARTMENT CONNECTIONS, FDC
- A. Location of the fire department connections shall be as indicated and as approved by the AHJ.
 - B. Working space of not less than 36" in width, 36" in depth, and 78" in height shall be provided and maintained in front of and to the sides of wall-mounted FDCs.
 - C. Fire department connection shall be located 42" above grade, unless otherwise required by the AHJ.
 - D. FDC line check valve shall be located in heated area of building, minimum of 30" from exterior or cold wall penetration and line slope to drain to automatic drip valve.
 - E. Piping between check valve and outside hose couplings shall have automatic drip valve.
 - F. Provide vehicle impact protection where the FDC is subject to impact by a motor vehicle.
- 3.9 PRESSURE GAUGES
- A. Pressure gauges shall be installed at fire water service entries, fire pump discharge pipe, pressure tanks, each main drain connection, top of each standpipe, and above and below each: alarm check valve, dry pipe valve, deluge valve, backflow preventer, or system riser check valve.

- B. Gauges shall be installed to permit removal and gauge connections shall be equipped with a shut-off valve and provisions for draining.
- C. Gauges shall be located so that water cannot freeze.

3.10 IDENTIFICATION

- A. Valves: Control, auxiliary control, drain, and test connection valve shall have permanently secured weatherproof metal identification signs.
 - 1. Systems with more than one control valve that must be closed to work on an area shall have a sign referring to existence and location of other valves.
 - 2. Control valve identification to include its function and what it controls.
- B. Coordinate with valve, zones, and pipe identification with Framed Building Plan and fire alarm nomenclature.
- C. Rooms containing control valve and similar equipment requiring fire department identification or access shall have signage.
- D. Exterior and interior signage shall be coordinated with architect and AHJ requirements.
- E. Sprinkler system hydraulic design and relevant general information. Information shall meet NFPA 13 and NFPA 25 requirements for inspection, testing, and maintenance.

3.11 ELECTRICAL WORK

- A. Provide electrical work, connections, routings, signals, power, and services as required by NFPA 72 and Division 26 requirements.
- B. Coordinate switches, connections, alarms, and number and type of devices with electrical work. Devices shall be compatible with Division 26 requirements.

3.12 PAINTING

- A. In areas exposed to public viewing clean and prepare pipe, fittings, hangers, restraints, supports, and miscellaneous items for areas to be painted.
- B. Refer to the requirements specified in Division 9.

3.13 ACCESS DOORS

- A. Provide access doors where "Fire Suppression" valves, switches, drain valves, or other controlling or monitoring devices are concealed. Label doors for quick location and recognition of concealed devices. For rated assemblies provide rated access door to match assembly's rating.

3.14 INSPECTORS TEST PIPING

- A. Discharge inspectors test pipes to approved floor drains in non-public areas, or outside building, but not on main walkways or over architectural surfaces easily stained or difficult to clean. Do not terminate discharge more than 48" above grade. Discharge main test and drain pipes used for service line flow testing outside and terminate with a 2-1/2" hose connection.

3.15 FLUSHING

- A. New Systems shall be arranged for flushing. Cross main ends shall be provided with readily removable fittings and shall terminate with 1-1/4" or larger pipe.
- B. Flush underground service pipes and distribution pipes before connecting underground pipes to sprinkler system. Flushing velocity shall be the larger of 10 feet per second flushing velocity or maximum design flow.
- C. Flush pipes before pressure testing.

3.16 TRAINING AND DEMONSTRATION

- A. Provide annual operational test including flow performance in accordance with NFPA 13 and NFPA 25 with Contracting Agency's representative and Owner's maintenance personnel.
- B. Train the Owner's designated maintenance manager in the operation and maintenance of the entire fire suppression system, minimum of 4 hours on-site training.
- C. Training materials shall include approved O&M manual and as-built drawings.
- D. Provide documentation stating date and length of training with list of attendees, instructor, and sign-off by Contracting Agency's representative stating that training and demonstration has been completed.

3.17 FIELD QUALITY CONTROL

- A. Arrange for proper witnessing of tests, as required by Authority Having Jurisdiction and as specified elsewhere. Contracting Agency's representative may witness tests. Notify Contracting Agency a minimum of 3 days in advance of test.
- B. Arrange new systems in or serving the area of work for testing.
- C. Hydrostatically test piping between the exterior fire department connection and the check valve in the fire department inlet pipe in the same manner as the balance of the system.
- D. Spot check installed sprinkler's identification to match approved shop drawings.
- E. Conduct tests in accordance with applicable codes. Test above ground and underground pipes at minimum 200 psig hydrostatic for two hours.

- F. Test tamper, supervisory, flow, and system alarm actuations and alarm monitoring systems.
- G. Test backflow device in accordance with Uniform Plumbing Code requirements.
- H. Provide backflow device full flow test per NFPA 25. Record and submit inlet and discharge pressures and discharge flow.
- I. Pipe shall not be concealed until satisfactorily pressure tested.
- J. Log of test shall be kept at the job site and shall identify:
 - 1. Who performed the test,
 - 2. Time and date of test,
 - 3. Section of system tested,
 - 4. Results of test,
 - 5. Completed Contractor's Material and Test Certification forms.
- K. Verify permanently marked weatherproof metal "Hydraulic Design Information Sign" is secured with corrosion resistant fastener at each alarm valve and information matches approved shop drawings and hydraulic calculations.
- L. Provide a letter of certification stating that testing and flushing has been performed in accordance with the applicable codes and standards. Itemize codes and standards complied with.

END OF SECTION 21 10 00

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SECTION 22 11 00

DOMESTIC WATER PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe, fittings, and connections for domestic potable water system.
2. Mechanical coupling systems.
3. Piping accessories.
4. Valves.
5. Water hammer arresters.
6. Trap primer valves.
7. Water Meters.
8. Cross Connection Protection Devices.
9. Access doors.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 29 - Mechanical Hangers and Supports
3. 20 05 53 - Mechanical Identification
4. 20 05 56 - Interior Trench Excavation and Backfill
5. 20 07 00 - Mechanical Insulation
6. 21 10 00 - Water Based Fire Suppression Systems
7. 22 13 00 - Sanitary Waste and Vent Piping and Specialties
8. 22 40 00 - Plumbing Fixtures
9. 23 05 93 - Testing, Adjusting and Balancing

1.2 REFERENCES

A. Codes and Standards:

1. International Building Code (IBC).
2. Uniform Plumbing Code (UPC).
3. ASCE 07-05, Minimum Design Loads for Buildings and Other Structures.
4. ANSI A117.1, Accessible and Usable Buildings and Facilities.
5. Foundation for Cross-Connection Control and Hydraulic Research, 9th edition, University of Southern California.
6. NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances.
7. 2011 Reduction of Lead in Drinking Water Act.
8. NSF/ANSI 61 - Drinking Water System Components - Health Effects.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the various plumbing systems and equipment.
2. Wetted surfaces of pipes, fittings, valves, and equipment in potable water systems shall be lead free as defined by the 2011 Reduction of Lead in Drinking Water Act.

B. Performance Requirements:

1. Potable water systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
2. Replace piping and equipment that does not perform as intended with properly operating equipment.

1.4 PRE-INSTALLATION MEETINGS

- A. Coordinate and sequence installation of plumbing systems and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components

1.5 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Product Data:
 - 1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.
 - 2. Indicate valve data and ratings.
 - 3. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings:
 - 1. This Section shop drawings to be submitted under Section 20 00 00 - Mechanical General Requirements.
 - 2. Show placement of fixtures and plumbing equipment.
- D. Certificates: Provide certificate of compliance from Authority Having Jurisdiction indicating approval of installation of cross contamination protection devices.
- E. Manufacturer's Installation, Operation, and Maintenance (IO&M) Manuals.
- F. Test and Evaluation Reports:
 - 1. Submit hydrostatic pressure test report.
 - 2. Submit sterilization of system report.

1.6 CLOSEOUT SUBMITTALS:

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Warranty Documentation.
- C. Record Documentation:

1. Record actual locations of valves, backflow preventers, water hammer arresters, and other components.
2. Record locations of access doors required for access or valves.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general maintenance material submittal requirements for the following:
- B. Tools: Provide an extra set of tools required for the installation of a copper press system.

1.8 QUALITY ASSURANCE

- A. Qualifications:
 1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
 2. Installers: Minimum three years' experience in the installation and start-up of plumbing systems and equipment.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
 1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
 2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.
- B. Storage and Handling Requirements:
 1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
 2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
 3. Replace damaged items with same item in new condition.

1.10 WARRANTY

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 WATER SERVICE PIPING (BURIED WITHIN 5 FEET OF BUILDING)

A. Water service transition into building:

1. Pipe: 4 inch and larger minimum Class 52 cement lined ductile iron pipe (AWWA C151).
2. Fittings: Ductile iron, standard thickness for pipe Class.
3. Joints:
 - a. Mechanically restrained joints (AWWA C110 and C1530).
 - b. Manufacturer: EBAA Iron, Inc., Model: Megalug.

2.2 WATER SERVICE PIPING (ABOVE GRADE INSIDE BUILDING)

A. Copper (Hard drawn):

1. Tubing: Type L (ASTM B88).
2. Fittings:
 - a. Cast copper alloy (ASME B16.18).
 - b. Wrought copper and bronze (ASME B16.22).
3. Joints: Solder, Grade 95TA (ASTM B32).

B. Copper Press Fitting System:

1. Limited to tubing sizes 4 inch and smaller.
2. Cast or wrought copper fittings, ASME B16.18 or ASME B16.22. Pre-formed grooves with pre-lubricated EPDM O-rings designed to seal fitting to copper tubing water tight with the use of manufacturer's crimping tool. Fittings shall be rated for 250 Degrees F., and 200 psi.
3. IAPMO UPC listing.
4. Manufacturer: Viega ProPress only, no substitutions.

2.3 UNIONS (STANDARD)

- #### A. Copper Piping (Sweat and Threaded):
- Cast bronze, ground joint, copper to copper, or copper to threaded joint. Nibco 733-LF series.

2.4 DIELECTRIC ISOLATORS (ELECTRICALLY INSULATING)

- A. Provide dielectric unions for 2 inch pipe and smaller.
- B. Provide dielectric flanges for 2-1/2 inch pipe and larger.
- C. Insulating gaskets, all types, shall be suitable for fluid type, temperature and pressure.
- D. Galvanized pipe to copper: Brass threaded end and sweat copper end.
- E. Black steel to copper: Zinc plated steel threaded end and sweat copper end.
- F. Manufacturers: Capitol, Epcu, Control Plastics, Watts, or approved equal.

2.5 VALVES

- A. General:
 - 1. Select valves of the best quality and type suited for the specific service and piping system used. Minimum working pressure rating 125 psig saturated steam or 200 psig W.O.G. Packing material or seals shall not contain asbestos.
- B. Ball Valves:
 - 1. Two (2) inch and smaller: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, blowout proof stem, 150 psig pressure/temperature rating (steam).
 - 2. Two and one half (2-1/2) inches through four (4) inch: Two piece type, full port, bronze body and silicone bronze ball or chrome plated brass ball, TFE seats, 150 psig pressure/temperature rating (steam). May be substituted for gate valves except where otherwise indicated.
- C. Gate Valves:
 - 1. Two (2) inch and smaller: Bronze body and trim, rising stem, solid wedge. Use only where shown on drawings.
 - 2. Two and one half (2-1/2) inch through four (4) inch: Iron-body, bronze trim, flanged threaded or sweat fitting. Non-rising stem: Inside screw. Rising stem: OS&Y. Bronze valves optional for 2-1/2 inch and three-inch.
- D. Globe Valves:
 - 1. Two (2) inch and smaller: Bronze body, renewable disc suitable for service.
 - 2. Two and one half (2-1/2) inch and larger: Iron body, bronze trim, flanged, bronze disc. Bronze valves optional for 2-1/2 inch and three-inch.
- E. Swing Check Valves:

1. Two (2) inch and smaller: Bronze body, horizontal swing, Y-pattern, Buna-N-disc for water, oil and gas. TFE disc for steam.
2. Two and one half (2-1/2) inch and larger: Iron body, horizontal swing, bolted bonnet, renewable bronze seat and disc, flanged.
 - a. Bronze valves optional for 2-1/2 inch and three (3) inch.

F. Butterfly Valves:

1. Two (2) inch and smaller: 150 psig bubble tight shutoff, suitable for 220 degrees F. operation, viton seal, lever handle, full flow low Cv type, bronze body and stainless steel trim, recommended by manufacturer for system intended. Manufacturer: Milwaukee "Butterball".

G. Drain Valves:

1. Full port ball valve with threaded hose adapter with bronze end cap.
2. Do not use sillcocks or butterfly valves as drain valves.

2.6 WATER HAMMER ARRESTERS

A. Manufacturers:

1. Sioux Chief
2. Precision Plumbing Products
3. Mifab
4. Zurn
5. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

B. Pressurized Piston Type:

1. Description: ASSE 1010 certified water hammer arrester.
2. Performance:
 - a. Maximum working temperature of 250 degrees F.
 - b. Maximum working pressure of 350 PSIG.
3. Materials:
 - a. Seamless copper body.

- b. EPDM o-rings lubricated with FDA approved compound.

2.7 TRAP PRIMER VALVES

A. Manufacturers:

- 1. Precision Plumbing Products.
- 2. Mifab.
- 3. ProFlo.

B. Non-Electronic Type:

- 1. Description: Valve designed to deliver a metered amount of water to floor drain traps upon pressure drop of 10 psi in the cold water line.
- 2. Performance: Factory set for proper operation with water pressure of 20 to 80 PSI.
- 3. Materials:
 - a. Lead-free brass body.
 - b. EPDM o-rings.
 - c. Stainless steel mesh screen.

C. Accessories: Distribution unit to serve multiple floor drains from a single trap primer.

2.8 BUILDING SERVICE WATER METER

- A. Provide rough in for water meter provided by utility company. Coordinate with utility company for space, flow and pressure loss requirements, and install meter. Provide temporary spool piece if meter delivery is delayed.

2.9 DOUBLE CHECK VALVE ASSEMBLY BACKFLOW DEVICE

- A. The double check valve assembly backflow-preventer shall consist of two independently operating, spring loaded cam-check valves, required test cocks, and inlet and outlet resilient seat shut off valves.
- B. The cam-checks include a stainless steel spring and cam-arm, rubber faced disc, and replaceable seats and seat discs. The body shall be cast silicon copper alloy, lead free, with a single two-bolt grooved style access cover. No special tools shall be required for servicing.
- C. Provide installation that meets access requirements of local code amendments.

- D. Water pressure drop through the assembly including shutoff valves shall not exceed six PSIG at 75 GPM.
- E. Manufacturer: AMES model LF2000B (Basis of design), Watts Regulator, Febco.

2.10 ACCESS DOORS

- A. Provide access doors for mechanical systems in accordance with Division 08.
- B. Provide UL labeled access doors and panels when required for fire resistance of surrounding construction.
- C. Provide key locks on access doors located in public areas below eight feet above finished floor.
- D. Prime coat steel.
- E. Coordinate location and size of access doors in walls, partitions, floors, and ceilings to correspond with valves, trap primers, cleanouts, and other devices requiring service or adjustment. Maintain any fire rating of the surrounding construction.
- F. Manufacturers: Elmdor, KARP, Milcor, MIFAB.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions: Cover equipment and plug piping connections to protect components from construction dirt and debris.
- B. Surface Preparation:
 - 1. Verify that excavations are to required grade, dry, and not over-excavated.
 - 2. Refer to Section 20 05 56 - Interior Trench Excavation and Backfill.

3.2 INSTALLATION

- A. Interface with Other Work:
 - 1. Review architectural drawings. Coordinate locations of access panels prior to piping installation.
 - 2. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related work shall be completed at no additional expense to the Owner.
4. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 for instructions on painting and coordination.

B. Water Service Piping:

1. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.
2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
4. At fixtures, install and connect hot water on left and cold water on right, as viewed when facing the fixture.

C. Valves: Provide accessible ball type isolation valves at major piping branches, and on main lines as shown.

D. Cross Connection Protection Devices: Conform to applicable code for installation of backflow prevention devices.

E. Provide finished products with protective covers during balance of construction.

F. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.3 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

3.4 SITE QUALITY CONTROL

A. Site Tests:

1. Test water piping hydrostatically at 100 psig or 150 percent of working pressure, whichever is greater, for a period of four hours. Observe piping during this period and repair leaks and retest.
2. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.

B. Inspection:

1. Arrange for inspections and provide notice to the Contracting Agency when the entire work or logical portions thereof, is ready for inspection.
2. The Victaulic Company's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. A distributor's representative is not considered qualified to conduct the training or jobsite visit(s).

3.5 CLEANING

A. Sterilization of Domestic Water Systems:

1. Sterilize each unit of completed supply line and distribution system with chlorine before acceptance for domestic operation.
2. Sterilization as described below or by the system prescribed by the American Water Works Association Standard C-651. Apply the amount of chlorine to provide a dosage of not less than 50 parts per million. Provide chlorine manufactured in conformance to the following standards:
 - a. Liquid Chlorine: Federal Specification BB-C-120.
 - b. Hypochlorite: General Specification O-C-114a, type 11, Grade B or Federal Specification O-X-602.
3. Introduce the chlorinating material to the water lines and distribution system after piping system has been thoroughly flushed. Maintain a contact period of not less than 24 hours. Flush the system with clean water until the residual chlorine content is not greater than 1.0 part per million.
4. Open and close valves in the lines being sterilized several times during above chlorination.
5. Certify in writing that sterilization has been completed in accordance with these requirements.

- B. After construction is completed, clean and wipe down exposed surfaces of piping and appurtenances.

END OF SECTION 22 11 00

SECTION 22 13 00

SANITARY WASTE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sanitary waste and vent pipe and fittings.
2. Cleanouts.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 29 - Mechanical Hangers and Supports
3. 20 05 53 - Mechanical Identification
4. 20 05 56 - Interior Trench Excavation and Backfill
5. 20 07 00 - Mechanical Insulation
6. 22 11 00 - Domestic Water Piping and Specialties
7. 22 40 00 - Plumbing Fixtures

1.2 REFERENCES

A. Codes and Standards:

1. International Building Code (IBC).
2. Uniform Plumbing Code (UPC).

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

4. ASA - American Supply Association.
5. CISPI - Cast Iron Soil Pipe Institute.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: This section describes specific requirements, products and methods of execution for sanitary waste systems and equipment.
- B. Performance Requirements:
 1. Sanitary waste systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
 2. Replace piping that does not perform as intended with properly operating equipment.
 3. Provide products with performance, output or salient features indicated or scheduled on the drawings.

1.4 PREINSTALLATION MEETINGS

- A. Coordinate and sequence installation of sanitary waste and vent piping and equipment with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components.

1.5 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Product Data:
 1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Clearly annotate literature to indicate specified salient features and performance criteria.
 2. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.
- C. Shop Drawings:
 1. This Section shop drawings to be submitted under Section 20 00 00 - Mechanical General Requirements.
 2. Indicate pipe grade and direction of slope. Indicate elevation of piping at the beginning and end of each main, and at branch connections.

3. Coordinate exact locations of drains, floor penetrations and structural penetrations with applicable trades.

D. Test and Evaluation Reports:

1. Submit pressure test report.
2. Submit system flushing report.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Warranty Documentation.
- C. Record Documentation:
 1. Record actual dimensioned locations for buried or inaccessible piping.
 2. Show actual cleanout locations and types.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Work shall be performed by workmen usually employed and experienced with the trade.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
 1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
 2. Remove damaged or otherwise unacceptable products from the project site when directed by the Contracting Agency.
- B. Storage and Handling Requirements:
 1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
 2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
 3. Replace damaged items with same item in new condition.

1.9 WARRANTY

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPING, BURIED BENEATH AND WITHIN FIVE FEET OF BUILDING

A. Hub-and-Spigot Cast Iron Pipe and Fittings:

1. Manufacturers:
 - a. Charlotte Pipe and Foundry.
 - b. Tyler Pipe and Coupling.
 - c. AB&I Foundry.
 - d. Equal.
2. Pipe: ASTM A74, service weight.
3. Fittings: Cast iron.
4. Joints: ASTM C564, neoprene gasket system.

B. Hub-less Cast Iron Pipe and Fittings:

1. Manufacturers:
 - a. Charlotte Pipe and Foundry.
 - b. Tyler Pipe and Coupling.
 - c. AB&I Foundry.
 - d. Equal.
2. Pipe: CISPI 301, ASA group 022.
3. Fittings: Cast iron.
4. Couplings:
 - a. Manufacturers:
 - 1). Husky Series 4000.

2). Approved equal.

b. Materials:

1). Heavy-duty 304-type stainless steel couplings and screws.

2). Minimum shield thickness: 0.015 inch.

3). Gaskets conforming to ASTM C564.

2.2 DRAINAGE PIPING, ABOVE GRADE

A. Hub-and-Spigot Cast Iron Pipe and Fittings:

1. Manufacturers:

a. Charlotte Pipe and Foundry.

b. Tyler Pipe and Coupling.

c. AB&I Foundry.

d. Equal.

2. Pipe: ASTM A74, service weight.

3. Fittings: Cast iron.

4. Joints: ASTM C564, neoprene gasket system.

B. Hub-less Cast Iron Pipe and Fittings:

1. Manufacturers:

a. Charlotte Pipe and Foundry.

b. Tyler Pipe and Coupling.

c. AB&I Foundry.

d. Equal.

2. Pipe: CISPI 301, ASA group 022.

3. Fittings: Cast iron.

4. Couplings:

a. Manufacturers:

- 1). Husky Series 2000
 - 2). MG Coupling
 - 3). Any other manufacturer meeting the requirements of the contract documents.
Substitution request not required.
- b. Description: No-hub cast iron pipe couplings conforming to standard CISPI 310.
- c. Materials:
- 1). Gaskets conforming to ASTM C564.
 - 2). Stainless steel clamp-and-shield assemblies.
- C. Copper Pipe: ASTM B306, DWV, ASTM B75, ASTM B88, ASTM B251 Type L.
1. Fittings: ASME B16.23 cast bronze, or ASME B16.29 wrought copper.
 2. Joints: ASTM B32, solder, Grade 50B.

2.3 ADAPTERS

- A. Manufacturers:
1. Romac.
 2. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.
- B. Use to connect pipes of same nominal size but different outside diameter or pipes of different material (cast iron to ductile iron, etc.).
- C. Rigid sleeve type coupling, ductile iron center ring and end rings, elastomeric gaskets, corrosion resistant bolts or polyethylene encasement.

2.4 CLEANOUTS

- A. Manufacturers:
1. Zurn.
 2. Mifab.
 3. J.R. Smith.
 4. Any other manufacturer meeting the requirements of the contract documents. Substitution request not required.

B. Floor Cleanouts:

1. Cast iron body, bronze plug with neoprene gasket.
2. Adjustable head to match finished floor elevation.
3. Round, scoriated bronze top.
4. Where indicated, provide cleanout tops with tile-terrazzo insert or carpet insert to match surrounding floor finish.

C. Wall Cleanouts:

1. Cast iron body, recessed bronze plug.
2. Wall access panel or access cover with center screw.

PART 3 - EXECUTION

3.1 PREPARATION

A. Interface with Other Work:

1. Review architectural and millwork shop drawings. Confirm location of cleanouts and access panels prior to installation.

B. Protection: Cover equipment and plug piping connections to protect components from construction dirt and debris.

C. Surface Preparation:

1. Verify that excavations are to required grade, dry, and not over-excavated.
2. See Section 20 05 56 - Interior Trench Excavation and Backfill.

3.2 INSTALLATION

A. Install plumbing systems in accordance with manufacturer's instructions and listing.

B. Provide finished products with protective covers during balance of construction.

C. Access Doors: Provide appropriate size and install such that plumbing features are readily accessible and maintainable.

D. Piping:

1. Grading: Minimum 1/4 inch per foot unless indicated otherwise on drawings and approved by AHJ for shallower slopes.
2. Install piping to maintain headroom, conserve space, and not interfere with use of space.
3. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
4. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
5. Where pipe support members are welded to structural building framing; scrape, brush clean, and apply one coat of zinc rich primer to welding.
6. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 9 - Finishes.
7. Connections:
 - a. Hub and hubless piping joints as specified above for underground piping.
 - b. Thread Joints: Assemble with TFE tape or approved non-hardening joint compound.
 - c. Solder Joints: Assemble with lead free solder.
 - d. Grooved and other joints: Assemble in accordance with manufacturer instructions.

E. Vents:

1. Install vents as indicated and as required by plumbing code. Add vents when field conditions increase the length of a trap arm or cause other changes in venting requirements.
2. Unless otherwise indicated, the portion of the vent extending through roof shall be increased in size from one foot below roof assembly to termination as defined below. Increase as follows:
 - a. Vent size two-inch and under; vent thru roof three-inch.
 - b. Vent size three-inch; vent thru roof four-inch.
 - c. Vent size four-inch; vent thru roof six-inch.
3. Termination of Vent: As required by the Uniform Plumbing Code.

F. Cleanouts:

1. Provide as indicated on drawings.

2. If field conditions create additional offsets or increase length of piping shown, provide additional cleanouts as required by the Uniform Plumbing Code and AHJ.
3. Where practical or as indicated provide cleanouts on vertical rainwater piping immediately above grade.

3.3 REPAIR/RESTORATION

- A. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.
- B. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- C. Substitute replacement parts from other manufacturers are not acceptable.

3.4 FIELD QUALITY CONTROL

- A. Inspections: Arrange for inspections and provide notice to the Contracting Agency when the entire Work, or logical portions thereof, is ready for inspection.
- B. Maintain current as-built drawings on-site recording including invert elevations, connections to fixtures, cleanouts, slopes, pipe sizes, and routing of pipes. Annotate sections of lines with dates when pressure tests have been approved by AHJ.
- C. Pressure Tests:
 1. Water Test: Test waste and vent system with water in accordance with the Uniform Plumbing Code.
 2. Test results shall be certified in writing as required by General Conditions. Include dates and sections tested, test pressure, test duration, printed names and signatures of person performing the test and Contracting Agency witnessing the test.
- D. Verify all penetrations are installed to maintain assembly integrity.

3.5 ADJUSTING

- A. Adjust functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.

3.6 CLEANING

- A. Flush drain piping to remove dirt and foreign debris from all systems.

- B. Clean all exposed pipes, fittings, and materials.
- C. Provide written certification which documents that the complete storm drain and sanitary sewer systems have been flushed of foreign debris. Include date and printed names and signatures of person(s) performing the flush and Contracting Agency witnessing the flush.

END OF SECTION 22 13 00

SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Water closets.
2. Urinals.
3. Lavatories.
4. Sinks.
5. Drinking fountains.
6. Floor drains and sinks.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 53 - Mechanical Identification
3. 20 07 00 - Mechanical Insulation
4. 22 11 00 - Domestic Water Piping and Specialties
5. 22 13 00 - Sanitary Waste and Vent Piping and Specialties

1.2 REFERENCES

A. Codes and Standards:

1. Uniform Plumbing Code (UPC)
2. International Building Code (IBC)
3. American Society of Safety Engineers (ASSE)
4. Standard for Accessible and Usable Buildings and Facilities (ANSI A117.1).ASCE 07-05, Minimum Design Loads for Buildings and Other Structures.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.
4. GPF - Gallons Per Flush.
5. PSI - Pounds per Square Inch.
6. PSIG - Pounds per Square Inch Gauge.
7. "Handicap", "handicapped", or "ADA compliant": Refers to fixtures that comply with the requirements of ANSI A117.1.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for plumbing fixtures.
2. Plumbing fixtures in potable water systems shall be lead free as defined by the 2011 Reduction of Lead in Drinking Water Act.

B. Performance Requirements:

1. Potable water systems shall perform quietly, with no objectionable vibration transmitted to the surrounding construction.
2. Replace piping and fixtures that do not perform as intended with properly operating piping and fixtures.

1.4 PRE-INSTALLATION MEETINGS

- #### A.
- Coordinate and sequence installation of plumbing fixtures with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any plumbing components.

1.5 SUBMITTALS

- #### A.
- See Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed:
- #### B.
- Product Data:

1. Provide plumbing specialty component sizes, rough-in requirements, service sizes, and finishes.
 2. Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Shop Drawings:
1. This Section shop drawings to be submitted under Section 20 00 00 - Mechanical General Requirements.
 2. Indicate dimensions and weights of fixtures and equipment, and placement of openings and holes.
- D. Manufacturer's Installation, Operation, and Maintenance (IO&M) Manual.

1.6 CLOSEOUT SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general closeout submittal requirements for the items listed below, supplemented with the additional requirements listed:
- B. Warranty Documentation.
- C. Record Documentation.

1.7 QUALITY ASSURANCE

- A. Qualifications:
1. Manufacturers: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
 2. Installers: Work shall be performed by workmen usually employed and experienced with the trade.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements:
1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
 2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.
- B. Storage and Handling Requirements:

1. Store products in covered storage area protected from the elements, outside the general construction zone until installed.
2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
3. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
4. Replace damaged items with same item in new condition.

1.9 WARRANTY

- A. See Section 20 00 00 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 FIXTURES

- A. Traps, Stops and Supplies:
 1. Provide traps, stops and supplies for fixtures.
 2. Sink/lavatory P-Traps: 17 gauge chrome-plated tubular brass or cast brass.
 3. Supplies: Flexible, stainless steel.
 4. Stops: Quarter-turn, removable key type. Commercial quality metal components only; no plastic parts.
- B. Escutcheons: Provide chrome plated wall escutcheons for pipe penetrations into walls.
- C. Flush Valve Manufacturers: Sloan, Zurn, no substitutions.
- D. Lavatory Faucets Manufacturers: Delta, Chicago Faucets, no substitutions.
- E. Carriers:
 1. Manufacturer: J.R. Smith, Josam, Zurn, MIFAB.
 2. Provide carriers for wall mounted fixtures.
- F. Fixtures specified elsewhere, or otherwise furnished:
 1. Provide appropriate strainer, tailpiece, trap, waste and supplies.
 2. Rough in and connect only.

G. Handicapped Fixtures:

1. Provide fixtures in compliance with the appropriate standard listed in Part 1.
2. Provide fixtures operable with one hand without grasping, pinching or twisting of the wrist, and requiring not more than five pounds of operating force.
3. Handicap accessible lavatories and sinks: Where piping is exposed, provide fixture insulation assembly. Refer to Section 20 07 00 - Mechanical Insulation.

H. Sensors operated fixtures: In addition to features described in the Fixture list, provide the following features:

1. General:
 - a. Provide with Infra-red sensors, solid state circuitry, 24 VDC operation.
 - b. Provide battery operated fixtures.
 - c. Adjustable sensor range, variable time-out adjustment.
 - d. Filtered solenoid valves.
2. Hand faucet:
 - a. ADA compliant.
 - b. Splash proof electronic circuitry.
 - c. Aerator/spray head with pressure compensating flow control.
 - d. Trim plate for 4-inch center-set sink.
 - e. Under-counter control module.
3. Manufacturer: Sloan, Zurn, Symmons.

2.2 WATER CLOSETS

A. P-1 - Water Closet:

1. Fixture: Wall hung, siphon jet, elongated bowl, low consumption (1.6 gpf), 1-1/2 inch top spud. American Standard model Afwall EL 1.6.
2. Flush Valve: Sloan Royal model 111-1.6.
3. Seat: Open front, commercial weight, heavy duty, solid plastic, stainless steel check hinge, without cover, white.
4. Carrier: Floor mounted. No residential.

B. P-1H - Water Closet:

1. Fixture: Wall hung, siphon jet, elongated bowl, low consumption (1.6 gpf), 1-1/2 inch top spud. American Standard model AFWall EL 1.6.
2. Flush Valve: Sloan Royal model 111-1.6.
3. Seat: Open front, commercial weight, heavy duty, solid plastic, stainless steel check hinge, without cover, white.
4. Carrier: Floor mounted. No residential.
5. ADA: ADA compliant. Handicapped mounting height.

C. P-6H - Water Closet:

1. Fixture: Floor mounted, gravity tank, siphon jet, elongated bowl, insulated, vitreous china, low consumption (1.28 gpf). American Standard Champion 4 Max Right Height 2586.128ST.
2. Seat: Open front, elongated, less lid.
3. ADA: ADA compliant.

2.3 URINALS

A. P-2 - Urinal:

1. Fixture: Siphon jet, vitreous china, low consumption (1.0 gpf). Integral flush rim, wall hangers, 3/4 inch top spud. American Standard model Trimbrook 1.0.
2. Flush valve: Sloan Royal model 186-1.0.
3. Carrier: Floor mounted. No residential.

2.4 LAVATORIES

A. P-3H - Wall Lavatory:

1. Fixture: Counter mounted, vitreous china, 20 inch by 17 inch oval bowl, front overflow, faucet holes on four inch centers. American Standard model Aqualyn.
2. Faucet: Sensor actuated, battery powered, 0.5 GPM spray head, deck mounted. Sloan model EBF-650.
3. Mixing valve: Thermostatic, ASSE 1070 listed. Leonard model 270-LF.
4. Drain: Metal grid strainer.

5. Floor mounted carrier. No residential.
6. ADA: ADA compliant. Handicapped mounting height.

2.5 SINKS

A. P-4H - Single Compartment Sink:

1. Fixture: Single compartment, 18 gauge, type 304 stainless steel, 19 inch by 17-1/2 inch by 6-1/2 inch deep, self rimming, sound deadened, with J-35 strainer. Just Manufacturing model SL-ADA-17519-A-GR.
2. Faucet: Delta model 470-DST, 4 inch centers.
3. ADA: ADA compliant. Pipe drain for handicapped access.

B. P-5 - Mop Sink:

1. Fixture: 24 inch by 24 inch with 10 inch high walls. Stainless steel drain body, factory installed. ProFlo Model PFMB2424S.
2. Accessories:
 - a. PFSSHE service hose.
 - b. PF296 service hose bracket.
 - c. PF1118 faucet with vacuum breaker, stops and bucket hook with brace.
 - d. PF245 mop hanger with wall clamps.
 - e. PFBG24V vinyl bumper guard
 - f. PFWG24S 24-inch stainless steel back-wall panels.

2.6 DRINKING FOUNTAINS

A. DF-1H - Drinking Fountain:

1. Fixture: Wall mounted, single station, polished stainless steel, hooded stream projector with push-button controls, perforated strainer, back panel. Halsey-Taylor model Contour or approved equal.
2. Carrier: Floor mounted. No residential.
3. ADA: ADA compliant. Handicapped mounting height.

2.7 FLOOR DRAINS

A. FD-1 - Floor Drain:

1. Fixture: Cast iron body with adjustable, polished nickel bronze top. No-hub outlet,
2. Grate: 6-inch round top except where 6-inch square top indicated (-B). Free area (minimum) 6-inch round = 9 square inches. Secured by vandal-proof screws.
3. Zurn Z415B or approved equal.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Installer: Perform work by experienced personnel previously engaged in plumbing system construction and fixture installation, and under the supervision of a qualified installation supervisor.

3.2 PREPARATION

- A. Confirm location and size of fixtures and openings before piping rough-in and installation.
- B. Verify that rough-ins have been provided, are correctly sized and are located within dimensional tolerances for fixtures to be installed prior to installation of fixtures.
- C. Interface with other Work: Review Architectural drawings and millwork shop drawings to verify correct fixture locations.

3.3 INSTALLATION

- A. Install piping and plumbing products in accordance with UPC and manufacturer's instructions. Provide seismic anchoring, bracing, supports, and clearance for equipment, piping, and sprinkler heads per UPC, IBC, and ASCE-07; most conservative criteria shall govern.
- B. Provide permanent metal and wire positioners, supports, and carriers to secure fixtures and piping rigidly in proper alignment without sway or sideplay.
- C. Anchor fixtures securely to withstand applied vertical load of not less than 250 pounds on the front of the fixture, without noticeable movement.
- D. Install fixtures plumb, level and to the finished architectural surface, so that the maximum gap between the fixture and the surface does not exceed 3/16 inch. Caulk the edge of the joint between fixture and surface with silicone or butyl type waterproof caulking compound.
- E. Install and connect hot water on left and cold water on right, as viewed when facing the fixture.

- F. Locate flush valve handles on handicapped accessible water closets on the wide side of the stall. Mount Accessible fixtures shown in the ADA guidelines to the heights indicated.

3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 SITE QUALITY CONTROL

- A. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.6 ADJUSTING

- A. Adjust functional components for proper operation in accordance with manufacturers' recommendations, or as otherwise directed.

3.7 CLEANING

- A. Clean fixtures and trim to a clean condition. Obtain a written certification from the Owner that this has been accomplished and accepted.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstration: Provide 1 hour of demonstration conducted by authorized factory start-up personnel to the Contracting Agency's authorized maintenance personnel.
- B. Training: Provide 1 hour of operational instruction conducted by authorized factory start-up personnel to the Contracting Agency's authorized maintenance personnel.

END OF SECTION 22 40 00

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: General requirements and methods of execution relating to the testing and balancing of the mechanical systems provided on this project.
- B. Related Sections:
 - 1. 20 00 00 - Mechanical General Requirements
 - 2. 20 05 13 - Common Motor Requirements
 - 3. 23 31 00 - Ducts and Accessories
 - 4. 23 34 00 - HVAC Fans
 - 5. 23 37 00 - Air Outlets and Inlets
 - 6. 23 74 23 - Packaged Makeup Air Units
 - 7. 23 82 00 - Terminal Heating and Cooling Units
 - 8. 25 90 00 - Sequence of Operations

1.2 REFERENCES

- A. Codes and Standards:
 - 1. National Environmental Balancing Bureau - Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems.
 - 2. National Environmental Balancing Bureau - Testing, Adjusting, Balancing Manual for Technicians.
 - 3. SMACNA - HVAC SYSTEMS Testing, Adjusting, and Balancing.
- B. Abbreviations and Acronyms:
 - 1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
 - 2. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

3. TAB: Testing, Adjusting, and Balancing.
4. NEBB: National Environmental Balancing Bureau

C. Definitions:

1. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical related definitions.
2. Accuracy: Capability of an instrument to indicate the true value of a measured quantity.
3. Adjusting: Varying of system flows by partially closing balancing devices, such as dampers, and valves, and varying fan speeds to achieve optimum system operating conditions within design and installation limitations.
4. Balancing: Methodical proportioning of air and hydronic flows through the system main, branches, and terminal devices using acceptable procedures to achieve the specified air or hydronic flow with testing and design limitations.
5. Calibrate: The act of comparing an instrument of unknown accuracy with a standard of known accuracy to detect, correlate, report, or eliminate by adjustment any variation in the accuracy of the tested instrument.
6. NEBB Certified TAB Firm: A Firm that has met and maintains all the requirements of the NEBB for Firm certification in TAB and is currently certified by NEBB. A NEBB Certified Firm shall employ at least one NEBB Qualified TAB Supervisor in the full time management position.
7. NEBB Certified TAB Report: Data presented in a NEBB Certified TAB Report accurately represents system measurements obtained in accordance with the current edition of the *NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems*. Variances from design quantities that exceed NEBB or contract document tolerances are to be noted in the TAB report project summary.
8. NEBB Qualified TAB Supervisor: Full time employee of the TAB Firm in a management position who has successfully passed the supervisor level written and practical qualification examinations and maintains the Supervisor re-qualification requirements of NEBB.
9. NEBB Qualified Technician: Full time employee of the TAB Firm who has met the technician level experience requirements of NEBB and has successfully passed the technician level written and practical qualification examinations. A NEBB Qualified TAB Technician shall be supervised by a NEBB Qualified TAB Supervisor. Supervision does not infer constant oversight; a NEBB Qualified Technician is capable of performing assigned tasks with periodic supervision.
10. Precision: Ability of an instrument to produce repeatable readings of the same quantity, or a tightly grouped set of values, under the same conditions.
11. Range: Upper and lower limits on an instrument's ability to measure the value of a quantity for which the instrument is calibrated.
12. Resolution: Smallest change in a measured variable that an instrument can detect.

13. Testing: Use of specialized and calibrated instruments to measure temperatures, pressures, rotational speeds, electrical characteristics, velocities, and air and hydronic quantities for an evaluation of flow conditions.
14. Testing and Balancing: As used in these specifications, testing and balancing refers to testing, adjusting, and balancing (TAB) as described in the above references.
15. TAB: A systematic process or service applied to heating, ventilating and air-conditioning (HVAC) systems and other environmental systems to achieve and document air and hydronic flow rates. The standards and procedures for providing these services are referred to as "Testing, Adjusting, and Balancing" and are described in this document.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: This section describes specific requirements, products and methods of execution for the testing, adjusting and balancing of the project.
- B. Performance Requirements: Furnish the services of a qualified and approved TAB Firm to perform the work of this specification section.
- C. The work of this section includes but is not necessarily limited to:
 1. Test and balance fans and supply, exhaust and relief ventilating systems.
 2. Test and adjust fan filter differential pressure switches wherever provided.
 3. Work directly with the control subcontractor to obtain proper system adjustments.
 4. Measure sound power levels if so directed.
 5. Provide a final report.
- D. The work of this section does not include:
 1. Adjusting burners for proper combustion operation.
 2. Liquid waste transfer system adjustment.
 3. Refrigeration work.
 4. Control system adjustments, unless noted otherwise herein.

1.4 SUBMITTALS

- A. See Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Sample report forms and outlines indicating adjusting, balancing, and equipment data required prior to commencing work.

C. Certificates:

1. Submit the name and qualifications of TAB Firm for approval with general product submittals. Submit copy of TAB Firm's NEBB certification.
2. Submit the names and certifications of the Firm's NEBB Qualified TAB Supervisor and NEBB Certified Technician.

D. Balancing Report:

1. Submit a complete report of the testing and balancing of all devices in a format equivalent to that shown in the SMACNA HVAC Systems Testing, Adjusting and Balancing manual. Compile the test data and submit eight copies of the complete test data for acceptance and/or analysis and recommendations.
2. Provide report in soft cover, letter size, comb bound binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include drawings within report.
3. Report Cover Sheet. Include the following data:
 - a. Project Name.
 - b. Project Address.
 - c. Names of Architect and Engineer.
 - d. Names of General Contractor and HVAC Contractor.
 - e. Report date.
 - f. Names of TAB technicians responsible for the measurements and report.
4. System Review Sheet:
 - a. List air systems balanced, with systems highlighted that were found to be performing outside design tolerances.
 - b. Include a summary of problems encountered, deviations from design, deficiencies in performance, remaining problems, recommendations, and comments.
5. Instrument Calibration Report:
 - a. Include a complete list of test equipment used, including apparatus manufacturer's name, model number, serial number, and date last calibrated.
 - b. List the instruments used on the project during the balancing work, on an NEBB "Instrument Calibration Report" form, or equivalent form. This includes flow measuring hoods and other related devices.

6. Air Systems Report. Prepare a report for each air system balanced. Tabulate data separately for each system. Describe balancing method used for each system. At minimum, include the following:
 - a. System Diagram: Include locations of air terminal units and pitot tube traverses. Include appropriate notes, static pressure reading locations, etc., taken during testing and balancing.
 - b. Air Apparatus or Fan Test Report: Include pertinent data on the test report forms. If test data could not be measured, or is not applicable, indicate such on report forms. List how each actual cfm measurement was obtained (duct traverse, total of outlet airflows, or a combination).
 - c. Duct Pitot Tube Traverse Reports: Include actual temperature and pressure readings recorded at the time of testing and balancing.
 - d. Air Outlet Test Reports: Include applicable A_k factors and terminal device sizes. If flow measuring hoods are used, indicate their use in the remarks column.
 - e. Include complete identification of elements. Identify by box number, room name and number, air outlet symbol, orientation in room, etc., as necessary to clearly and positively identify the location of each element.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. The work described in this section shall be performed by a Firm certified by the National Environmental Balancing Bureau for air and hydronic balancing.
2. The Firm shall have a record of operation within Alaska for at least three years prior to bid date of this project and shall have demonstrated satisfactory completion of five projects of similar size and scope in the State of Alaska. Provide references if requested.
3. The Firm's Technician and Supervisor for this project shall be NEBB certified for their respective positions.
4. Bids by suppliers, contractors or any Firm whose principal business is not that of testing, adjusting, and balancing HVAC systems are not acceptable.

B. Balancing Standards:

1. Perform total system balance in accordance with NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
2. Maintain one (1) copy of balancing procedural document on site.
3. Use standard NEBB forms.

C. Timing of Work:

1. Sequence work to commence after completion of systems. Do not begin balancing and testing until the systems are complete and in full working order.
2. Schedule the testing and balancing work in cooperation with other trades.
3. Schedule completion of testing and balancing before Substantial Completion of Project.

D. Construction team responsibility to TAB Agency: Refer to 20 00 00 - Mechanical General Conditions.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify systems are complete and operable before commencing work.
- B. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- C. Report defects and deficiencies that may preclude proper TAB of systems and equipment.

3.2 PREPARATION

- A. Schedule work under the provisions of Section 20 00 00 - Mechanical General Conditions.
- B. Provide calibrated instruments required for testing, adjusting, and balancing operations.
- C. Prior to starting work, review drawings and actual field conditions for additional balancing devices or components required for correct balance. Coordinate provision of additional balancing devices as required elsewhere in these specifications. Refer to Related Sections above.
- D. Preliminarily adjust grille, register, and diffuser blades or pattern controllers per drawings. If airflow blow patterns are not shown on drawings, adjust for uniform diffusion pattern(s) or diffusion into long dimension of room.

3.3 SPECIAL TECHNIQUES:

- A. Use instrumentation in accordance with NEBB requirements, calibrated to the accuracy standards specified by this organization.
- B. Flow measuring hoods are acceptable for measurement of ceiling diffuser performance if used in a manner as recommended by the manufacturer and calibration and accuracy data is provided with the balancing report.

- C. Upon request, make available to the Contracting Agency copies of current calibration certificates.

3.4 ACCEPTABLE CRITERIA

- A. Systems will be considered balanced in accordance with NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* when the following conditions are satisfied:

- 1. Air Handling Systems:

- a. Measured airflow quantities are within plus or minus 10 percent of design quantities. Deficiencies shall be noted in the TAB report.
- b. There is at least one direct path with fully open dampers from the fan or terminal unit device to an air inlet or outlet. Additionally, if a system contains branch dampers, there will be at least one wide open path downstream of every adjusted branch damper.

- 2. Air Outlets and Inlets:

- a. Measured airflow quantities total to within plus or minus 10 percent of design to space and individual outlets and inlets in space to within plus or minus 10 percent of design.
- b. Grilles, registers, and diffusers blades or pattern controllers are adjusted for uniform diffusion in the space. Re-adjust airflow patterns that result in airflow velocities greater than 50 FPM at 5 feet AFF.

- B. If systems or components cannot be adjusted to within specified tolerances:

- 1. Coordinate the replacement of sheaves, belts, or other components or devices needed for correct balance as required elsewhere in these specifications.
- 2. Note deficiencies in the TAB report.

3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on equipment sheaves, belts, dampers, valves, air outlets and inlets and each system according to the procedures contained in the current edition of the NEBB *Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems* and this section.
- B. Adjustments shall be made with air handler filters blanked off to create a filter pressure drop of 60 percent of the manufacturer's recommended filter final pressure. Where multiple filters are encountered each set shall be individually blanked off, for a cumulated pressure drop of 60 percent of each filters final pressure.
- C. Ensure recorded data represents actual measured or observed conditions.

- D. Permanently mark final settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- E. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Contracting Agency.
- H. Schedule and provide assistance in final adjustment and test of fire alarm system with Authority Having Jurisdiction.

3.6 SITE QUALITY CONTROL

- A. Make calibrated test instruments available to Contracting Agency to facilitate spot checks during testing and commissioning as appropriate.
- B. Re-balance components or systems found to be out of tolerance at no additional expense to the Owner.

END OF SECTION 23 05 93

SECTION 23 11 23

FUEL GAS PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Specific requirements, products, and methods of execution relating to the provision of fuel gas systems for the project.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 29 - Mechanical Hangers and Supports
3. 20 05 53 - Mechanical Identification
4. 23 74 23 - Packaged Makeup Air Units

1.2 REFERENCES

A. Codes and Standards:

1. International Fuel Gas Code (IFGC).
2. Uniform Plumbing Code (UPC).
3. NFPA 54 - National Fuel Gas Code.

B. Abbreviations, Acronyms and Definitions:

1. Refer to Division 01 for general abbreviations, acronyms, and definitions.
2. Refer to Section 20 00 00 - Mechanical General Requirements for general mechanical related definitions.
3. Refer to Mechanical Drawings legend sheet for general mechanical related abbreviations.

1.3 SYSTEM DESCRIPTION

A. Design Requirements:

1. This section describes specific requirements, products and methods of execution for interrelated systems necessary for the distribution of natural gas within the building.
2. Provide products including above ground piping, connections to gas burning apparatus, and work at the gas source to provide complete fuel gas systems where required. Provide gas equipment pressure regulator vents to outside the building at fuel gas trains.

B. Performance Requirements:

1. Underground gas service piping to the meter location, and the meter itself, is existing to remain.
2. Modify natural gas piping on / within the building as shown on drawings.

1.4 PREINSTALLATION MEETINGS

- A. Coordinate installation of gas piping and equipment with trades responsible for portions of this and any other related specification sections prior to installation of any components.

1.5 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Provide manufacturers' product literature for items specified in Part 2 and those products required by the performance standards of this section, clearly annotated to indicate specified salient features and performance criteria.
- C. Shop Drawings: Submit dimensioned shop drawings of gas piping size and routing as part of the plumbing shop drawings, with callouts indicating deviations from layout shown.
- D. Test and Evaluation Reports:
1. Obtain a certificate of final inspection from the Contracting Agency.
 2. Submit a letter of certification with copy of certificate of final inspection, indicating that the gas piping has been completed, tested, and inspected.
- E. Quality Control Submittals: Provide a certified test report showing the system has been tested in accordance with Code requirements and is in compliance.

1.6 CLOSEOUT SUBMITTALS:

- A. Operation and Maintenance (IO&M) Manuals:
 - 1. Refer to Section 20 00 00 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
 - 2. Provide copies of approved submittal information for inclusion within the project IO&M Manual. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, parts listings, and spare parts list.
- B. Record Documentation: Record actual locations of equipment, piping, and components, and areas required for maintenance access.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum three years' experience in the installation of gas piping and equipment.
- B. Regulatory Requirements: NFPA 54.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.9 WARRANTY

- A. See Section 20 00 00 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 PIPING

- A. Above ground, pressure less than 14 inches water column:
 - 1. Schedule 40 black steel pipe.
 - 2. Welded or threaded black malleable iron fittings.
- B. Above ground, pressure greater than or equal to 14 inches water column:
 - 1. Welded schedule 40 black steel pipe.
 - 2. Welded schedule 40 steel fittings.

2.2 GAS METER

- A. Gas meter is existing to remain.

2.3 PRESSURE REGULATORS

- A. Cast iron or steel body, maximum 125 psig. Steel spring and seat, stainless valve stem, zinc plated steel diaphragm.
- B. Adjustable pressures setting, capacity as indicated.
- C. Double ported body, soft seat valve plug disc. Trim can be removed for inspection and maintenance without disassembling the actuator or removing the regulator from the pipeline.
- D. Manufacturer: Sprague, Fisher.

PART 3 - EXECUTION

3.1 INSTALLERS

- A. Installer: Perform work by experienced personnel under the supervision of a qualified installation supervisor.

3.2 PREPARATION

- A. Protection of In-Place Conditions: Plug piping connections for protection from construction dirt and debris.

3.3 INSTALLATION

- A. Special Techniques:
 - 1. Install equipment in accordance with manufacturer's instructions and requirements of the codes specified herein.
 - 2. Arrange products to be readily accessible for inspection, testing, and shutting off gas supply.
 - 3. Install pipe and fittings clean and free from cuttings, burrs, and defects in structure of threading, and thoroughly brushed and scale blown.
 - 4. Do not install any piping in concrete, in masonry, or below grade inside the building.
 - 5. Provide connection to gas consuming appliances. Connect gas appliances and fixtures with flexible connectors in accordance with the requirements of the appliance listing and manufacturer's instructions.

- B. Interface with Other Work: Coordinate and sequence installation of gas piping and equipment with trades responsible for portions of this and other related sections of the Project Manual.

3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 RE-INSTALLATION

- A. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.6 SITE QUALITY CONTROL

- A. Site Test and Inspections:
 - 1. Test gas piping before connection to the gas source. Do not enclose or conceal any untested portion of the gas system.
 - 2. Test piping in accordance with IFGC requirements.
- B. Non-Conforming Work: Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.7 CLEANING

- A. Clean gas piping, fittings, valves, etc., of grease, rust, dust and dirt.
- B. Paint interior piping with one coat of a suitable rust-inhibiting primer and one final coat of heat-resistant enamel paint to provide a uniform appearance. Color: black.
- C. Paint exterior piping with one coat of a suitable rust-inhibiting primer and one final coat of enamel paint to provide a uniform appearance. Color: black.

END OF SECTION 23 11 23

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SECTION 23 31 00

DUCTS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Metal Ductwork and Fittings.

2. Flexible Ductwork.
3. Acoustical Linings.
4. Volume Dampers.
5. Control Dampers.
6. Gravity Backdraft Dampers.
7. Flexible Duct Connectors.
8. Access Panels and Doors.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 29 - Mechanical Hangers and Supports
3. 20 07 00 - Mechanical Insulation
4. 23 05 93 - Testing, Adjusting and Balancing
5. 23 34 00 - HVAC Fans
6. 23 37 00 - Air Outlets and Inlets
7. Division - Electrical

1.2 REFERENCES

A. Codes and Standards:

1. International Building Code (IBC).
2. International Mechanical Code (IMC).

3. SMACNA HVAC Duct Construction Standards - Metal and Flexible, Third Edition 2005.
4. SMACNA HVAC Air Duct Leakage Test Manual, Second Edition 2012.

1.3 PREINSTALLATION MEETINGS

- A. Coordinate installation of ductwork and accessories with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of ductwork and accessories.

1.4 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data: Include manufacturer's detailed fire, smoke, and combination fire/smoke damper installation instructions for each specific wall, ceiling, and floor construction type(s) for the project.
- C. Shop Drawings:
 1. Include the following information in the scaled ventilation system shop drawings:
 - a. Label duct sizes using the same labeling method as the Contract Documents.
 - b. Show terminal equipment ductwork connections.
 - c. Volume, control, backdraft, fire, smoke, and combination fire/smoke damper locations as applicable.
 - d. Flexible connection locations.
 - e. Access panels and doors with sizes and swing directions shown.
 2. Casings and plenums: Submit detailed shop drawings showing the proposed plenum and casing materials to be used and the construction method.
- D. Installation, Operation and Maintenance (IO&M) Manuals.

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 00 00.

- C. Record Documentation: Record actual locations of ductwork and areas required for maintenance access in accordance with Section 20 00 00 - Mechanical General Requirements.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturers: Minimum 5 years of documented experience manufacturing commercial HVAC duct work and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
2. Installers: Minimum 5 years of experience in the installation of commercial HVAC ductwork and accessories in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.8 WARRANTY

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 METAL DUCTWORK AND FITTINGS

- A. General: Provide metal ductwork and fittings fabricated in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, G90 zinc coated unless otherwise noted.
- B. Low Pressure/Velocity Ductwork:
 1. Duct Pressure Class: 2 inches WC.
 2. Seal Class: A.
 3. Maximum Velocity: 1,500 FPM.

2.2 FLEXIBLE DUCTWORK

- A. Manufacturers:
 1. Thermaflex, Model M-KE.

2. Hart & Cooley.
3. JPL.
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Description: UL listed, Class 1 flexible ductwork in compliance with NFPA 90A and 90B.

C. Performance/Design Criteria:

1. Positive Pressure Rating:

Ten inches WC	(4"-12" ID).
Six inches WC	(14"-16" ID).
Four inches WC	(18"-20" ID).

2. Negative Pressure Rating:

One inch WC	(4"-12" ID).
One half inch WC	(14"-20" ID).

3. Maximum Velocity: 5000 FPM.
4. Operating Temperature Range:
 - a. 0 degrees F to 140 degrees F (continuous).
 - b. Minus 20 degrees F to 250 degrees F (intermittent).

D. Materials:

1. Acoustically rated black polyester core permanently bonded to coated spring steel wire helix.
2. Fiberglass insulation.
3. Tear resistant, reinforced metalized vapor barrier.

2.3 ACOUSTICAL LININGS

A. Manufacturers:

1. Knauf.
2. Johns Manville.
3. Owens-Corning.

B. Description:

1. UL listed.
2. NFPA 90A and 90B compliant.
3. One inch thick, 1.5 PCF, flexible, edge-coated, mat-faced glass fiber insulation bonded with thermosetting resin.
4. Does not promote growth of fungi or bacteria.

C. Performance/Design Criteria:

1. Maximum Velocity: 6000 FPM.
2. Operating Temperature Range: Up to 250 degrees F.
3. Maximum Water Vapor Sorption: Three (3) percent by weight.

2.4 VOLUME / BALANCING DAMPERS

A. Manufacturers:

1. Ruskin.
2. Greenheck.
3. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Materials:

1. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for fabricated volume damper construction requirements.
2. Round ducts to 12 inch diameter and rectangular to 18 inch width:
 - a. Flat sheet, galvanized steel, single blade damper.
 - b. Damper blade two gauges thicker than the duct gauge at the location installed (24 gauge minimum for round, 22 gauge minimum for rectangular).
 - c. Manual hand quadrant.
3. Round ducts over 12 inch diameter:
 - a. Flat sheet, galvanized steel, single blade damper.
 - b. Damper blade two gauges thicker than the duct gauge at the location installed (22 gauge minimum).
 - c. Manual hand quadrant with continuous steel rod.

4. Rectangular ducts over 18 inch width:
 - a. Flat sheet, galvanized steel, single blade damper.
 - b. Damper blade 18 gauge minimum.
 - c. Manual hand quadrant with continuous steel rod.
5. Accessible and lockable damper operators.

- C. Extractors: Not Permitted.
- D. Splitter Dampers: Not Permitted.

2.5 REMOTE VOLUME DAMPER OPERATORS

- A. Manufacturers:
1. Duro-dyne.
 2. Young Regulator.
 3. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.
- B. Provide flush mounted chrome plated remote operators with tamperproof cover, extension rod, and not more than one 90 degree angle gear drive.
- C. Regulator: Duro-dyne Series SRC-380 or Young Regulator 301.
- D. Angle Drive: Duro-dyne Model AD-38 or Young Regulator 927.

2.6 CONTROL DAMPERS

- A. Manufacturers:
1. Ruskin, Model CD50 (rectangular) or CDR25 (round).
 2. Greenheck, Model VCD-43 (rectangular).
 3. Air Balance.
 4. Pottorff.
- B. Rectangular:
1. Performance/Design Criteria:
 - a. Temperature Limits: Minus 72 degrees F. to plus 275 degrees F.

- b. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
 - 1). Closed Position: Maximum pressure of 13 inches W.C. at a 12-inch blade length.
 - 2). Open Position: Maximum air velocity of 6,000 feet per minute.
 - c. Leakage: Maximum 3.0 cubic feet per minute per square foot at 1.0 inch W.C. for sizes 24 inches wide and above.
 - d. Pressure Drop: Maximum 0.05 inches W.C. at 1,500 feet per minute across 24 inch by 24 inch damper.
 - 2. Material:
 - a. Frame: Five inches by one inch by minimum 0.125 inch 6063T5 extruded aluminum hat channel, mounting flanges on both sides of frame, reinforced at corners.
 - b. Blades: Airfoil-shaped, single-piece blades made of heavy-duty 6063T5 extruded aluminum. Maximum 6 inches blade depth.
 - c. Bearings: Non-corrosive, molded synthetic sleeve, turning in hole in frame.
 - d. Seals:
 - 1). Blade: Extruded vinyl type for ultra-low leakage. Mechanically attached to blade edge.
 - 2). Jamb: Flexible metal compressible.
 - e. Linkage: Concealed in frame.
 - f. Axles: Minimum 1/2-inch diameter plated steel hex, mechanically attached to blade.
 - 3. Finishes: Mill aluminum.
- C. Round:
 - 1. Performance/Design Criteria:
 - a. Temperature Rating: Maximum 250 degrees F.
 - b. Capacity: Demonstrate capacity of damper to withstand HVAC system operating conditions.
 - c. Closed Position: Maximum pressure of 10 inches W.C.
 - d. Maximum system velocity: 4,000 feet per minute.

- e. Maximum Leakage: Maximum 6 cubic feet per minute per square foot at 1 inch W.C.
- f. Pressure Drop: Maximum 0.05 inch W.C. at air volume of 7,000 cubic feet per minute through 24 inch diameter damper.
- 2. Material:
 - a. Frame:
 - 1). Under 6 inches Diameter: Two inches by minimum 12 gauge galvanized steel tube.
 - 2). 6 through 12 inches Diameter: Two inches by 1/2 inch by minimum 14 gauge galvanized steel channel.
 - 3). Above 12 through 24 inches Diameter: Two inches by 1/2 inch by minimum 1/8 inch galvanized steel channel.
 - b. Blade: Provide single-piece construction made of the following material:
 - 1). 18 inches diameter and less: Minimum 12 gage galvanized steel.
 - 2). Over 18 inches diameter: Minimum 10 gage galvanized steel, stiffeners as required.
 - c. Blade Seals: Closed cell polyethylene foam rubber or neoprene, fully encompassing and mechanically attached to blade edge.
 - d. Bearings: Self-lubricating stainless steel sleeve.
 - e. Axles: Minimum 1/2 inch diameter plated steel, full length of and extending 6" beyond damper frame, mechanically attached to blade.
- 3. Finishes: Mill galvanized.

2.7 GRAVITY BACKDRAFT DAMPERS

- A. Manufacturers:
 - 1. Ruskin model BD2A1.
 - 2. Greenheck.
 - 3. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.
- B. Performance/Design Criteria:
 - 1. Blades fully open static pressure drop: 0.10-inch WC (maximum).

C. Materials:

1. Frame: 6063T5 extruded aluminum, 0.090" wall thickness.
2. Blades: Formed aluminum, 0.025" wall thickness. Extruded vinyl edge seals, mechanically locked into blade edge.
3. Bearings: Corrosion resistant synthetic.
4. Linkage: Concealed in frame.

2.8 FLEXIBLE DUCT CONNECTORS

A. Manufacturers:

1. Duro-dyne Corporation.
2. Vent Fabrics.
3. Ductmate
4. Any other manufacturer meeting the requirements of the Contract Documents. Substitution request not required.

B. Performance/Design Criteria: Provide fan connectors with static pressure ratings suitable for each specific application. Minimum pressure ratings must be greater than, or equal to, the fan's shut-off static pressure, as indicated by the submitted fan curve, with a fifty (50) percent safety factor.

C. Materials:

1. Metal edging: 24 gauge galvanized steel.
2. Fabric: UL Listed, polyester blend with vinyl coating. Double folded seams. Four (4) inch width.

2.9 ACCESS PANELS AND DOORS FOR DUCTS AND PLENUMS

A. Manufacturers:

1. Air Balance Inc. model FSA-100.
2. Ruskin.
3. Ductmate.

B. Material:

1. Frame and Door: Minimum 24 gauge galvanized steel.

2. Reinforced doors with cross-bracing and/or otherwise stiffened to prevent rattling and vibration.
 3. Seals: Rubber gaskets, secured to door or frame.
 4. Where ductwork is insulated or lined, provide double-walled access door panels with 1 inch of internal insulation to match duct or plenum insulating and/or sound attenuating characteristics.
 5. Walk Through Doors:
 - a. Construct in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
 - b. Provide insulation and inner liner to match plenum or casing.
- C. Hinges and Latches:
1. Low velocity system access panels:
 - a. Sizes 12 inches by 12 inches through 24 inches by 24 inches.
 - b. Continuous steel hinge mechanically fastened to frame and quarter turn cam latches.
 2. Medium velocity system access panels:
 - a. Sizes 12 inches by 12 inches through 24 inches by 24 inches.
 - b. Continuous steel hinge mechanically fastened to frame.
 - c. Provide a minimum of two latches for rolled plate doors.
 - d. Cement sheet rubber gasket to door.
 3. Walk through doors (any dimension over 24 inches):
 - a. Provide three hinges.
 - b. Provide two latches with inside and outside handles.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify location, size and type (i.e. fire resistive construction) of wall, floor and ceiling/roof penetrations.

3.2 PREPARATION

- A. Protection on In-Place Conditions: During construction, install temporary closures of sheet metal, cardboard or polyethylene taped over ductwork openings to prevent construction dust and debris from entering duct systems.

3.3 INSTALLATION

A. Metal Ductwork and Fittings:

1. Install, seal and support ductwork and fittings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible for the duct pressure class and seal class specified. The use of “duct tape” as a duct seal method is prohibited.
2. Provide low pressure/velocity ductwork at the following locations:
 - a. Outside air intake ductwork.
 - b. Exhaust and relief air ductwork.
 - c. Constant volume ventilating systems.
3. Proprietary or other joint systems may be substituted for SMACNA details when submitted and approved in writing before starting work.
4. Where ducts penetrate through walls exposed in occupied spaces, provide sheet metal escutcheons at each penetration to provide a clean, finished appearance.
5. Duct penetrations: See Section 20 05 29 – Mechanical Hangers and Supports.
6. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoffs, use 90-degree conical tee or low-loss tee connections.
7. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream of equipment.
8. Provide orifice plates or balance dampers at branch connections as required for proper ventilation system balancing. Select balancing device and installation method to limit noise from mechanical vibration or air bypass.
9. Do not use turning vanes in medium velocity duct systems.
10. Support duct mounted equipment equal to or greater than 40 pounds, such as heating coils, independently from ductwork.
11. Support duct mounted equipment less than 40 pounds using standard duct supports and sway bracing located within 12 inches of equipment.

12. Where offsetting ductwork is not possible, ducts may be reduced a maximum of 20 percent to clear obstacles with Contracting Agency's permission.
13. Where steel ductwork is visible through air outlets or inlets, paint visible interior ductwork flat black.

B. Flexible Ductwork:

1. Install, connect and support flexible ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
2. Connection to air outlets in suspended grid ceiling systems: Provide a flexible duct length of 8 to 10 feet with one 90-degree bend or large radius 180-degree curve in addition to outlet connection. Support flexible duct at connections to air outlets to maintain minimum recommended bend radius.
3. Seal flexible duct connections to rigid ductwork with draw bands to the pressure class of the rigid duct system.
4. Flexible duct connections between medium pressure ductwork and air terminal units are prohibited.
5. Flexible ductwork is prohibited in inaccessible locations, such as above "hard" ceilings.
6. Flexible ductwork is prohibited at penetrations through walls.

C. Acoustical Lined Ductwork:

1. Provide standard one inch thick acoustically lined ductwork as indicated using the acoustical liner material specified. Attach the lining material to the ductwork in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide thicker acoustical lining where specifically noted.
2. Duct dimensions indicated are net free-area duct dimensions. Add twice the liner thickness to obtain outside duct dimensions.
3. Sleeve acoustical duct penetrations through full height walls perpendicular to wall surface. Provide 1/2" minimum gap between sleeve and duct. Fill gap with mineral wool backer and seal each side of penetration with acoustical sealant.

D. Volume Dampers:

1. Provide air volume dampers at each low-pressure duct main and branch take-off for proper air balancing.
2. Locate dampers a minimum of 10 feet from diffusers except where shown otherwise.

E. Control Dampers:

1. Provide opposed blade type dampers for the following applications:

- a. Exhaust fan discharge dampers.
 - b. Outside air intake dampers.
 - c. Isolation dampers.
 2. Provide parallel dampers for the following application: Make up air unit.
- F. Gravity Backdraft Dampers:
1. Provide backdraft dampers where shown on drawings and at each building exhaust or relief location where a motor operated control damper is not indicated.
 - a. When provided for roof curb mounted exhaust fans, locate backdraft damper in the curb opening.
 - b. When provided for fans located within building, locate backdraft damper in the discharge duct immediately upstream of the louver or hood.
 2. Double leaf butterfly dampers in roof outlets are permissible only for paint booths and similar applications.
- G. Flexible Duct Connectors:
1. Install duct connectors in accordance with the manufacturers written installation instructions.
 2. Provide a flexible airtight joint between fans and other vibrating equipment and the air distribution ductwork systems.
 3. Externally isolated air handling units and fans: Provide flexible connections where ducts attach to unit inlet and outlet(s) of unit.
- H. Penetrations:
1. Coordinate mechanical penetrations with architectural and structural construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
 2. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.
 3. Penetrations through roof, exterior walls and floors to be weather and water tight.
 4. Other penetrations to have acoustical seals.
- I. Access Panels and Doors:
1. Locate access doors to enable in-duct equipment to be easily inspected, cleaned, maintained and tested and/or reset.
 2. Provide access doors at the following locations:

- a. Fire, smoke and combination fire/smoke dampers.
 - b. Motor operated dampers.
 - c. Each side of duct mounted coils.
 - d. Each side of duct mounted humidification dispersion panels.
 - e. As necessary for duct cleaning in accordance with NADCA Industry Standard for Mechanical Cleaning of Non-Porous Air Conveyance System Components.
 - f. As necessary for maintenance access to serviceable instrumentation and control equipment.
3. Coordinate location and size of access doors in walls, partitions and ceilings to correspond with duct access doors, dampers and automatic control devices and instruments.
 4. Coordinate with supplier of component air handlers, package units and similar equipment to ensure that access doors and panels will not be obstructed when the equipment is installed.

J. Interface with Other Work:

1. Assist electrical and controls trades in mounting instrumentation devices and safety controls in ductwork and air handling units.
2. Make penetrations through exterior building walls watertight. Detail ductwork connections to prevent condensation or leakage from entering into surrounding building construction. Provide sleeves, special connections and sealant as required to accomplish this performance requirement.

3.4 SITE QUALITY CONTROL

- A. Verify accessibility to ventilation system components for maintenance, adjustment and cleaning.

3.5 ADJUSTING

- A. Adjust and balance dampers in accordance with Section 23 05 93 - Testing. Adjusting and Balancing.

3.6 CLEANING

- A. Prior to building occupancy and after ventilating systems are complete and functional, verify cleanliness of ventilating system ductwork. Verification shall comply with the inspection method(s) outlined in the National Air Duct Cleaners Association (NADCA) Standard for Assessment, Cleaning, and Restoration of HVAC Systems 2013. Conduct inspection in the presence of a Contracting Agency representative.

- B. If the ductwork does not comply with the standard for cleanliness, clean the affected ductwork as follows:
1. Small systems: Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient airflow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
 2. Large systems: Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning.

END OF SECTION 23 31 00

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SECTION 23 34 00

HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. In-line centrifugal fans.
2. Ceiling exhaust fans.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 13 - Common Motor Requirements
3. 20 05 29 - Mechanical Hangers and Supports
4. 20 05 53 - Mechanical Identification
5. 23 05 93 - Testing, Adjusting and Balancing
6. 23 31 00 - Ducts and Accessories
7. 23 37 00 - Air Outlets and Inlets
8. 25 90 00 - Sequence of Operations
9. Divisions 26, 27 and 28 - Electrical

1.2 REFERENCES

A. Codes and Standards:

1. International Mechanical Code (IMC).
2. NFPA 70 - National Electrical Code.
3. Air Movement and Control Association (AMCA) 99 - Standards Handbook.
4. ANSI/AMCA 210 (ANSI/ASHRAE Standard 51) - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.

5. AMCA Publication 261 Directory of Products Licensed to Bear the AMCA Certified Rating Seal.
6. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
7. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

1.3 PREINSTALLATION MEETINGS

- A. Coordinate installation of fans with trades responsible for portions of this and other related sections of the Project Manual prior to installation of fans.

1.4 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
 1. Provide fan curves with scheduled operating point clearly plotted.
 2. Provide sound power levels (in decibels) for each octave band for inlet, discharge, and radiated sound power for the assembled fan unit. Obtain sound level data by one of the following methods:
 - a. Actual measurements from tests performed in accordance with AMCA Standards in an AMCA registered test chamber.
 - b. Documented calculations that start with AMCA tested fan sound data and are modified in accordance with ASHRAE procedures identified in Chapter 48 of the 2011 ASHRAE HVAC Applications Handbook to accurately predict the sound power levels for the configuration shown.
 3. Provide electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- C. Shop Drawings. Include the following information in the scaled ventilation system shop drawings:
 1. Location, orientation and size of fans.
 2. Maintenance access and clearance requirements.
 3. Fan support methods (i.e. housekeeping pads, roof curbs, etc).
 4. Ductwork connections and sizes.
- D. Operation and Maintenance (IO&M) Manuals.

1.5 CLOSEOUT SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 00 00.
- C. Record Documentation: Record actual locations of fans and components and areas required for maintenance access in accordance with Section 20 00 00 - Mechanical General Requirements.

1.6 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturers: Minimum 5 years of documented experience manufacturing commercial HVAC fans and related equipment in accordance with AMCA standards.
 - 2. Installers: Minimum 5 years of experience in the installation of commercial HVAC fan systems.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general delivery, storage and handling requirements.
- B. Storage and Handling Requirements:
 - 1. Maintain fan covers and shrouds in place.
 - 2. Cover fan inlets and outlets to protect components from construction dirt and debris.

1.8 WARRANTY

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers:
 - 1. Greenheck.
 - 2. Cook.

3. PennBarry.
4. Acme.
5. AcoustiFLO.

B. Description:

1. Regulatory Requirements:
 - a. AMCA Certified Ratings seal for sound and air performance.
 - b. Products Requiring Electrical Connection - Listed and classified by Underwriters Laboratories Inc., or by a testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

C. Performance/Design Criteria: As scheduled.

D. Manufacturer's Nameplate: Permanently affixed, embossed metal containing model number and individual serial number for future identification, located on a permanent part of the fan.

2.2 IN-LINE CENTRIFUGAL FANS

- A. Duct mounted, direct drive, in-line centrifugal type fans. Rectangular fan housing design constructed of heavy gauge galvanized steel with rectangular duct mounting collars.
- B. Removable panel in fan cabinet of sufficient size to permit access for service to internal components without dismantling the cabinet.
- C. Centrifugal backward inclined fan wheel, constructed of aluminum and matched wheel and inlet cones for precise running tolerances. Dynamically and statically balanced at the factory.
- D. Heavy duty ball bearing type fan motors, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives readily accessible for maintenance.
- E. NEMA 1 disconnect switch provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring provided from motor to the handy box.
- F. AMCA Certified Ratings. Seal for both sound and air performance.

2.3 CEILING EXHAUST FAN

- A. Galvanized steel housing with 1/2" acoustical lining.
- B. Outlet collar with integral backdraft damper.
- C. Forward curved direct drive fan, dynamically balanced, AMCA airflow and sound rated.
- D. Plug-in disconnect for motor mounted on vibration isolators.

- E. Integral grille with concealed attachment.
- F. Integral solid state speed controller.
- G. Maximum sound as scheduled.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Preparation:

- 1. Provide roof penetrations and level roof curbs for roof mounted fans.
- 2. Coordinate penetration locations with structure.

3.2 INSTALLATION

A. General:

- 1. Install fans in compliance with manufacturer's written installation instructions.
- 2. Provide flexible connections at fan duct connections as shown or specified. See Section 23 31 00 - Ducts and Accessories for flexible duct connectors.
- 3. Support fans independently from ductwork. Provide fan support in accordance with 20 05 29 - Mechanical Hangers and Supports.
- 4. Ensure that fan access doors and panels are not obstructed when the equipment is installed.
- 5. Extend lubrication points so each is easily reached for maintenance.

B. Interface with Other Work:

- 1. Coordinate and sequence installation of fans with trades responsible for portions of this and other related sections of the Project Manual.
- 2. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate the installation with related work shall be completed at no additional expense to the Owner.

3.3 REPAIR/RESTORATION

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general repair/restoration requirements.

3.4 SITE QUALITY CONTROL

- A. Manufacturer Services: Verify fans are installed and operational in accordance with the manufacturer's written installation instructions.

3.5 SYSTEM STARTUP

- A. Start-up and operate fans in accordance with the manufacturer's written installation and operation manual check list.

3.6 ADJUSTING

- A. Adjust and balance fans in accordance with Section 23 05 93 - Testing, Adjusting and Balancing.

3.7 CLEANING

- A. Upon completion of installation and prior to initial start-up, vacuum clean and wipe down external system components and internal shrouded areas.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper system operation in accordance with Section 25 90 00 – Sequence of Operations, utilizing the building automation system.

END OF SECTION 23 34 00

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Air Diffusers and Registers.
2. Return/Exhaust Grilles.
3. Stationary Louvers.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 29 - Mechanical Hangers and Supports
3. 23 05 93 - Testing, Adjusting and Balancing
4. 23 31 00 - Ducts and Accessories

1.2 REFERENCES

A. Codes and Standards:

1. SMACNA HVAC Duct Construction Standards - Metal and Flexible Third Edition 2005.
2. NFPA 90A - Installation of Air Conditioning and Ventilation Systems.
3. ARI Standard 890-2001 - Air Diffusers and Air Diffuser Assemblies.
4. MOA Handout A.04 - Suspended Ceilings Industry Standard Construction, May 1, 2008.

1.3 PREINSTALLATION MEETINGS

- A. Coordinate and sequence installation of air diffusers, registers, grilles, and louvers with trades responsible for portions of this and other related sections of the Project Manual prior to installation of air outlets and inlets.

1.4 SUBMITTALS:

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Product Data:
 - 1. Air outlets and inlets performance data at operating conditions.
 - 2. Submit color selections for louvers from manufacturer's color selection chart.
- C. Shop Drawings:
 - 1. This Section shop drawings to be submitted under Section 20 00 00 - Mechanical General Requirements.
 - 2. Include the following information on scaled ventilation system shop drawings:
 - a. Air diffuser, register and grille locations, duct connection sizes and throw directions.
 - b. Louver locations with plenum dimensions.
 - c. Louver penetration detail which clearly shows wall type, louver frame type, duct connection method, sealant and or gasket locations and drainage path.
- D. Test and Evaluation Reports:
 - 1. Louver plenum water tightness test: Submit written certification that louver plenums have been satisfactorily tested and have been verified water-tight prior to insulating plenums. Refer to louver test under Part 3 below.
- E. Installation, Operation and Maintenance (IO&M) Manuals.

1.5 CLOSEOUT SUBMITTALS:

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements for the items listed below, supplemented with the additional requirements listed.
- B. Warranty Documentation: Provide standard manufacturer's warranty and submit documentation in accordance with Section 20 00 00.
- C. Record Documentation.

1.6 QUALITY ASSURANCE:

- A. Qualifications:
 - 1. Manufacturers: Minimum 5 years of documented experience manufacturing the products specified.

2. Installers: Minimum 5 years of experience in the installation of products specified.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general delivery, storage and handling requirements.

1.8 WARRANTY

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general warranty requirements.

PART 2 - PRODUCTS

2.1 AIR DIFFUSERS AND REGISTERS

- A. Manufacturers:
 1. Titus.
 2. Price.
 3. Nailor Industries Inc.
- B. Performance/Design Criteria: As scheduled.
- C. Finishes: Standard white, baked enamel or powder coated finish suitable for field application of custom finish color as required.
- D. Accessories:
 1. Equalizing grids.
 2. Earthquake tabs.
- E. Correlate diffuser style, dimension, and fit with ceiling. Provide diffusers with modules of the proper size to match the suspended ceiling layout or with appropriate factory provided frame for surface mounting.

2.2 RETURN/EXHAUST GRILLES

- A. Manufacturers:
 1. Titus.
 2. Price.

3. Nailor Industries Inc.

B. Performance/Design Criteria: As scheduled.

C. Finishes: Standard white, baked enamel or powder coated finish suitable for field application of custom finish color as required.

D. Accessories: Earthquake tabs.

E. Correlate grille style, dimension, and fit with ceiling. Provide grilles with modules of the proper size to match the suspended ceiling layout or with appropriate factory provided frame for surface mounting.

2.3 WALL LOUVERS

A. Manufacturers:

1. Ruskin.

2. Greenheck.

3. Pottorff.

B. Description:

1. General:

a. Six inch deep, stationary wall louvers.

b. Horizontal drainable blades (37.5 degree blade angle) with integral downspouts incorporated into frame jamb and mullion design.

c. Frame style designed for installation into wall penetration construction type indicated. See Architectural penetration details to coordinate style types.

d. Louver frame with surfaces designed to accept exterior caulking.

2. Regulatory Requirements:

a. Louvers shall bear the AMCA Certified Ratings label for Water and Air Performance.

b. Manufacturer's ratings based on testing in accordance with AMCA Publication 511.

C. Performance/Design Criteria:

1. Size and performance as scheduled.

2. Water penetration: 0.01 ounces of water per square foot of free area at 1000 FPM free area velocity.

- D. Materials: Heavy gauge extruded aluminum.
- E. Finishes:
 - 1. Prime coat to be field painted.
- F. Accessories:
 - 1. Bird Screens: Flattened, expanded aluminum with 1/2 inch mesh pattern. Located on internal side of louver assembly.
 - 2. Blank-off Panels:
 - a. Provide factory installed, insulated blank-off panels as scheduled and/or as shown.
 - b. Paint exterior side of blank-off panel flat black
 - c. Field installed blank-off panels are not acceptable.
 - 3. Extended Sills: Extruded aluminum.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Removal: Remove existing air diffusers, registers and grilles designated for relocation and reuse after repair and cleaning.

3.2 INSTALLATION

- A. General:
 - 1. Install products in compliance with the manufacturer's written installation instructions.
 - 2. Connect air outlets, registers, grilles and louvers to ventilation duct systems in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. Air Diffusers, Registers and Grilles:
 - 1. Install air diffusers, registers and return/exhaust grilles at the locations shown.
 - 2. Orient and adjust diffusers to provide the throw directions indicated.
 - 3. Provide appropriate borders for the ceiling, wall or floor construction type.
- C. Wall Louvers:

1. Install wall louvers at the locations shown and in accordance with manufacturer's written installation instructions and details for the specific wall type.
2. Coordinate louver locations, borders and mullion spacing with architectural panels.
3. Install louvers plumb, level, in plane of wall, and in alignment with adjacent work.
4. Seal louver penetrations watertight. Install, seal and insulate louver ductwork (intake or exhaust/relief plenums) to interior louver frame to prevent condensation or entrained water that enters ductwork from leaking into building. Provide sleeves, special connections and sealant as required to accomplish this requirement.
5. Slope plenum ductwork such that any entrained water drains out through base frame of wall louver. If drain holes are not provided by the manufacturer, drill 1/2-inch (minimum diameter) weep holes at twelve (12) inch intervals on center through base of louver as required for drain water to escape. Touch-up holes with factory supplied touch-up paint.
6. Field paint louver per manufacturer's instructions, coordinate with Division 09.

3.3 REPAIR/RESTORATION

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general repair/restoration requirements.
- B. Clean and repair existing air outlets and inlets to function as originally intended prior to reinstallation. Air outlets and inlets which require major repair may be replaced at the Contractor's option.

3.4 SITE QUALITY CONTROL

- A. Site Tests and Inspections: Prior to insulating louver intake and exhaust/relief plenums, with applicable fans shutdown, lightly spray water into louver from building exterior such that water enters plenums. Verify that the water readily drains out of louver drain holes without pooling and that no visible leakage is present. Repair and retest as necessary until performance requirements are met.

3.5 CLEANING

- A. Clean exposed surfaces of air outlets and inlets to remove fingerprints and dirt. Use water and mild soap or detergent not harmful to finish.

END OF SECTION 23 37 00

SECTION 23 74 23

PACKAGED MAKEUP AIR UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Direct-Fired Air Handling Units.
2. Manual Discharge Temperature Control Systems.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 13 - Common Motor Requirements
3. 20 05 53 - Mechanical Identification
4. 20 07 00 - Mechanical Insulation
5. 23 05 93 - Testing, Adjusting and Balancing
6. 23 11 23 - Fuel Gas Piping and Specialties
7. 23 31 00 - Ducts and Accessories
8. 23 34 00 - HVAC Fans
9. 23 37 00 - Air Outlets and Inlets
10. 25 90 00 - Sequence of Operations
11. Divisions 26, 27 and 28 - Electrical

1.2 REFERENCES

- A. International Mechanical Code (IMC).
- B. International Fuel Gas Code (IFGC).
- C. ANSI/NFPA 70 - National Electric Code.

1.3 SYSTEM DESCRIPTION

- A. Provide a self-contained, packaged, factory assembled and pre-wired gas fired make-up air unit to supply 100 percent outside air forced ventilation for the building.
- B. Performance Requirements: As scheduled.

1.4 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements, for general submittal requirements.
- B. Product Data: Provide manufacturers' product literature, clearly annotated to indicate specified salient features and performance criteria for each product specified.
- C. Shop Drawings:
 - 1. Provide scaled shop drawings which incorporate the following installation information:
 - a. Equipment locations and hanger details.
 - b. Coordination of equipment placement with structural members.
 - c. Natural gas pipe routing and sizing.
- D. Quality Assurance/Control Submittals:
 - 1. Manufacturer's Instructions:
 - a. Provide a complete manufacturer's written installation, operation and maintenance manual for each type of installed equipment. Clearly annotate the manual to indicate applicable information for the specific equipment model(s) installed.
 - b. Provide copy of start-up report.
- E. Operation and Maintenance (IO&M) Manuals:
 - 1. Provide copies of approved submittal information for inclusion within the project IO&M Manual.
 - 2. Refer to Section 20 00 00 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.

1.5 QUALITY ASSURANCE

- A. Manufacturer qualifications: Company specializing in manufacturing the products specified in this section with a minimum of 10 years' documented experience.

- B. Installer qualifications: Minimum 3 years' experience in the installation and start-up of packaged central air handling systems.
- C. Regulatory requirements: Products requiring electrical connection - Listed and classified by Underwriters Laboratories Incorporated, or by a testing firm acceptable to the Authority Having Jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at Site:
 - 1. Verify that products are new and delivered in original factory packaging/crating and are free from damage and corrosion.
 - 2. Replace equipment delivered to job site that does not comply with above requirements at no expense to Owner.
- B. Storage and Protection:
 - 1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
 - 2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
 - 3. Replace damaged items with same item in new condition.

1.7 WARRANTY

- A. See Section 20 00 00 - Mechanical General Requirements, for general mechanical warranty requirements.

1.8 MAINTENANCE

- A. Extra Materials: Provide one set of extra filters in original factory sealed container.

PART 2 - PRODUCTS

2.1 DIRECT-FIRED MAKEUP AIR UNITS

- A. General: Provide self-contained, packaged, factory assembled, pre-wired gas fired make-up air unit to provide single speed, 100 percent outside air forced ventilation/make-up air for the maintenance garage.
- B. Acceptance and Approvals:
 - 1. UL listed.

2. American Gas Association (AGA) certified.
 3. NFPA Standard 54 Compliant.
- C. Dimensions:
1. Overall make-up air unit dimensions and base frame heights scheduled are for the basis of design air handler manufacturer.
 2. The dimensions for “as equal” manufacturers may differ.
 3. Prior to submitting equipment provided by an “as equal” manufacturer, verify that the unit will adequately fit in the space provided with proper access for operation and maintenance to include the removal/replacement of each component.
- D. Unit Casing Construction:
1. Minimum 18 gauge galvanized steel cabinet sections with minimum 14 gauge galvanized steel channel base frame. Exterior casing sections, base frame and accessories coated with baked enamel finish.
 2. Internal components and accessories coated with baked enamel finish.
 3. One inch thick, 1-1/2 pound density insulation.
 4. Designed for indoor suspended mounting.
 5. Parts connected with plated, galvanized steel fasteners.
 6. Steel stamped nameplate with air handler performance data clearly indicated.
 7. Gas piping enclosure with service access door.
 8. Electrical controls enclosure with service access door.
- E. Inlet Damper Section:
1. Minimum 18 gauge galvanized steel damper frame.
 2. Minimum 14 gauge galvanized steel damper blades.
 3. Motorized two position damper actuator motor controller.
- F. Vee-Bank Filter Section:
1. Factory assembled galvanized steel construction.
 2. Filters:
 - a. Manufacturers: Farr 30/30, American Air Filter or approved equal.

- b. Provide disposable, pleated dry media filters having an average efficiency of 25 percent to 30 percent when tested in accordance with ASHRAE 52.1-1992 with an average arrestance of 90 percent to 92 percent. Complete filter shall be UL listed as a Class 2 air filter.

G. Direct Gas-Fired Heating Section:

1. Gas Burner: Single-stage, intermediate pilot ignition, 100 percent lockout on flame failure with manual reset.
2. Gas Train: UL listed.
3. Gas Burner Safety Controls:
 - a. Flame safeguard control.
 - b. Blocked Vent Safety Switch: Prevents unit heater operation if vent is blocked.
 - c. High Temperature Limit Control: Fixed stop at maximum permissible setting, de-energizes burner on excessive bonnet temperature.
 - d. Safety pre-purge time delay relay.
4. Fan:
 - a. Single speed, direct drive, backward curved blower(s) sized as scheduled.
 - b. Pillow block type bearings with extended bearing grease lines.
 - c. Internal vibration isolation.
5. Fan Motor:
 - a. Motor horsepower and electrical power requirements as scheduled.
 - b. See Section 20 05 13 - Motors, for detailed fan motor specifications.
6. Sound data:
 - a. Factory test fan assemblies to determine suction, discharge and radiated sound levels (decibels) for each octave band in accordance with AMCA Standards. Include sound level data with fan submittals.
 - b. When sound ratings are not specified, physical characteristics including type, wheel diameter and fan speed shall be the basis of comparison with specified requirements.
 - c. Octave band sound power levels shall not exceed those scheduled.

H. Electrical:

1. Factory pre-wired for single point connection.
2. Auxiliary fan motor starter contact.

I. Manufacturers:

1. Greenheck.
2. Modine.
3. Rupp.

2.2 TEMPERATURE CONTROLS

- A. Provide packaged manual discharge air temperature control system from same manufacturer as direct fired make-up air unit to include the following features:
1. Manual supply air temperature setpoint adjustment dial (55 to 90 degrees F adjustment range).
 2. Summer/Off/Winter selector switch.
 3. "Main Gas Valve ON" indicator light.
 4. "Flame Failure Alarm" indicator light.
 5. NEMA 12 enclosure.
 6. Supply air temperature sensor and room temperature override thermostat each packaged loose for field mounting and wiring. Room temperature override thermostat acts as room temperature low limit thermostat.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection:

1. Maintain air handling unit covers and shrouds in place and access doors closed at all times.
2. Cover cabinet openings and plug piping connections to protect components from construction dirt and debris.

3.2 EXAMINATION

- A. Verify that space is ready for installation of equipment and that hangers and supports are properly sized to support the weight of the actual unit to be installed.

- B. Verify that proper power supply is available.
- C. Verify that proper fuel supply is available for connection.

3.3 INSTALLATION

- A. Install products at the locations shown and provide filed wiring in strict compliance with the manufacturer's written installation instructions.
- B. Install natural gas piping in accordance with Section 23 11 23 - Fuel Gas Piping.

3.4 CONSTRUCTION

- A. Interface with other Work:
 - 1. Coordinate and sequence installation of each component with trades responsible for portions of this and other related sections of the Project Manual.
 - 2. Rework required, as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work, shall be completed at no additional expense to the Owner.

3.5 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
 - 1. Verify products are installed and operational in accordance with the manufacturer's written installation and operation instructions.
 - 2. Provide a written startup report and submit in accordance with submittal requirements.

3.7 ADJUSTING

- A. Adjust and balance fan to meet the performance requirements as scheduled and to minimize sound and vibration levels.

3.8 CLEANING

- A. Upon completion of installation and prior to initial start-up, vacuum clean and wipe down external system components and each internal compartment.

3.9 DEMONSTRATION & START-UP

- A. Start-up, operate and test equipment in accordance with the manufacturer's written installation and operation manual.
- B. Demonstrate proper system operation utilizing manual temperature control system.
- C. Demonstrate remote start/stop capability utilizing the operational crank timer.

END OF SECTION 23 74 23

SECTION 23 82 00

TERMINAL HEATING AND COOLING UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall mounted heaters.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 20 05 13 - Common Motor Requirements
3. 20 05 29 - Mechanical Hangers and Supports
4. 20 05 53 - Mechanical Identification
5. 23 05 93 - Testing, Adjusting and Balancing
6. 25 90 00 - Sequence of Operations

1.2 REFERENCES

- A. International Mechanical Code (IMC).
- B. NFPA 70 - National Electrical Code.

1.3 SYSTEM DESCRIPTION

- A. Design Requirements: Provide terminal heating and cooling units, piping, appurtenances, and controls to automatically maintain interior temperature setpoint for each area of the building.
- B. Performance Requirements: Provide performance and output shown or scheduled on drawings.

1.4 SUBMITTALS

- A. Refer to Section 20 00 00 - Mechanical General Requirements for general submittal requirements.
- B. Product Data:

1. Submit product literature for items specified in Part 2 and those products required by the performance standards of this section. Literature clearly annotated to indicate specified salient features and performance criteria.
 2. Include the following:
 - a. Performance characteristics as scheduled.
 - b. Enclosure style, material and grille arrangement.
 - c. Dimensional data.
- C. Shop Drawings:
1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.
 2. Indicate mechanical and electrical service locations and requirements.
- D. Samples:
1. Provide color samples of cabinet unit heater enclosures.
 2. Colors to be selected by the Contracting Agency.
- E. Provide certificates, manufacturer's instructions, and manufacturer's field reports for Quality Assurance/Control Submittals:
1. Provide a complete manufacturer's written installation, operation and maintenance manual for each type of installed equipment.
 2. Clearly annotate the manual to indicate applicable information for the specific equipment model(s) installed.
 3. Included with the manual one copy of the completed start-up and operation checklist. The checklist shall include:
 - a. Printed names and signatures of the installers.
 - b. Documentation from Manufacturer's representative and Contracting Agency that the equipment has been properly installed and is fully operational, thus validating the equipment warranty.
- F. Closeout Submittals:
1. Project Record Documents: Record actual locations of components and locations of access doors in terminal unit cabinets required for access or valves.
 2. Operation and Maintenance (IO&M) Manuals:

- a. Refer to Section 20 00 00 - Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.
- b. Provide copies of approved submittal information for inclusion within the project IO&M Manual. Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, parts listings, and spare parts list.

1.5 QUALITY ASSURANCE

- A. Manufacturer qualifications: Company specializing in manufacturing the products specified in this section with a minimum of three years documented experience.
- B. Installers' qualifications: Minimum three years' experience in the installation and start-up of packaged central air handling systems.
- C. Pre-Installation Meetings: Coordinate installation of terminal heating and cooling units with trades responsible for portions of this and any other related sections of the Project Manual prior to installation of any terminal heating and cooling unit components.
- D. Regulatory requirements: Products requiring electrical connection - Listed and classified by Underwriters Laboratories Incorporated, or by a testing firm acceptable to the Authority Having Jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Acceptance at Site:
 1. Verify that products are delivered in original factory packaging and are free from damage and corrosion.
 2. Remove damaged, or otherwise unacceptable, products from the project site when directed by the Contracting Agency.
- B. Storage and Protection:
 1. Outside the general construction zone, store products in covered storage area protected from the elements, until installed.
 2. Handle items carefully to avoid breaking, chipping, denting, scratching, or other damage.
 3. Replace damaged items with same item in new condition.

1.7 WARRANTY

- A. See Section 20 00 00 - Mechanical General Requirements, for general mechanical warranty requirements.

PART 2 - PRODUCTS

2.1 WALL HEATERS

- A. Performance: Provide heating performance as scheduled.
- B. Cabinet:
 - 1. Front Cover: Heavy gauge steel, louvered, factory finish.
 - 2. Back box: Recessed, rough-in type, heavy gauge galvanized steel, with knockouts for power leads.
 - 3. Surface mount installation.
- C. Finish: Factory applied powder paint finish over phosphatized steel, except for back box.
- D. Coil: Nickel-chromium wire elements enclosed in steel tubes to which plate fins are copper brazed.
- E. Motor: Totally enclosed, impedance protected, permanently lubricated, totally enclosed rotor.
- F. Control: Manufacturer's integral thermostat and thermal cutout switch.
- G. Electrical Characteristics:
 - 1. Horsepower, voltage, and phase as scheduled.
 - 2. Refer to Division 16.
- H. Manufacturers: Qmark, or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection: Cover equipment and plug piping connections to protect components from construction dirt and debris.
- B. Preparation: Prior to installation of terminal units, make sure wall construction is complete enough to correctly locate and mount units.

3.2 INSTALLATION

- A. Install terminal equipment in accordance with manufacturer's instructions.
- B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

- C. Provide finished cabinet units with protective covers during balance of construction.
- D. Wall Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.

3.3 CONSTRUCTION

- A. Interface with Other Work:
 - 1. Coordinate and sequence installation of terminal heating units with trades responsible for portions of this and other related sections of the Project Manual.
 - 2. Rework required as a result of failure to follow the manufacturer's written installation instructions or to properly coordinate with related Work shall be completed at no additional expense to the Owner.

3.4 REPAIR/RESTORATION

- A. Repair any product components broken during installation or startup with replacement parts supplied by the product manufacturer.
- B. Substitute replacement parts from other manufacturers are not acceptable.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Verify units are installed and operational in accordance with the manufacturer's written installation instructions.

3.6 ADJUSTING

- A. Adjust functional components for proper operation in accordance with manufacturer's recommendations, or as otherwise directed.
- B. Coordinate and work directly with the Testing, Adjusting and Balancing Agency to provide systems in proper operating order. Make corrections and adjustments as required by the Balancing and Testing Agency in a timely manner.

3.7 CLEANING

- A. After construction is completed (including painting), and prior to initial start-up, clean and wipe down exposed surfaces of units. Vacuum clean coils and inside of cabinets and enclosures.
- B. Touch up marred or scratched surfaces of factory finished cabinets and enclosures, using finish materials furnished by manufacturer.
- C. Clean permanent filters or install new disposable filters.

3.8 DEMONSTRATION AND STARTUP

- A. Start-up and operate terminal heating units in accordance with the manufacturer's written installation and operation manual check list.

END OF SECTION 23 82 00

SECTION 25 90 00

SEQUENCE OF OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. This section describes the building automation system (BAS) control sequences for the heating, ventilating and air-conditioning (HVAC) systems, electrical systems and plumbing systems provided for this project.

B. Related Sections:

1. 20 00 00 - Mechanical General Requirements
2. 22 40 00 - Plumbing Fixtures
3. 23 05 93 - Testing, Adjusting and Balancing
4. 23 31 00 - Ducts and Accessories
5. 23 34 00 - HVAC Fans
6. 23 74 23 - Packaged Makeup Air Units
7. 23 82 00 - Terminal Heating and Cooling Units
8. 28 16 00 - Security Alarm and Detection
9. 28 31 00 - Addressable Fire Alarm

1.2 SUBMITTALS

A. Refer to 20 00 00 – Mechanical General Requirements.

B. Product Data:

1. Provide manufacturers' product literature, clearly annotated to indicate performance criteria to include the following:
 - a. Controllers. Include building locations and equipment controlled by each controller.
 - b. Sequences of operation for HVAC, electrical and plumbing systems.

- c. Process control diagrams to support each sequence of operation. Show field mounted control device locations and circuit routing.
- C. Quality Assurance/Control Submittals:
 - 1. Installation and Functional Performance Test Letter.
 - a. Provide a letter certifying that the controls hardware is completely installed and sequences of operation have been programmed, operationally tested, with physically verification, to comply with the sequences of operation as specified. The installer(s), sub-contractor(s) and the Contractor must sign the letter.
 - b. Include as an attachment, a list of programming deviations from the specified sequences of operation with justification to support each deviation.
 - c. Include as an attachment, a table of final adjustable setpoint values for each applicable control point.
- D. Installation, Operation and Maintenance Data:
 - 1. Refer to Section 20 00 00 – Mechanical General Requirements, for IO&M Manual formatting requirements and number of copies required.

1.3 QUALITY ASSURANCE

- A. Qualifications of Installers/Programmers: Minimum 3 years' experience in the installation and programming of direct digital control systems.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 VENTILATION MAKE UP AIR SYSTEM (MAU-1)

- A. General Ventilation System Description:
 - 1. Unit provides ventilation for the gathering area.
 - 2. Unit is a direct fired gas makeup air unit.
 - 3. Unit is equipped with packaged digital controls.
- B. Heating Mode: Modulate unit burner to provide 85 degrees F. (adjustable) discharge air temperature.

- C. Cooling Mode: Modulate unit burner to provide 55 degrees F. (adjustable) discharge air temperature.
- D. Full Shutdown Mode:
 - 1. Fan unit is off.
 - 2. Burner is off.
- E. Operating Mode:
 - 1. 2-hour crank timer activates MAU operation.
 - 2. Room heating setpoint is 68 degrees F (adjustable).
 - 3. Room cooling setpoint is 72 degrees F (adjustable).
 - 4. Cycle burner on and off to maintain room temperature setpoint.
- F. Fire Alarm System Interface: Refer to Section 28 31 00 – Addressable Fire Alarm System for sequence of operation.
- G. Low temperature shutdown: If supply air temperature falls below 45 Degrees F, turn unit off, closed outside air damper, and generate an alarm.

3.2 JANITOR ROOM EXHAUST FAN (EF-1)

- A. Exhaust fan EF-1 provides exhaust for the janitor room.
- B. Exhaust fan runs continuously to provide exhaust ventilation of the room.

3.3 TOILET EXHAUST FANS (EF-2 AND EF-3)

- A. Exhaust fans EF-2 and EF-3 provide general exhaust for public toilet rooms.
- B. Interlock fan operation with room light switch.

3.4 COMM ROOM EXHAUST FAN (EF-4)

- A. Exhaust fan EF-4 provides cooling transfer air for the telecom room.
- B. Exhaust fan runs continuously to provide cooling transfer ventilation of the room.

END OF SECTION 25 90 00

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SECTION 26 00 00

ELECTRICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specifications Sections, apply to this Section.
- B. This section describes specific requirements, products, and methods of execution, which are typical throughout the electrical work of this project. Additional requirements for the specific systems may modify these requirements.
- C. This Section applies to all Divisions 26, 27 and 28 and is part of all other Divisions 26, 27 and 28 Sections.
- D. Index of Electrical Specifications:
 - 1. 26 00 00 - Electrical General Requirements
 - 2. 26 05 19 - Low Voltage Electrical Power Conductors and Cables
 - 3. 26 05 26 - Grounding and Bonding for Electrical Systems
 - 4. 26 05 29 - Hangers and Supports for Electrical Systems
 - 5. 26 05 33 - Raceway and Boxes for Electrical Systems
 - 6. 26 05 36 - Cable Tray for Electrical Systems
 - 7. 26 05 53 - Identification for Electrical Systems
 - 8. 26 24 16 - Panelboards
 - 9. 26 27 26 - Wiring Devices
 - 10. 26 28 00 - Low Voltage Circuit Protective Devices
 - 11. 26 28 16 - Enclosed Switches and Circuit Breakers
 - 12. 26 29 00 - Low Voltage Controllers
 - 13. 26 29 16 - Enclosed Contactors
 - 14. 26 43 00 - Surge Protective Devices

15. 26 50 00 - Lighting Fixtures
16. 265561 - Networked Lighting Control System
17. 27 20 10 - Telecom Distribution System
18. 28 23 10 - IP Closed Circuit Television
19. 28 31 00 - Addressable Fire Alarm System

1.2 REFERENCES

- A. Codes: Perform work in strict accordance with applicable national, state and local codes; including, but not limited to the latest legally enacted editions of the following specifically noted requirements:
 1. NFPA 70, National Electrical Code - NEC.
 2. ANSI-C2, National Electrical Safety Code - NESC.
 3. International Building Code - IBC.
 4. International Fire Code - IFC.
 5. Underwriters Laboratory (UL) or approved equal.
- B. Standards: Reference to the following standards infers that installation, equipment and material shall be within the limits for which it was designed, tested and approved, in conformance with the current publications and standards of the following organizations:
 1. American National Standards Institute - ANSI.
 2. American Society for Testing and Materials - ASTM.
 3. American Society of Heating Refrigerating and Air Conditioning Engineers - ASHRAE.
 4. Institute of Electrical and Electronics Engineers - IEEE.
 5. Insulated Cable Engineers Association - ICEA.
 6. National Electrical Manufacturers' Association - NEMA.
 7. National Fire Protection Association - NFPA.

1.3 DEFINITIONS

- A. "Accessible" means arranged so that an appropriately dressed man, 6 feet-2 inches tall, weighing 250 pounds, may approach the area in question with the tools and products necessary for the work intended and may then position himself to properly and safely perform the task to be accomplished, without disassembly or damage to the surrounding installation.
- B. "Authority Having Jurisdiction" is the individual official, board, department, or agency established and authorized by the political subdivision created by law to administer and enforce the provisions of the Code as adopted or amended.
- C. "As Specified" denotes a product, system, or installation that:
 - 1. Includes all of the salient characteristics identified in the Drawings and Specifications;
 - 2. Meets all of the requirements of the "Basis of Design"; and
 - 3. Is produced by a manufacturer listed as acceptable on the Drawings or in the Specifications.
- D. "Basis of Design" refers to products around which the design was prepared. Some or all of the particular characteristics of Basis of Design products may be critical to the fit or performance of the completed installation. Such characteristics are often subtle. Where substitutions are made to products that are the Basis of Design, the Contractor is alerted that nominally acceptable substitutions may produce undesirable side effects such as switchboards that no longer fit the space due to increased product dimensions. The Contractor is responsible for resolving all impacts of substitutions. Approval of a substitution request does not relieve the Contractor of complying with the design intent and all Codes.
- E. "Contracting Agency" is the Owner and as defined in the General Conditions of the Contract.
- F. "Demolish" means to permanently remove a component, equipment, or system and its appurtenances with no intent for reuse and to properly dispose of it.
- G. "Furnish" means to purchase material as shown and specified, and cart the material to an approved location at the site or elsewhere as noted or agreed to be installed by supporting crafts.
- H. "Install" means to set in place and connect, ready for use and in complete and properly operating finished condition, material that has been furnished.
- I. "Product" is a generic term that includes materials, equipment, fixtures and any physical item used on the project.
- J. "Provide" means furnish all products, labor, subcontracts, and appurtenances required and install to a complete and properly operating, finished condition.
- K. "Remove" means to remove a component, equipment, or system and its appurtenances and either store it for re-installation, reuse, or turn it over to the Contracting Agency.

- L. "Rough-in and Connect" means provide an appropriate system connection such as conduit with junction boxes, wiring, switches, disconnects, etc., and wiring connections. Equipment furnished is received, uncrated, assembled, and set in place under the Division in which it is specified.
- M. "Serviceable" means arranged so that the component or product in question may be properly removed, and replaced without disassembly, destruction or damage to the surrounding installation. "Serviceable" components shall be "accessible".
- N. "Shop Drawings" are dimensioned working construction drawings drawn to scale to show an entire area of work in sufficient detail to demonstrate service and maintenance clearances and complete coordination of all trades.
- O. "Substitution" is a product, system or installation that is not by a listed manufacturer or does not conform to all salient characteristics identified in the Contract Documents, but which the Contractor warrants meets all specific requirements listed in the Contract Documents.
- P. "System Drawing" is a diagrammatic engineered drawing that shows the interconnection and relationship between products to demonstrate how the products interact to accomplish the function intended. Examples of system drawings include control and instrumentation diagrams, and wiring diagrams. Some drawings, such as dimensioned and complete Fire Suppression Drawings may be both System Drawings and Shop Drawings.

1.4 PERFORMANCE REQUIREMENTS

- A. Provide labor, products and services required for the complete installation, checkout and startup of electrical systems shown and specified. Where the work of several crafts is involved, coordinate related work to provide each system in complete and in proper operating order.
- B. Lay out the work in advance and avoid conflict with other work in progress. Physical dimensions shall be determined from existing conditions. Verify locations for junction boxes; disconnect switches, stub-ups, etc., for connection to equipment furnished by others, or in other Divisions of this Work.
- C. Refer to the "Suggested Coordination Schedule" in Section 20 00 00 - Mechanical General Requirements.
- D. Cooperate with others involved in the project, with due regard to their work, to promote rapid completion of the entire project.
- E. Coordinate installation of panels, equipment, system components, and other products to provide proper service areas and access for items requiring periodic maintenance inspection or replacement.
- F. Reference to a specific manufacturer's product (even as "Basis of Design") does not necessarily establish acceptability of that product without regard to compliance with all other provisions of these specifications.
- G. Local Conditions: The Contractor shall thoroughly familiarize himself with the work as well as the local conditions under which the work is to be performed. Schedule work with regard to

seasons, weather, climatic conditions and other local conditions which may affect the progress and quality of the work.

- H. Utility Coordination: Coordinate work with the serving utilities (electrical, telephone, cable television, etc.) and provide equipment and installation in accordance with the respective utility requirements. Meet with the serving utilities and coordinate the installation and location of the services. Provide a written statement of approval from each serving utility.
- I. Demolition: Coordinate related demolition in support of the project. Restore circuits and systems, which are to remain, but which are affected in any way by demolition Work. Conduct a site visit prior to bid to determine Scope. Refer to Part 3 of this Section for execution requirements.

1.5 SUBMITTALS

- A. Refer to Division 1 for general submittal, closeout submittal and product substitution requirements. In addition, prepare Divisions 26, 27 and 28 submittals in accordance with the following.
- B. Specification section drawings, calculations, and products shall be complete and submitted together in one package.
- C. General:
 - 1. The Contracting Agency's obligation to review submittals and to return them in a timely manner is conditioned upon the prior review and approval of the submittals by the Contractor as required by the Construction Contract.
 - 2. Streamlining: in many instances, the products, reference standards, and other itemized specifications have been listed without verbiage. In these cases, it is implied that the Contractor shall provide the products and perform in accordance with the references listed.
 - 3. Submittal review is for general design and arrangement only and does not relieve the Contractor from any of the requirements of the Contract Documents.
 - 4. Submittals will not be checked for quantity.
 - 5. Submittals will not be exhaustively checked for dimension or fit, or for proper technical design of manufactured equipment. Provision of a complete and satisfactory working installation is the responsibility of the Contractor.
 - 6. Furnish suppliers with the applicable portions of the Contract Documents and review and verify that the suppliers' submittals clearly represent products which comply with the Contract Documents.

D. Electronic Submittals:

1. Submittals may be in electronic (PDF) format.
 - a. Electronic submittals shall follow the organization and formatting required for paper submittals.
 - 1). Provide electronic bookmarks within the PDF document in place of tabs and sub-tabs.
 - 2). If individual PDF files are provided for each product or shop drawing sheet, organize files into folders and name files and folders to correspond with applicable specification sections or drawing titles.
 - b. If submittal is a scanned document, run the optical character recognition OCR function to ensure the document is searchable and can be copied and pasted.
 - c. Electronic submittals may be transmitted via Email, disc or download from a project or construction Website.

E. Coordination:

1. Create and maintain a master submittal log for all items submitted in Divisions 26, 27 and 28. SUBMIT MASTER SUBMITTAL LOG WITH FIRST SUBMITTAL.
2. Prior to submission for approval hold a meeting of all trades to review all shop drawings and submittals. All trades shall cross-check all shop drawings and submittals for conflicts, clearances, physical space allocation and routing, discrepancies, dimensional errors, omissions, contradictions, departures from the Contract requirements, correct electrical/mechanical services and connections, and provisions for commissioning.
3. Revise, correct, and appropriately annotate submittals prior to submission for approval.
4. A current copy of approved submittals and the submittal log shall be kept at the job site.

F. Product Submittals

1. General: This section describes in detail the preparation of electrical product submittals. Submittals not provided as described shall be rejected without review. This procedure is designed to accelerate and improve the accuracy of the technical review process, as well as, simplify the preparation of the Installation, Operation, and Maintenance Manuals (IO&Ms) during project closeout.
2. Submittal Organization:
 - a. Organize product submittal information in the same order as the products are specified to simplify the technical review process. Provide a separate tabbed divider for each Divisions 26, 27 and 28 specification section. Provide the typed section number on each tab.

- b. Within each section, organize the product information in the same order as the products are specified in Part 2 of each applicable specification section. Provide sub-tabs within each section for each separate product article. Provide the typed product article number on each tab.
- c. Provide product submittal information for each product specified in 8-1/2" x 11" format. Fold-out 11" x 17" format is also acceptable.
- d. If a particular specified product is being omitted from the product submittal or will not be used for the project, provide a single sheet within the article tab identifying the product and annotated with a brief reason why the product is not being submitted, for example: "NOT USED," NO SUBMITTAL REQUIRED," "TO BE SUBMITTED BY (PROVIDE DATE)," etc. This will inform the reviewer that the product was not overlooked.
- e. Partial submittals from individual subcontractors may be provided which cover a particular sub-contractor's scope of work. Partial submittals shall be limited to equipment and products that require long lead time or require Shop Drawings for review.
- f. Partial submittals are permitted for the following: LIGHTING, POWER DISTRIBUTION, GENERATORS, FIRE ALARM, ACCESS CONTROL SYSTEM, CCTV/VIDEO SECURITY and TELECOMMUNICATIONS.
- g. Note: Submittals for other Sections' equipment and products shall be submitted as one single submittal. Multiple submittals for these sections will be REJECTED without review.
- h. Within each system classification, arrange product submittals by specification section, as described, such that each specification section can easily be reorganized into a master set of Divisions 26, 27 and 28 product submittals organized by specification section. This will greatly simplify the preparation of IO&M manuals as described below.
- i. Bind product submittal information in 3 inch wide, hard backed, loose leaf, 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes such that the pages in each binder rest naturally on one side of rings.
- j. Provide a master table of contents at the front of each volume which lists the Divisions 26, 27 and 28 specification sections and indicates which sections are located within each volume.
- k. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
- l. Provide identical cover and spine inserts for each product submittal volume.
- m. For multiple volumes, label each volume. Include the following typed information on the front cover and spine inserts of each volume:

- 1). The Contracting Agency Name
 - 2). Project Name
 - 3). Contractor Name
 - 4). Subcontractor Name preparing the submittal.
 - 5). Date that the submittal or resubmittal was initiated.
 - 6). “Electrical Product Submittals”, etc. as appropriate.
 - 7). “Volume 1 of X, Volume 2 of X,” etc.
3. Product Information:
- a. Indicate manufacturer's name and address, and local supplier's name, address, phone number.
 - b. Indicate each product as “Basis of Design”, “As Specified” or as “Proposed Substitution.”
 - c. Identify Catalog designation and/or model number.
 - d. Neatly annotate each salient characteristic and design options of the product to demonstrate compliance with the Contract Documents to include: Scheduled information, drawing information and specified information. Clearly indicate product deviations from the Contract Documents and mark out non-applicable items on generic “cut-sheets.”
 - e. Include manufacturer provided dimensioned equipment drawings with mechanical and electrical rough-in connections.
 - f. Include operation characteristics, performance curves and rated capacities.
 - g. Include motor characteristics and wiring diagrams for the specific system.
 - h. Provide basic manufacturer’s installation instructions.
4. Provide coordination data to check protective devices.
5. Provide information required to verify compliance with the short circuit withstand and interrupting ratings, as shown on the Drawings or further stated in these Specifications.
6. Provide certification that all data shown on the Drawings or further stated in these Specifications concerning available short-circuit currents has been confirmed with the serving Electric Utility.
7. Product Substitutions:

- a. Clearly indicate both in the section table of contents and on the individual product submittal information each proposed substitution, deviation or change from the product as described in the Contract Documents.
- b. Submittal approval does not include substitutions, deviations or changes from the requirements of the Contract Documents unless they are specifically itemized and approved. The term "No Exceptions Taken" will not apply to substitutions, deviations or changes not clearly identified.
- c. Provision of a satisfactory working installation of equal quality to the system as described in the Contract Documents shall be the responsibility of the Contractor.
- d. Correct unapproved deviations from the Contract Documents discovered in the field as directed by the Contracting Agency at no additional cost to the Owner.

G. System Drawings:

1. Submit System Drawings for dynamic elements/systems of the project which are performance specified to include but not limited to: Fire Alarm Systems, Lighting Controls, Special Systems, Power Distribution, Generators and stand-alone packaged equipment.
2. Prepare system drawings on full sized sheets of the same size as the original construction drawings.
3. Include with each system a sequence of operation narrative which describes each mode of system operation in sufficient detail to demonstrate compliance with the Contract Documents to the satisfaction of the Contracting Agency.

H. Shop Drawings:

1. General:
 - a. The Contract Documents are not intended for nor are they suitable for use as shop drawings. Do not use Contract Drawings for direct fabrication or installation of products or equipment.
 - b. Divisions 26, 27 and 28 products and systems shall not be installed without shop drawings approved by the Contracting Agency.
 - c. Rework, changes or additional engineering support required as a result of the installation of products and systems prior to the approval of applicable shop drawings by the Contracting Agency shall be provided at the Contractor's expense.
2. Preparation:
 - a. Review each Divisions 26, 27 and 28 specification section and identify the project's shop drawing requirements.
 - b. Prepare shop drawings on full sized sheets of the same size as the original construction drawings.

- c. Arrange shop drawings to scale, showing dimensions where accuracy of location is necessary for coordination or communication purposes.
- d. Incorporate the actual dimensions and configurations of the products and systems approved through the product submittal process into the shop drawings.
- e. Provide dimensioned maintenance clearance areas around each product as recommended by the manufacturer.
- f. Meet with and coordinate Divisions 26, 27 and 28 work with the interrelated work of other trades including Architectural, Civil, Structural, and Mechanical to identify and resolve potential conflicts.
- g. Clearly identify and provide recommendations to resolve major conflicts which may impact the design of the systems as shown. Resolve such conflicts during the shop drawing review process.
- h. In cases where one or more equipment items in a mechanical or electrical room or space differ in dimensions or configuration from Basis of Design equipment, the working drawing shall show the entire area. The drawing shall be dimensioned to indicate that required aisle ways and maintenance clearances are being maintained to at least the degree shown on the Contract Drawings.
- i. Provide shop drawings for all products, systems, system components, and special supports that are not a standard catalog product and which may be fabricated for the Contractor or by the Contractor.

Provide shop drawings for:

- 1). Electrical and telecommunications rooms and spaces, including all equipment. Demonstrate all required clearances and working spaces are provided.
- 2). Routing and interdisciplinary coordination of groups of conduits numbering more than one and over two inch trade size.
- 3). Fire Alarm Systems
- 4). Electrical Distribution Equipment
- 5). Lighting Controls
- 6). Telecommunications
- 7). CCTV/Security Camera Systems
- 8). Where noted on the drawings.
- 9). Where noted in other Divisions 26, 27 and 28 sections.

- j. Record Shop Drawings: Provide a copy of the final, corrected, approved shop drawings for the project, updated to show as-built conditions. Drawings shall indicate exact device locations and conduit and wire routing. Prepare drawings using the latest release of AutoCAD and deliver files to the Contracting Agency. Refer to other specification sections for additional system specific requirements.
- 3. Shop Drawing Submittal:
 - a. Submit dimensioned shop drawings as specified to demonstrate proper planning and sequencing of the applicable trades for the installation and arrangement of Divisions 26, 27 and 28 with respect to other interrelated work.
 - b. Installation conflicts arising from the failure to properly coordinate the work of related trades shall be resolved at the Contractor's expense.
- I. Record Drawings
 - 1. General: As the Work progresses, neatly annotate a designated and otherwise unused, set of Divisions 26, 27 and 28 Contract Drawings to show the actual locations and routing of Divisions 26, 27 and 28 Work and the terminal connection points to related Work. As a minimum, include the following:
 - a. Annotate record drawings to incorporate each applicable addendum.
 - b. Annotate record drawings as directed by each applicable Request for Information (RFI) and accepted Change Order Proposal.
 - c. Modify record drawings to show actual equipment sizes and locations.
 - d. Provide fully dimensioned locations for permanently concealed conduits.
 - e. Show routing of work in permanently concealed blind spaces within the building.
 - f. Maintain drawings in an up-to-date fashion in conjunction with the actual progress of installation. Accurate progress mark-ups shall be available on-site for examination by the Contracting Agency or his representative at all times.
 - 2. Preparation:
 - a. Neatly annotate record drawings to provide clear interpretation to support electronic drafting by a third party.
 - b. Tape electronic sketches from addendums and/or RFIs directly to the record drawings as overlays.
 - c. Annotate the record drawings in colored pencil using the same symbols and abbreviations as indicated in the Divisions 26, 27 and 28 legends and schedules of the Contract Drawings.
 - 1). Red to add information.

- 2). Green to delete information.
- 3). Blue to provide additional clarifying information which is not to be drafted.
- d. After submittal to the Contracting Agency, provide additional clarification, information or rework as necessary to support the accurate interpretation and electronic drafting of the record drawings.
3. Submittals:
 - a. Provide complete record drawings for concealed areas (i.e. above lay-in and hard ceilings and inside walls) to the Contracting Agency prior to concealment.
 - b. Provide the remaining portion of the record drawings for exposed areas to the Contracting Agency prior to the final completion of the project.
 - c. Prepare wiring diagrams for individual special systems as installed. Identify components and show wire and terminal numbers and connections. Include diagrams from the shop drawings and submittals, updated to show as-built condition.
- J. Test Certificates:
 1. Review the submittal requirements for Quality Assurance/Control Submittals for each specification section.
 2. Submit copies of design data, test reports, certificates, manufacturer's instructions and field test reports as specified. This information may be included within the Operations and Maintenance (IO&M) Manuals as determined by the Contracting Agency.
- K. Operations and Maintenance (IO&M) Manuals:
 1. Provide specific product IO&M information for each section as detailed within each Divisions 26, 27 and 28 section.
 2. Begin the preparation of the electrical Operation and Maintenance Manuals with a complete and fully approved set of electrical product submittals organized, annotated and with the product information as indicated within the "Product Submittals" article for each specification section.
 3. Next, augment each individual product submittal with the written installation, operations and maintenance information for each specific product. Obviously, this type of information is not applicable (or available) for bulk commodity or simplistic products such as conduit or equipment tags, etc.

4. Maintenance information shall include:
 - a. Preventive maintenance requirements for each product, including the recommended frequency of performance of each preventive maintenance task.
 - b. Instructions for troubleshooting, minor repair and adjustments required for preventive maintenance routines, limited to repairs and adjustments that may be performed without special tools or test equipment and that require no extensive special training or skills.
 - c. Information of a maintenance nature covering warranty items, etc., that have not been discussed in the manufacturers' literature.
 - d. Information data for spare and replacement parts for each product and system. Properly identify each part by part number and manufacturer.
 - e. Recommended spare parts list.
5. Organize the Operation and Maintenance Manual information by specification section (not by sub-contractor) with a tabbed divider separating each section. Provide the typed section number on each tab.
6. Within each section, organize the product information in the same order as the products are specified in Part 2 of each applicable section. Provide sub-tabs within each section for each product. Provide the typed product article number on each tab.
7. Bind the information in identical, 3 inch wide; hard backed loose leaf 3 ring binders with clear front and spine insert pockets. Divide information into multiple volumes so that the pages in each binder rest naturally on one side of rings.
8. Provide a master table of contents at the front of each volume which lists the Divisions 26, 27 and 28 specification sections and indicates which sections are located within each volume.
9. Provide a table of contents within each section which lists the Part 2 products for that section in the same order as the applicable specification section.
10. Provide identical cover and spine inserts for each IO&M manual volume.
11. For multiple volumes, label each volume.
12. Include the following typed information on the front cover and spine inserts of each volume:
 - a. The Contracting Agency Name.
 - b. Project Name.
 - c. "Electrical Operations and Maintenance Manual".

d. "Volume 1 of X, Volume 2 of X," etc.

13. Submit copies of all Operation and Maintenance Manuals in electronic format (Adobe PDF).

1.6 QUALITY ASSURANCE

- A. Qualifications: Perform the Work using qualified workmen that are experienced and usually employed in the trade.
- B. Product Testing and Certification:
1. Nationally Recognized Testing Laboratory (NRTL) Labeling: Electrical equipment and conductors shall be "Approved," "Certified," "Identified," or "Listed" and "Labeled" to establish that the electrical equipment is safe, free of electrical shock and fire hazard, and suitable for the purpose for which it is intended to be used. The manufacturer shall have the specific authorization of one of the Occupational Safety and Health Administration (OSHA) approved Nationally Recognized Testing Laboratories (NRTLs) in accordance with the applicable national standards to label the equipment as suitable.
 2. Further details on the specific NRTLs, as well as the product standards that they are specifically recognized to evaluate equipment in accordance with, can be found on the OSHA Web site: <http://www.osha.gov/dts/otpca/nrtl/>
- C. Drawings and Specifications:
1. The Drawings and specifications are complementary. Do not scale the Drawings. Locations of devices, fixtures, and equipment are approximate unless dimensioned.
 2. The Drawings are partly diagrammatic and do not show precise routing of conduits or exact location of all products, and may not show in minute detail all features of the installation; however, provide all systems complete and in proper operating order.
 3. Drawing symbols used for basic materials, equipment and methods are commonly used by the industry. Special items are identified by a supplementary list of graphical illustrations, or called for on the Drawings or in the specifications.
- D. Tests and Inspections:
1. Schedule, obtain, and pay for permits and fees required by local authorities and by these specifications.
 2. Request for Tests: Notify the Contracting Agency a minimum of 72 hours in advance of tests. In the event the Contracting Agency does not witness the test, certify in writing that all specified tests have been made in accordance with the specifications.
 3. Deficiencies: Immediately correct deficiencies that are evidenced during the tests and repeat tests until system is approved. Do not cover or conceal electrical installations until satisfactory tests are made and approved.

4. Operating Tests: Upon request from the Contracting Agency, place the entire electrical installation and/or any portion thereof, in operation to demonstrate satisfactory operation.
5. The Contracting Agency may inspect and approve sample installation of systems and equipment prior to general installation of units.
6. Test Witness: Arrange for the Contracting Agency to witness tests. The Contracting Agency may waive witnessing any specific test at its discretion.
7. Tests: During final inspection, conduct operating tests for approval. Demonstrate installation to operate satisfactorily in accordance with requirements of Contract Documents. Should any portion of installation fail to meet requirements of Contract Documents, repair or replace items failing to meet requirements until items can be demonstrated to comply. Have instruments available for measuring light intensities, voltage, and current values and for the demonstration of continuity, grounds, or open circuit conditions. Furnish personnel to assist in taking measurements and making tests. In the event that systems are not complete and fully operational at the time of final inspection, all costs of any subsequent inspections shall be borne by the Contractor at no additional cost to the Owner.
8. Certificate of Completion: Submit at time of request for final inspection, a complete letter in _____ the _____ following _____ format:
I, _____ (Name), of _____ (Firm), certify that the electrical work is complete in accordance with Contract Plans and Specifications, and authorized change orders (copies of which are attached hereto) and will be ready for final inspection as of _____ (Date). I further certify that the following Specifications requirements have been fulfilled:
 - a. Megger readings performed, ____ copies of logs attached.
 - b. Operating manuals completed and instruction of operating personnel performed, _____ (Date) _____ (Signed)
Owner's Representative
 - c. Record document drawings up-to-date, accurate, and ready to deliver to Contracting Agency.
 - d. Emergency systems tested and fully operational.
 - e. Fire Alarm System tested and fully operational.
 - f. Telecommunications System test reports have been submitted to and approved by the Contracting Agency. The test reports shall certify that the Telecommunications System is complete, passes all test criteria, is fully operational, and that all work has been witnessed as specified.
 - g. Other tests required by Specifications have been performed.
 - h. Specified Owner training complete.

- i. Systems are fully operational. Project is ready for final inspection.

SIGNED: _____ DATE: _____
TITLE: _____

9. Operating Instructions: Prior to final acceptance, instruct an authorized representative of the Owner for four hours on the proper operation and maintenance of electrical systems and equipment provided under this contract. This requirement is for several systems, and is in addition to special training specified in other sections. Make available a qualified technician for each component of the installation for this instruction. Give these operating instructions after the operation and maintenance manuals have been furnished to the Owner. Submit written certification, signed by the Contractor and an authorized representative of the Owner, that this has been completed.

1.7 SPARE PARTS

- A. Furnish spare parts for systems and equipment as listed in applicable sections of Divisions 26, 27 and 28.
- B. Clearly label each part with name, manufacturers part number, system and/or equipment where used and location.
- C. Deliver parts to location and person designated by the Contracting Agency, in durable storage boxes.
- D. Group cartons containing smaller items by system or application and deliver in an appropriate number of storage boxes.

1.8 WARRANTY

- A. Warranty work shall be promptly coordinated and performed at the Contractor's sole expense. Workmanship, labor and materials (without limitation) in this Division shall be warranted for the longer of the following:
1. As called for in the General Conditions of the Contract.
 2. For a minimum period of one year from the date of final acceptance.
 3. For the extended warranty period specified in a specific Section under this Division.
- B. Where a specific product carries a longer warranty as a standard offering of its manufacturer, extended warranty coverage beyond these requirements shall be retained by the Owner. The Owner will have recourse back to the manufacturer only in these cases, when the warranty as specified in A above has expired.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT FURNISHED IN DIVISIONS 26, 27 AND 28

- A. Materials furnished and installed in permanent construction shall be new, full-weight, standard in every way, and in first class condition.
- B. Materials shall conform to the standards of an organization acceptable to the Authority Having Jurisdiction and concerned with product evaluation that maintains periodic inspection of labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner. Only materials designed for the purpose employed shall be used.
- C. Materials shall be identical with apparatus or equipment that has been in successful operation for at least two years. Materials of similar class or service shall be of one manufacturer.
- D. Capacities, sizes, and dimensions given are minimums unless otherwise indicated. Systems, materials and equipment proposed for use on this project shall be subject to review for adequacy and compliance with Contract Documents.

2.2 MATERIALS AND EQUIPMENT FURNISHED IN OTHER DIVISIONS

- A. Controls, including conduit, wiring, and control devices required for the operation of systems furnished in other Divisions shall be provided complete under the Division of the Specifications in which the equipment is specified, unless otherwise noted or specified.
- B. Work on the project that falls under the jurisdiction of the electrical trade shall be performed by Licensed Electricians in conformance with the electrical specifications.
- C. Provide complete power connections to equipment including but not limited to feeders, connections, disconnects and motor running overcurrent protection. Where starters are provided as part of packaged equipment, overcurrent heaters shall be provided under Divisions 26, 27 and 28.

PART 3 - EXECUTION

3.1 COORDINATION WITH ROOM NUMBERING

- A. Certain systems provided under this Division rely on identification systems that are based on room names or numbers. Systems labeled in this fashion include, but are not limited to, panelboards, circuit directories, communication and data systems identifiers, fire alarm systems, etc.
- B. The numbering scheme indicated in these Contract Documents is based on room numbers assigned during the design process. The Owner reserves the right to change the numbers prior to substantial completion, and the final names and numbers will not necessarily match those found

in the Documents. Obtain from the Owner the final room numbers prior to commencing the numbering of Divisions 26, 27 and 28 systems. Tag and label all system circuits and devices in accordance with the final numbering scheme at no additional cost.

3.2 INSTALLATION

- A. Skilled craftsmen shall install materials and equipment. The norms for execution of the work shall be in conformity with NEC Chapter 3 and the National Electrical Contractors' Association "National Electrical Installation Standards", which herewith is made part of these specifications.
- B. Repair surfaces and furnish all required material and labor to maintain fireproof, airtight and waterproof characteristics of the construction.
- C. Installation of equipment shall be in accordance with manufacturers' instructions.

3.3 MULTIWIRE BRANCH CIRCUITS

- A. Multiwire branch circuits shall not be used on this project. Each branch circuit shall be provided with its own dedicated neutral conductor.

3.4 MOUNTING HEIGHTS

- A. Mounting height shall be to center of box above finished floor (AFF) as noted below unless otherwise shown or indicated. Other mounting heights are indicated on the Drawings by detail. Specific dimensions AFF are shown adjacent to the symbol. Where devices are shown on architectural elevations, the elevation height shall govern.

Lighting switches	48 inches
Convenience outlets and similar devices	18 inches
Convenience outlets in mechanical, boiler rooms and workrooms	48 inches
Motor controllers	60 inches to top
Panelboards	76 inches to top
Telecommunications (Data/Telephone) outlets	18 inches (see note below)
Wall mounted audible and/or visual appliances such as bells, horns, strobes and similar signal devices	90 inches (or 6 inches below ceiling height for ceiling heights less than 96 inches)
Manual fire alarm box	48 inches (or 48 inches to operable part where operable part of device is above centerline of device)
Fire alarm control panel	72 inches to top
Fire alarm graphic annunciator	72 inches to top

Fire alarm text annunciator	60 inches to center
Security Keypad	60 inches to center
Security Card Reader	48 inches to center

3.5 CUTTING & PATCHING

- A. Obtain written permission of the Contracting Agency before cutting or piercing structural members.
- B. Wall and floor penetrations shall be in accordance with Section 26 05 29 - Hangers and Supports.
- C. Holes through existing concrete shall be core drilled. X-ray concrete before core drilling. Do not cut rebar without specific authorization from the Contracting Agency. Seal openings with UL Listed fire resistant resilient sealant.

3.6 VAPOR RETARDER/BARRIER PENETRATIONS

- A. Provide solid blocking installed flat at all vapor retarder penetrations. Provide flat blocking at the interior face of the exterior stud wall. Blocking shall be a minimum of 4 inches larger than the penetration. Locate the penetration at the centerline of the flat blocking. Secure vapor retarder to blocking.
- B. Seal the interior of raceways penetrating the vapor retarder inside the building. Between point of sealing inside of raceway (typically at junction box or conduit) and vapor retarder penetration, seal conduit joints (connectors and couplings) with vapor retarder tape, paint on sealer or approved means acceptable to Contracting Agency.
- C. To reduce thermal transfer and ensure sealing of raceway, PVC or equivalent conduit shall be used where penetrations of building envelope are made above ground where installation of PVC is allowed by NEC.
- D. Penetrations of the building vapor retarder/barrier caused by the electrical installation shall be minimized, and where they are required, the opening in the vapor retarder/barrier shall be cut smaller than the penetrating object, so that the penetration will be a stretch fit. The penetration shall then be securely sealed with vapor barrier tape or an adhesive or caulk compatible with the surfaces being sealed.
- E. Boxes (electrical boxes, outlet boxes and telecommunication boxes, etc) penetrating walls with vapor retarder/barriers shall be sealed airtight using STI Series SSP Firestop Putty Pads. Mold putty pads around electrical junction boxes and conduits and behind vapor retarder/barrier to form an airtight seal in accordance with manufacturer's installation instructions.

3.7 FIRE RESISTIVE CONSTRUCTION

- A. Provide "tenting" or other protection acceptable to the Authority Having Jurisdiction for devices or fixtures installed in fire resistive construction (i.e., ceilings, walls, etc.) to maintain the fire resistive rating of the complete assembly.

- B. Where electrical raceways or other features penetrate fire rated building surfaces, they shall maintain the integrity of the building surface being penetrated. This shall be accomplished with either of the following methods:
1. Sealing the penetration with an approved fire rated caulk or putty.
 - a. Fire rated caulk or putty: 3M Fire Barrier Caulk No. CP25, 3M Fire Barrier Moldable Putty, or as approved.
 2. A fire rated assembly enclosing the penetration.
 - a. Fire rated assembly: STI EZ Path, or as approved.
 3. Firestopping shall be applied according to the manufacturer's recommendations, and in a manner that is listed by a nationally recognized independent testing agency (such as UL) as preserving the fire time rating of the construction.

3.8 SOUND ISOLATION

- A. Where electrical raceways or other features penetrate walls that extend to structure, they shall maintain the integrity of the building surface being penetrated. Refer to the requirements of FIRESTOPPING as specified above. Note that this requirement exists regardless of whether the building surface being penetrated has a fire rating.
- B. Boxes (electrical boxes, outlet boxes and telecommunication boxes, etc) penetrating wall types that extend to structure or that contain batts shall be sealed airtight using STI Series SSP Firestop Putty Pads to reduce sound transmission. Mold putty pads around electrical junction boxes and conduits to form an airtight seal in accordance with manufacturer's installation instructions.

3.9 PROTECTIVE FINISHES

- A. Take care not to scratch or deface factory finish of electrical apparatus and devices. Repaint all marred or scratched surfaces.
- B. Provide hot dip galvanized components for ferrous materials exposed to the weather.

3.10 SEPARATION OF SYSTEMS

- A. Conductors and equipment of different voltage levels, frequency, current characteristics (AC & DC) or functions (normal vs. emergency, etc.) shall not share the same raceways or enclosures unless specifically shown on the Drawings or approved by the Contracting Agency, or inherently necessary for correct system function (i.e., at transfer switches, transformers, etc.)

3.11 TESTING

- A. Prior to final test, switches, panelboards, devices and fixtures shall be in place.

- B. Test electrical systems. They shall be free from short circuits and unintentional grounds.
- C. Make changes necessary to balance the actual electrical loads on the complete system. Arrange for balanced conditions of circuits under connected load demands, as contemplated by the normal working conditions. Final load and balance test shall be demonstrated in the presence of the Contracting Agency.
- D. Feeder cables shall be megger tested prior to final termination. If conductor fails test, replace wiring or correct defect and retest. Perform a 1,000 volt megohm meter test on each circuit cable rated 600 volts between the conductor and ground. Submit logs of megger readings. The insulation resistance between conductor and ground shall not be less than the following:
 - 1. 8 megohms for a single conductor length of less than 2,500 feet.
 - 2. 6 megohms for a total single conductor length of 2,500 feet and over.
- E. Furnish one (1) copy of certified test results to the Contracting Agency prior to final inspection.

3.12 STORAGE AND HANDLING

- A. Items shall be delivered and stored in original containers, which shall indicate manufacturer's name, the brand, and the identifying number. Items subject to moisture and/or thermal damage shall be stored in a dry, heated place. Items shall be covered and protected against dirt, water, chemical, ultraviolet (UV) and/or mechanical damage.

3.13 PROTECTION OF MATERIAL AND EQUIPMENT

- A. The Contractor shall be responsible for materials and equipment to be installed under this Contract. The Contractor shall make good at his own cost any injury or damage which said materials or equipment may sustain from any source or cause whatsoever before final acceptance.
- B. Cover and protect electrical equipment during construction from dust, dirt, debris, overspray, or other construction contaminants.

3.14 CLEANING AND REPAIR

- A. Throughout the work, the Contractor shall keep the work area reasonably neat and orderly by frequent periodic cleanups.
- B. Prior to substantial completion, clean equipment and systems used during construction.
- C. Repair surfaces damaged or impacted by the work. Restore to original condition or better. Retexture surfaces to match surrounding surfaces. Repaint affected surfaces, with extent of paint to include adjacent surfaces to next wall or other clean break to avoid mismatched finish.
- D. As independent parts of the installation are completed, they may be tested and utilized during construction.

3.15 ACCESS DOORS

- A. Provide access doors required for access to equipment provided under Divisions 26, 27 and 28. Doors shall be rated for the surrounding construction. Use of access doors shall be minimized, and all locations and cosmetic features shall be submitted for approval in advance.
- B. Doors shall be finished to match surrounding surfaces as approved by the Contracting Agency.

3.16 DEMOLITION

- A. Examination Prior to Bid: Drawings involving existing conditions are based on building record drawings and/or limited field observation. Conduct a site inspection prior to submission of Bid to become thoroughly familiarized with the Scope of Work. Report discrepancies to Contracting Agency. Submission of bid certifies acceptance of existing conditions.
- B. Examination Prior to Start of Demolition: Conduct a thorough site inspection before disturbing existing installation. Verify field measurements and circuiting arrangements. Verify that abandoned wiring and equipment serve only abandoned facilities. Beginning of demolition certifies acceptance of existing conditions.
- C. Preparation:
 - 1. Disconnect electrical systems in walls, floors, ceilings, etc., scheduled for removal.
 - 2. Coordinate utility service outages with utility companies and Contracting Agency.
 - 3. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
 - 4. Existing Electrical Service: Maintain existing systems in service until new systems are complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 72 hours before partially or completely disabling system. Contractor shall not be entitled to any additional compensation due to inability of Owner to grant an outage at the desired time. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- D. Demolition of Existing Electrical Work:
 - 1. Remove, relocate, and extend existing installations to accommodate new construction.
 - 2. Remove abandoned wiring to source of supply.
 - 3. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut concealed conduit flush with walls and floors, and patch surfaces.
 - 4. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets,

which are not removed. In finished areas, blank covers shall be blank plates matching the device plates specified for new work, unless otherwise noted or specified.

5. Disconnect and remove abandoned panelboards and distribution equipment.
6. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
7. Disconnect and remove abandoned light fixtures. Remove brackets, stems, hangers, and other accessories.
8. Repair adjacent construction and finishes damaged during demolition and extension work.
9. Maintain access to existing electrical installations that remain active. Modify installation or provide access panels as appropriate.
10. Restore circuits and systems to remain that are affected in any way by demolition Work, such as loads downstream of demolished equipment, switched lighting circuits where selected fixtures are demolished, etc.
11. Salvage or disposal of removed items shall be as noted on the Drawings or as directed by the Contracting Agency. Items, which the Owner does not desire to retain, shall be disposed of at a legal disposal site.

E. Cleaning and Repair:

1. Clean and repair existing materials and equipment that remain or are to be reused or are affected by this work.
2. Panelboards: Clean exposed surfaces and interior of cabinet and retorque electrical connections. Provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION 26 00 00

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SECTION 26 05 19

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes specific requirements, products, and methods of execution relating to wire and cable, 600 volts or less, approved for use on this project.
- B. Related Sections
 - 1. 26 05 33 – Raceways and Boxes for Electrical Systems
 - 2. 26 05 53 – Identification for Electrical Systems

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 - National Electrical Code.
 - 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.

1.4 QUALITY ASSURANCE

- A. Conductors shall be sized per American Wire Gauge (AWG). Stranding, insulation, rating and geometrical dimensions shall conform to UL and ICEA specifications.

PART 2 - PRODUCTS

2.1 INSULATION TYPES

- A. Branch circuit conductors shall be 600 volt insulated, and unless otherwise noted on the Drawings, shall have the following insulation types:
 - 1. Heated indoor spaces - THHN/THWN or XHHW.
 - 2. Outdoors, wet locations (such as slab-on-grade), or other cold locations (such as unheated attics) - XHHW.
- B. Feeder conductors shall be 600 volt insulated, and unless otherwise noted on the Drawings, shall have the following insulation types:
 - 1. Heated indoor spaces - THHN/THWN or XHHW-2.
 - 2. Outdoors, wet locations (such as slab-on-grade), or other cold locations (such as unheated attics) - XHHW-2.
- C. Nylon-jacketed conductors such as Types THHN or THWN shall not be used in any location subject to ambient temperatures below 20° F.
- D. Special applications: Conductors in fluorescent fixture wiring channels shall have 90° C insulation rating, Types THHN, XHHW, or equal. Conductors in high temperature locations shall have one of the special insulation types suitable for the use and as permitted by the NEC.

2.2 TYPE FPLP/MC CABLE

- A. In existing non-accessible spaces, where required to be fished, Type FPLP/MC metal clad fire alarm/control cable is acceptable on this project. Cable shall be UL Listed as Type FPLP Metal Clad/Power limited fire-protective signaling cable - FPLP (105°C) / MC (90°C). Submit for approval, prior to installation, all intended applications. Cable installed without prior approval is subject to removal at the Contractor's expense at the discretion of the Contracting Agency.
- B. Type FPLP/MC technical specifications:
 - 1. Armor: Galvanized steel (red striped).
 - 2. Conductors: Solid copper (number as required for application).
 - 3. Conductor insulation: TFN/THHN.
 - 4. Assembly covering: Polypropylene tape.
 - 5. Maximum temperature rating: FPLP 105°C (dry); MC 90°C (dry).
 - 6. Grounding: Bare grounding conductor.

7. Maximum voltage rating: FPLP 300V; MC 600V.
8. Minimum conductor size: 18 AWG 16 AWG 14 AWG 12 AWG.
- C. Fittings for use with Type FPLP/MC metal clad fire alarm/control cable shall be designed specifically for use with Type FPLP/MC and manufactured by the producer of the Type FPLP/MC cable.

2.3 FLEXIBLE CORD

- A. Flexible cord shall be Type SO or ST, or for the larger sizes, Type G.

2.4 MISCELLANEOUS

- A. Miscellaneous: Miscellaneous wire and cable for special purpose applications and not covered in the categories as indicated above or otherwise specified, shall be as shown on the plans and/or required by the intended use.

2.5 MINIMUM SIZE

- A. Unless specified otherwise minimum wire sizes shall be as follows:
 1. #12 AWG for branch circuit wiring.
 2. #20 AWG for low voltage switching circuits if part of an approved cable assembly, #18 AWG otherwise.
 3. #14 AWG for control circuit wiring.
 4. #16 AWG for light fixture whips, refer to specification section 26 05 33 - Raceway and Boxes for Electrical Systems, for maximum fixture whip lengths.
- B. On 20A circuits, with one-way conductor lengths measured from panel to farthest receptacle, or center of lighting string (as applicable):
 1. #10 AWG for 120V circuits of 75 feet to 120 feet.
 2. #8 AWG for 120V circuits of 120 feet to 200 feet.
- C. Similar oversizing shall apply to circuits of other ratings and/or greater lengths, as necessary to comply with the voltage drop limitations in Part 3 of this Section.
- D. Cable or conductors for fire alarm systems and other special systems shall be as described in other sections of the specifications, noted on the drawing, or recommended by the equipment manufacturer, whichever is greater.

2.6 CONDUCTORS

- A. Conductors used on this project shall be copper, solid or stranded for wiring #10 and smaller, stranded for #8 and larger.
- B. Aluminum conductor of an equivalent ampacity may be used in sizes #4 and larger. Conductor size shall be increased if required to maintain original voltage drop. Conduits shall be re-sized accordingly to maintain original fill ratio.
- C. Stranded control, communication, and alarm conductors shall have compression terminations where terminated on screw terminals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Unless otherwise noted or specified, all conductors shall be run in raceways as specified in Section 26 05 33 – Raceways and Boxes for Electrical Systems. Raceways shall be installed as a complete system, free from obstructions, and clean before conductors are installed.
- B. Provide conductors from outlet to outlet and splice branch circuit conductors only at outlet or junction boxes. Install all conductors in a single raceway at one time and leave sufficient cable at all fittings or boxes. Keep conductors within the manufacturer's allowable tension. Do not violate minimum bending radii. Lubricants for wire pulling, if used, shall conform to UL requirements for the insulation and raceway material.
- C. Do not install Type XHHW conductors in temperatures below -10° F, or the other types in temperatures below +20° F.
- D. Conductors that extend below grade shall be suitable for wet locations (type XHHW or XHHW-2). The use of THHN below grade is not acceptable.

3.2 CONDUCTOR SUPPORT

- A. Provide conductor supports as recommended by the NEC or cable manufacturer in vertical conduits.

3.3 SPLICING

- A. No splicing or joints are permitted in branch circuits except at outlet or accessible junction boxes. Prior to splicing, conductors shall be stripped to the exposed length recommended by the splicing device manufacturer.
- B. Utilize compression type solderless connectors when making splices or taps in conductors No. 8 AWG or larger. Provide heat or cold shrink type insulating tubing on splices and tape outer

surface continuously with Scotch #88 plastic tape to secure insulation strength equal to that of the conductors joined.

- C. Utilize pre-insulated connectors, hard-shell type only, Ideal Industries, Inc., "Wing-Nut" or "Twister Pro" or "In-Sure Push-in Connectors" for splices and taps in conductors No. 10 AWG and smaller in dry locations.
- D. Utilize Ideal "Twister DB Plus", water repellent, sealant filled, UL 486D Listed connector splices and taps in conductors No. 10 AWG and smaller in damp or wet locations.
- E. Utilize "Buchanan pre-insulated crimp connectors" on stranded conductors for fire alarm control and alarm circuits.
- F. Feeder conductors shall be installed with no splices unless otherwise noted on the Drawings. Splices in feeder conductors, where specifically allowed, shall be compression type butt splices.

3.4 CONDUCTOR TERMINATION

- A. Provide power and control conductors that terminate on equipment or terminal strips with solderless lugs or T & B "Sta-Kon" terminals.
- B. Prior to termination, conductors shall be stripped to the exposed length recommended by the termination device manufacturer.

3.5 CONDUCTOR PHASE COLOR CODING

- A. Service, feeder and branch circuit conductors throughout the project secondary electrical system shall be color coded as follows:

208/120 Volts	Phase
Black	A
Red	B
Blue	C
White	Neutral
Green	Ground

Permanently post conductor color code at each panelboard in accordance with NEC Article 210 and Section 26 05 53 – Identification for Electrical Systems

- B. Where color coded conductors are not commercially available, colored non-aging, plastic tape may be utilized where permitted by NEC.
- C. Where neutrals of different systems exist on the project, neutral conductor identification method shall satisfy the Authority Having Jurisdiction, as to compliance with NEC Article 200. Branch

circuit neutral conductors shall have a color stripe matching the corresponding phase conductor where neutral is not shared.

- D. Phases in panelboards and similar equipment shall be connected Phase A, B, C from left to right, top to bottom, or front to back.

3.6 DERATING OF CONDUCTORS

- A. Derating of conductors shall be per National Electrical Code.

3.7 VOLTAGE DROP

- A. The maximum total voltage drop shall not exceed three (3) percent in branch circuits or feeders, for a total of five (5) percent to the farthest outlet based on steady state design load conditions. Wire sizes shown on the Drawings are for minimum ampacity. Wire and conduit sizes shall be increased to limit voltage drop based upon actual lengths required in the field. Base voltage-drop calculations on NEC Chapter 9, Table 9.

3.8 RULES FOR WIRING ABOVE LAY-IN CEILINGS OR AREAS WITH OPEN CEILINGS

- A. Where specifically allowed in other Sections of these specifications, open wiring not-in-conduit may be used for Class 2 special systems where installed in areas with open ceiling or above accessible ceiling in areas with lay-in ceilings.
- B. Open wiring shall be shall plenum rated and approved for the application and the specific system.
- C. Open wiring shall be supported by cable tray or J-hooks only and as outlined under Specification Section 26 05 29 - Hangers and Supports for Electrical Systems and 27 20 10 - Telecom Distribution System.
- D. Approved conduit sleeves shall be provided for all cables passing in or through walls, whether such sleeves are shown on the Drawings. Seal with UL Listed fire resistant resilient sealant.
- E. Wiring shall be in conduit where exposed or concealed within walls, under floors or above non-lay-in ceilings. The intent of this paragraph is to provide a complete raceway system for open wiring, using accessible ceiling spaces as a raceway.
- F. Groups of cables common to a specific system shall be neatly bundled and routed along the edges of corridors. Cross corridors at right angles.
- G. Raceways and sleeves shall be sized in accordance with the cabling requirements for the special system involved.

3.9 TESTING

- A. Feeder cables shall be megger tested prior to final termination in accordance with Section 26 00 00 – Electrical General Requirements.

END OF SECTION 26 05 19

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SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general requirements, products and methods of execution relating to the furnishing and installation of a complete grounding system as required for this project.
- B. Related Sections:
1. 26 24 16 - Panelboards
 2. 26 43 00 - Surge Protective Devices
 3. 27 20 10 - Telecom Distribution System

1.2 REFERENCES

- A. The publications listed below form a part of this specification. The publications are referred to in the text by basic designation only, latest edition.

NUMBER	TITLE
ANSI/IEEE C2	National Electrical Safety Code
ANSI/NFPA 70	National Electrical Code
ANSI/TIA/EIA 606-A	Administration Standard for Commercial Telecommunications Infrastructure
ANSI/TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage Surge Protective Devices
IEEE C62.42	Guide for the Application of Gas Tube Arrester Low-Voltage Surge Protective Devices
IEEE Draft P1250 (D4)	Guide on Service to Equipment Sensitive to Momentary Voltage Disturbances
IEEE Std 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment
IEEE Std 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems

NUMBER	TITLE
IEEE STD 81	Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth
NFPA 70	National Electric Code (NEC) - Codebook and Handbook
REA PE-33	(1985) Shield Bonding Connectors
UL 1449 Edition 3	Surge Protective Devices (SPDs)
UL 467 Edition 6	Grounding and Bonding Equipment
UL 497 Edition 5	Protectors for Paired Conductors for Communication Circuits
UL 497A Edition 1	Secondary Protectors for Communication Circuits
UL 497B Edition 1	Protectors for Data Communication and Fire Alarm Circuits

1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1. Include copies of catalog cuts, data sheets and other descriptive information for all specified materials.

1.4 MINIMUM REQUIREMENTS

- A. The minimum requirements for the system shall conform to Article 250 of the NEC.

1.5 SPECIAL REQUIREMENTS

- A. Unless specified elsewhere, the ohmic values for grounds and grounding systems shall be as follows:
 - 1. For grounding metal enclosures and frames for electrical and electronically operated equipment -- 5 ohms maximum.
 - 2. For grounding systems to which electrical utilization equipment and appliances are connected -- 5 ohms maximum.
 - 3. For grounding secondary distribution systems, neutrals, noncurrent carrying metal parts associated with distribution systems, and enclosures of electrical equipment not normally within reach of other than authorized and qualified electrical operating and maintenance personnel -- 10 ohms maximum.

1.6 TELECOMMUNICATIONS GROUNDING SYSTEM

- A. Telecommunications ground systems shall be provided as shown on the Contract Drawings and as related herein.
1. Telecommunications Main Grounding Busbar (TMGB) - The TMGB serves as a dedicated extension of the building grounding electrode system for telecommunications infrastructure. The TMGB is located in the main telecommunications entrance room or as shown on the Drawings.
 2. Telecommunication Bonding Backbone (TBB) - A copper conductor extending from the telecommunications main grounding busbar (TMGB) to each telecommunications grounding busbar (TGB).
 3. Telecommunications Main Grounding Busbar (TMGB) - The TMGB serves as a dedicated extension of the building grounding electrode system for telecommunications infrastructure. The TMGB is generally located in the main telecommunications entrance room or as shown on the Drawings.
 4. Telecommunications Grounding Busbar (TGB) - A busbar placed in a convenient and accessible location in a Telecom Room (TR) that is connected back to the TMGB. All equipment served from the TR shall be connected to the local TGB.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Grounding conductors, ground rods, and equipment required for ground systems shall be listed for the purpose intended and approved by a Nationally Recognized Testing Laboratory (NRTL), and be in accordance with U.L. 467 and as follows:
1. Ground rods shall be 3/4 inch by 10 foot copper bonded steel. Erico Eritech or approved equal.
 2. Grounding conductors shall be copper. Unless specified otherwise, raceway for service grounding conductor shall be Schedule 40 PVC.
 3. Grounding conductor for telephone service entrance and telephone/data panels shall be #6 insulated copper, with 6 feet-0 inches slack cable at each panel. Comply with intersystem bonding requirements of NEC.

2.2 CONNECTIONS

- A. Clamps, lugs, connectors, bonding bushings, and other such grounding and bonding items shall be:
1. Labeled or listed for the purpose.

2. Shall be made (both body and hardware) of hot dip galvanized steel, bronze, or other corrosion resistant alloy (except bushing throats shall be plastic).
3. Shall be the products of O-Z/Gedney, T & B, Raco, or accepted equals.
4. In outdoor, damp, or corrosive environments, metals for these items shall be copper (with or without tin-plating), bronze, or other corrosion resistant alloys only; O-Z/Gedney or accepted equal.

2.3 TELECOMMUNICATIONS GROUNDING SYSTEMS

A. Telecommunications Bonding Backbone (TBB):

1. The TBB shall be a green 6 AWG minimum, 600 volt insulated copper conductor. The minimum size of each TBB shall be such that the total DC resistance back to the TMGB is less than 0.10Ω.
2. Cable supports shall be strut with distribution rings.

B. Grounding Busbars shall be Cadweld P/N B544A028, 1/4 inch by 4 inches by 16 inches copper with lug patterns for #8 through 1000 KCMIL conductors. Grounding busbars shall be electrolytic copper and mounted on fiberglass insulators rated at 2,700V.

1. Provide one Grounding Busbar for each:
 - a. Telecommunications Main Grounding Busbar (TMGB).

2.4 TELECOMMUNICATIONS SYSTEM BONDING

A. Bond telecommunication equipment chassis, ladder racks, cable trays, conduits, equipment frames, cabinets, and all other telecommunication room and equipment room metallic components to the TMGB with green #6 AWG, 600 volt, insulated copper conductor. Each piece of equipment shall be connected back to the TMGB in a radial configuration, i.e., equipment ground connections shall not be "daisy chained" and then connected to TMGB.

B. Bonding of grounding conductors shall be with the following methods as specified herein:

1. Connections to grounding busses: Cool Amp Plating, field applied to both surfaces for bolted and compression connections.
 - a. Approved gas tight two hole copper grounding compression lugs T&B 54205 series 2 hole, crimp Cool Amp plated compression type for connection to grounding busses.
 - b. Fasteners shall be nickel plated steel nuts, bolts and lockwashers.
2. Conductor splices and connection to ground rods:

- a. Cadweld exothermic welds. All bonds below grade shall be exothermic.
- b. Burndy type “YG” extruded wrought copper prefilled with Pentrox heavy duty compression connectors with probe holes (Type YGA and YGS not acceptable).

2.5 IDENTIFICATION AND LABELING

- A. Grounding conductors shall be labeled in accordance with TIA/EIA-606-A.

PART 3 - EXECUTION

3.1 SERVICE GROUND

- A. Create an equipotential plane for the grounding system for this project at the service entrance equipment by connecting the following to the existing service entrance ground bus at the service Main Disconnect:
 - 1. The commercial system's grounded neutral conductor.
 - 2. Telecommunications Grounding System.
 - 3. Main Metallic water services to the building.
 - 4. The service entrance equipment and conduits entering and leaving the equipment.
 - 5. The metallic piping systems in the building.
 - 6. The metallic gas piping system upstream from the equipment shutoff valve.
- B. Current carrying capacity of the grounding and bonding conductors shall be in conformity with Table 250.66 of the NEC. Exception: The bonding conductor for metallic gas piping shall be sized in accordance with Table 250.122 based on the largest overcurrent device protecting feeder conductors exiting the main distribution switchboards.
- C. Measure resistance to earth of service grounds by the fall of potential method per IEEE STD 81 “Recommended Guide for Measuring Ground Resistance and Potential Gradients in the Earth”. Record and submit test readings.

3.2 EQUIPMENT GROUND

- A. The raceway system shall be bonded in conformity with NEC requirements to provide a continuous ground path. Where required by Code or Ordinance or where called for on the plans an additional grounding conductor shall be provided, sized in conformity with Table 250.122 of the NEC, unless larger size is noted.

- B. Provide separate grounding conductor securely bonded and effectively grounded to the enclosures at both ends of all non-metallic raceways and all flexible conduit.
- C. Provide an equipment grounding conductor sized in conformity with Table 250.122 of the NEC, unless larger size noted, for all new feeder and branch circuit conduits. Where conductors are adjusted in size to compensate for voltage drop, equipment grounding conductors shall be adjusted proportionately according to circular mil area.
- D. Refeeding existing feeder/branch circuits that do not have an existing equipment grounding conductor: Bond equipment grounding conductor of new feeder or branch circuit to junction box and new and existing conduits.

3.3 CONCEALED CONNECTIONS

- A. Permanent grounding connections, where permitted by the NEC to be concealed, shall not be so concealed until inspected and accepted by the Contracting Agency. Failure to comply with this requirement shall make the Contractor liable for all expenses incurred in the process of re-exposing the connections for inspection, and subsequent repair and patching of the concealing construction, including the work of other trades. The Contractor shall schedule inspection of such connections at least one work week in advance of concealment, and shall not be entitled to any additional compensation or time extension for delays caused by inability of the Contracting Agency's representative to be available at the desired time.

3.4 CORDS AND NONMETALLIC CABLES

- A. Unless specifically permitted otherwise, cords and nonmetallic cables shall be furnished with integral Code-sized grounding conductor. Securely bond metal components and effectively ground the entire electrical system.

3.5 TELECOMMUNICATIONS GROUNDING SYSTEM

- A. Service Ground:
 - 1. Provide connection to the electric power service ground. The Main Grounding Conductor from the TMGB shall be as shown on the Drawings.
- B. Telecommunications Main Grounding Busbar (TMGB):
 - 1. Equipment and metallic raceways located in the same room as the TMGB shall be bonded to the TMGB. Each piece of equipment shall be connected back to the TMGB in a radial configuration, i.e., equipment ground connections shall not be "daisy chained".
 - 2. Where a panelboard for telecommunications is located in the same room as the TMGB, the panelboards Alternating Current Equipment Ground (ACEG) bus or the enclosure shall be bonded to the TMGB.
 - 3. Connect the TMGB to the service entrance ground bus with a bolted lug connection.

C. Bonding and Connections:

1. General:

- a. Cadweld or braze concealed or below grade connections and at ground rods.
- b. Compression connections shall be made using a hydraulic 4 way compression die.
- c. Compression connections shall be exposed.
- d. Insulated wire splices shall be insulated with preformed wire covers.

2. To Building Steel:

- a. Cadweld connections to building steel.

D. Identification and Marking:

- 1. Show conductors on neatly marked record drawings. Submit to the Contracting Agency.
- 2. Grounding conductors shall be marked per ANSI/TIA/EIA 606-A and as directed by the Contracting Agency. Mark each cable end using tie wrap style cable markers.

3.6 EXTERNAL BONDING JUMPERS

- A. Not permitted; bonding jumpers shall be run inside the raceways for the circuits they serve.

END OF SECTION 26 05 26

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. General hanger and support requirements for electrical equipment, conduit and cable trays not required to be vibration and/or seismically controlled.
2. Penetrations, sleeves and seals.

B. Related Sections:

1. 26 00 00 - Electrical General Requirements
2. 26 05 33 - Raceways and Boxes for Electrical Systems
3. 26 05 36 - Cable Tray for Electrical Systems
4. 26 24 16 - Panelboards
5. 26 29 00 - Low Voltage Controllers
6. 26 50 00 - Lighting Fixtures
7. 27 20 10 - Telecom Distribution System

1.2 REFERENCES

- A. NFPA 70: National Electrical Code (NEC) latest legally enacted edition.

1.3 DESCRIPTION

- A. Provide general hanger and support requirements for electrical equipment, conduit and cable trays not required to be vibration and/or seismically controlled in accordance with the manufacture's written installation instructions and NFPA 70.

1.4 SUBMITTALS

- A. See Section 26 00 00 - General Electrical Requirements for general submittal requirements

B. Product Data:

1. Provide manufacturers catalog data for each product specified. Indicate channel gauge and maximum load capacities of the selected products.
2. Manufacturer's Installation Instructions: Include assembly instructions, recommended parts and special procedures as required.

C. Shop Drawings:

1. Provide shop drawings to include the following:
 - a. Pre-engineered and field fabricated support system details for each installation location.

To include but not limited to:
 - 1). Raceway and Lighting Fixture support.
 - 2). Conduit and Control Panel support.
 - 3). Cable tray support.
 - 4). Telecommunications Rack support.
 - b. Equipment locations and conduit and cable tray routing coordinated with mechanical equipment and systems. Indicate routing height above finished floor.
 - c. Indicate hanger type/attachment method and hanger spacing intervals.

D. Project Record Information:

1. Indicate installed locations of hangers and supports on project as-built shop drawings.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Acceptance at Site:

1. Verify products are delivered in original factory packaging and are free from damage and corrosion.
2. Replace equipment delivered to job site that does not comply with above requirements at no expense to the Owner.

B. Storage and Protection:

1. Store products in covered storage area, protected from the elements, outside the general construction area until installed.
2. Handle items to avoid damage.

3. Replace damaged items with same item in new condition.

1.6 WARRANTY

- A. Provide warranty in accordance with Section 26 00 00 - General Electrical Requirements.

PART 2 - PRODUCTS

2.1 PRE-ENGINEERED SUPPORT SYSTEMS

A. Manufacturers:

1. Unistrut
2. Super-Strut
3. B-Line
4. K-Line
5. Erico.

B. Material:

1. Cold worked steel.
2. Type 304 stainless steel: Use for PVC, liquid-tight flex, or plastic-coated conduit installed on wood construction in outdoor, damp, corrosive or marine environments.

C. Finish:

1. Heated indoor areas: Pre-galvanized zinc coating.
2. Outdoor areas: Hot dipped galvanized finish. In addition, coat hot dipped galvanized finish channel field cuts with zinc rich paint provided by the support system manufacturer.
3. Painted areas: Paintable galvanizing or phosphatized and primed.
4. Surface metal raceways: U.L. Listed epoxy coating.

D. Channel:

1. Standard Size: 1-5/8 inch x 1-5/8 inch. Gauge thickness as required for attached load.
2. Standard Hole Pattern: Slotted. Provide solid channel in exposed public areas.

E. Nuts and Hardware:

1. Channel nuts: Hardened steel (ASTM-A675 and ASTM A36).
 2. Bolts, screws and nuts: Hardened steel (ASTM-A307, ASTM A563 and SAE J429).
 3. Finish: Electroplated zinc.
- F. Fittings: Plate steel (ASTM A635). Epoxy or electroplated zinc coating.
- G. Electrical Accessories: Provide accessories from the support system manufacturer designed for the specific equipment to be supported to include but not limited to:
1. Light fixture hangers.
 2. Outlet box adapters.
 3. Snap-in closures.
 4. Conduit connection plates.
 5. Junction box adapters.
 6. Strut joiners.
 7. "Caddy" fasteners are permitted for support of conduit to concealed metal studs and for conduit concealed above suspended acoustical ceilings.

2.2 J-HOOKS

- A. Where specifically permitted on the Drawings, cables from individual outlets may be run from the conduit stub-out to the cable tray system using j-hooks.
- B. Size J-hooks for 50% spare capacity.
- C. No bridle rings are permitted.
- D. Equipment: Erico/Caddy CableCat, Panduit J-Mod, or as approved.

2.3 SLEEVES, ACOUSTICAL SEALS AND FIRE-STOPPING

- A. See Part 3 - PENETRATIONS.
- B. Sleeves for pipes through fire rated and fire resistive floors and walls, and fire proofing: UL listed prefabricated fire rated sleeves and seals.

2.4 WALL/FLOOR PENETRATION WATER SEALS

- A. Mechanical seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the conduit and the wall opening.

- B. EPDM seals.
- C. 316 Stainless steel bolts and nuts.
- D. Hot-dipped galvanized or coated sleeve with full water stop flange with continuous weld on both sides.
- E. Manufacturer: Metraflex, Thunderline, Crouse-Hinds, or pre-approved equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installation, prepare detailed shop drawings of the planned installation of hanger and support products specified by this section. Coordinate the location, type and size of hangers and supports, housekeeping pads (thickness/perimeter overhang dimensions) and roof curbs with Architectural and Structural elements utilizing the shop drawing review process.
- B. Submit shop drawings required by this section coordinated with the seismic design and associated shop drawings required by Section 25 05 48 – Mechanical Vibration and Seismic Control as a single submittal.
- C. Do not install hangers and supports without approved shop drawings.

3.2 GENERAL INSTALLATION

- A. Install hangers and supports in accordance with manufacturer's instructions, applicable Code requirements (NFPA 70) and approved shop drawings.
- B. See Section 26 00 00 – Electrical General Requirements for electrical equipment wall mounting heights.

3.3 VIBRATION AND SEISMIC CONTROL PRODUCT INSTALLATION

- A. Install vibration isolators, seismic control and wind restraint systems in strict compliance with the manufacturer's written instructions and certified and approved application engineering installation drawings and details in accordance with Section 250548 - Vibration and Seismic Control.

3.4 INSERT AND ATTACHMENT INSTALLATION

- A. Inserts
 - 1. Provide inserts or cast-in-place channels for placement in concrete formwork.

2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
4. Use expansion type anchor bolts with pre-cast concrete including concrete masonry units within loading limits of the pre-cast material and anchor bolt manufacturer's recommendations.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
6. Plastic screw inserts and caulked lead inserts are prohibited, except for mounting instructions and control diagrams.

B. Attach electrical equipment to structure as follows:

1. Hollow masonry: Toggle bolts.
2. Solid masonry and concrete: Preset inserts or expansion bolts.
3. Structural steel: Beam clamps which engage both sides of structural member or have retaining clips or other approved means for positive engagement.
4. Metal surfaces: Machine screws, bolts or welding.
5. Wood construction: Wood or sheet metal screws. Bugle head drywall screws or deck screws are not allowed.
6. Do not use powder actuated fasteners for anchorage in tension applications. Obtain written permission from the Owner prior to using any type of powder powered studs.
7. Attachment to plaster or gypsum board (sheet rock) not approved. Equipment shall be attached to or supported from structure.

3.5 RACEWAY INSTALLATION

- A. Support raceways using approved types of wall brackets, ceiling trapeze hangers or malleable iron straps utilizing attachment methods described above. "Perforated plumber's strap" is not permitted as a means of support.
- B. Support raceways independent of ceiling systems, piping and ductwork. Exceptions: Lighting fixtures and outlet boxes (i.e. ceiling speaker boxes) specifically designed for attachment to suspended ceiling systems
- C. Support EMT conduit (1-1/2 inch and smaller/dry locations) using hanger rods with spring steel fasteners.
- D. Support cable trays and multi-conduit runs independently from other support systems utilizing double hanger rods at each support point.

3.6 LIGHTING INSTALLATION

A. General

1. Attach safety hanger wires to lighting fixtures such that in event of a ceiling suspension system failure or primary support hanger wires or support pendant, no part of the fixture will drop more than 6 inches below normal ceiling height. Secure each end of each wire with a minimum of three tight wraps. Attach safety hanger wires to structural members using approved clamps and rods.

B. Pendant-hung lighting fixtures

1. Support lighting fixtures from structural members capable of supporting the total weight of the fixture and independent from electrical wiring system.
2. For each fixture, provide direct support from the structure above using a minimum of two 12 gauge wires, equivalent aircraft cable or an approved alternate support system without using the ceiling suspension system for direct support. Securely attach wire/cable to fixture, route through fixture stem and securely attached to structure.
3. Provide loop and hook or swivel hanger assemblies fitted with a restraining device to secure stem in the support position during earthquake motion.
4. Support fixtures with flexible hanger device at the attachment point to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
5. Provide means for seismic sway bracing to prevent lighting fixture from swaying during a seismic event. Bracing shall prevent lighting fixture from swaying more than 45 degrees above the normal plane AND to prevent lighting fixture from swaying into another object (wall, structure, another fixture or object).

C. Fixtures (suspended ceiling system applications)

1. Positively attach lighting fixtures to suspended ceiling grid for 100 percent of fixture weight acting in any direction using positive clamping devices that fully surround the supporting member (i.e. Caddy "IDS" or equal).

D. Provide supplemental safety hanger wires as follows:

- a. Fixtures (weighting less than 56 pounds): Provide two 12 gauge wires or equivalent chains connected from the diagonal corners of the light fixture housing to the structure above. These wires may be slack.
- b. Fixtures (weighting greater than 56 pounds): Provide full direct support from the structure above. Attach wires from within 3 inches of each corner of the fixture.

3.7 PENETRATIONS

- A. Coordinate electrical penetrations with architectural, structural and mechanical construction details prior to installation. Set sleeves in position in concrete formwork. Provide reinforcement around sleeves as required.
- B. Provide compatible materials, fasteners, adhesives, sealants, and other products required for proper installation.
- C. Penetrations through roof, exterior walls and floors shall be weather and water tight (see floor penetration seals).
- D. Firestopping: Provide UL rated firestopping assemblies for rated roof, wall and floor penetrations in accordance with Division 7.
- E. Conduit Sleeves
 - 1. Provide sleeves for conduit passing through floors, walls, ceilings, or roofs.
 - a. Fabricate sleeves in non-load bearing walls from 20 gauge galvanized sheet steel conforming to ASTM A 924/A 924M.
 - b. Fabricate sleeves in load bearing walls from standard weight galvanized steel pipe conforming to ASTM A 53/A 53M.
 - c. Provide 1/2 inch clearance between conduit and sleeve opening.
- F. Acoustical Seals
 - 1. Monolithic sound walls (i.e. poured concrete or masonry): Provide wall sleeve with approximately one-inch annular space around conduit. Pack annular space with backer rod or acoustical filler as specified in Division 7. Allow a 1 inch recess at each end of sleeve. Caulk sleeve flush with flexible sealant or fire-stopping material as specified in Division 7.
 - 2. Where acoustical wall is a two component type, such as a staggered or double stud partition, treat each component as a separate wall. Pack and seal each half of penetration sleeve as previously specified, except that only the exposed end of each sleeve portion shall be caulked with sealant or firestop. Provide adequate separation between each sleeve.
- G. Wall Penetration Seals
 - 1. Provide pre-engineered wall penetration water seal systems for exterior wall penetrations.
 - 2. Select appropriate wall penetration sealing systems based on conduit material and nominal conduit size in accordance with the manufacturer's selection charts.

3. Install conduit and sealing system prior to waterproofing the wall. Grout void between water seal and outside face of foundation wall to provide continuous bearing surface for waterproofing fabric.

H. Floor Penetration Seals

1. Provide pre-engineered floor penetration water seal systems for conduit floor penetrations in rooms where a pipe leak/failure could result in water damage to adjacent spaces (i.e. mechanical rooms located above the ground floor or basement) and other areas as noted.
2. Extend conduit floor penetration sleeves 2 inches above finished floor.

3.8 FIELD QUALITY CONTROL

- A. Document each installation and operational step in accordance with approved shop drawings and manufacturers requirements.

END OF SECTION 26 05 29

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SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes specific requirements, products, and methods of execution relating to conduit, conduit fittings, surface raceways, multi-outlet assemblies, wireways, outlet boxes, pull boxes and junction boxes approved for use on this project. Type, size and installation methods shall be as shown on Drawings, required by Code and/or specified in this Section.
- B. Related Sections
 - 1. 26 05 19 – Low Voltage Electrical Power Conductors and Cables
 - 2. 26 05 26 – Grounding and Bonding for Electrical Systems
 - 3. 26 05 29 – Hangers and Supports for Electrical Systems

1.2 REFERENCES

- A. American National Standards Institute/Underwriters Laboratory
 - 1. ANSI C80.1 – Electrical Rigid Steel Conduit
 - 2. ANSI C80.3 – Steel Electrical Metallic Tubing
 - 3. ANSI C80.5 – Electrical Rigid Aluminum Conduit
 - 4. ANSI C80.6 – Electrical Intermediate Metal Conduit
 - 5. ANSI/UL 1 – Flexible Metal Conduit
 - 6. ANSI/UL 6 – Electrical Rigid Metal Conduit – Steel
 - 7. UL 6A – Standard for Electrical Rigid Metal Conduit – Aluminum and Stainless Steel
 - 8. UL 360 – Standard for Liquid Tight Flexible Steel Conduit
 - 9. UL 514A – Metallic Outlet Boxes
 - 10. UL 514B – Conduit, Tubing and Cable Fittings
 - 11. UL 651 – Standard for Schedule 40 and 80 Rigid PVC Conduit and Fittings

12. UL 651A – Type EB and A Rigid PVC Conduit and HDPE Conduit
13. ANSI/UL 651B – Standard for Continuous Length HDPE Conduit
14. ANSI/UL 797 – Electrical Metallic Tubing – Steel
15. ANSI/UL 1242 – Electrical Metal Intermediate Conduit – Steel

B. National Electrical Manufacturers Association

1. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
2. NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
3. NEMA OS 1 – Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports
4. NEMA RN 1 – Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
5. NEMA TC 2 – Electrical Polyvinyl Chloride (PVC) Conduit
6. NEMA TC 3 – Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing
7. NEMA WD 6 - Wiring Device Configurations.

C. NECA (National Electrical Contractors Association) Standard of Installation.

1.3 SUBMITTALS

- A. Provide submittals for all products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.
- B. Product Data: Provide dimensions, knockout sizes and locations, materials, fabrication details, surface raceway finishes (custom factory pre-painting, color as selected by architect), and accessories.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 QUALITY ASSURANCE

- A. Raceways and boxes shall be standard types and sizes as manufactured by a nationally recognized manufacturer of this type of materials and be in conformity with applicable standards and UL listings.

- B. Surface raceways shall be of the latest approved design as manufactured by a nationally recognized manufacturer and shall be listed by the Underwriters' Laboratory and bear the UL label.
- C. Pull and junction boxes 50 cubic inches and smaller shall conform to specifications for outlet boxes.
- D. Pull and junction boxes larger than 50 cubic inches shall conform to U.L. Standard 50, Cabinets and Boxes.
- E. Perform Work in accordance with NECA Standard of Installation.
- F. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 CONDUIT

- A. Conduit types specifically approved for use on this project shall be of the following types only:
 - 1. Galvanized rigid metal conduit - GRC or RMC.
 - 2. Intermediate metal conduit - IMC.
 - 3. Rigid copper-free aluminum conduit.
 - 4. Electrical metallic tubing - EMT.
 - 5. Polyvinyl chloride conduit - PVC: May be Schedule 40 or Schedule 80, except where Schedule 80 is specifically noted or specified.
 - 6. Flexible metal (steel) conduit - FMC or flex: In short lengths as specifically permitted.
 - 7. Liquid-tight flexible steel conduit - LFMC: In short lengths as specifically permitted.
 - 8. Extreme temperature liquid-tight flexible steel conduit - AT: Shall have temperature rating of -67 ° F to +220 ° F, Liqueatite "ATLA", or as approved.
 - 9. Types specifically identified on the Drawings or in the Specifications
 - 10. Other products not specifically approved such as ENT, MC Cable (except FPLP Type for Fire Alarm), etc., are not allowed.

2.2 FIRE ALARM CONDUIT

- A. EMT conduit utilized for fire alarm system wiring shall be factory pre-painted with a bright red topcoat, Allied Fire Alarm Red or as approved. Other conduit types utilized for fire alarm system wiring shall be identified with red paint or red tape wrapped a minimum of 4 times around the conduit every 10 feet and at each fire alarm system junction box.

2.3 CONDUIT FITTINGS

- A. Fittings utilized with rigid steel, IMC, and aluminum shall be galvanized steel or iron or copper-free aluminum and shall be threaded. Conduit bushings shall be provided and shall be of the insulated types. Where grounding bushings are required, provide insulated grounding bushings with integral pressure type ground lugs, Thomas & Betts "Blackjack", or as approved.
- B. Couplings and connectors for EMT shall be made of steel or malleable iron. Die-cast products shall not be used. Connectors shall have insulated throats. Connectors and couplings shall be setscrew or compression type.
- C. Fittings for PVC 40 shall be polyvinyl chloride, installed using PVC solvent to form a watertight joint, except elbows (including bends exceeding 15°) shall be metallic. These metallic elbows and bends shall be of the type specified in this section for the environment in which they are to be installed.
- D. Fittings for flexible metal conduit shall be steel or malleable iron only. All throats shall be insulated.
- E. Fittings for liquid-tight flexible conduit shall be steel or malleable iron, of a type incorporating a threaded grounding cone, nylon or plastic compression ring, and a tightening gland, providing a low resistance ground connection. All throats shall be insulated.

2.4 WIREWAY

- A. Unless otherwise noted on the Drawings, surface wireway in exposed or concealed locations shall be sheet metal channel suitable for use as a wiring trough, with hinged or screw cover, sized in accordance with the NFPA 70. Wireway shall be Square D Class 5100, 5120, 5140, as appropriate for the environment, or as approved.
- B. Wireway shall be of the NEMA Type (general purpose, oil-tight, dust-tight, rain-tight, etc.) appropriate for the environment where installed.
- C. Wireway shall be furnished without factory pre-punched concentric or eccentric conduit knockouts. Knockouts shall be field punched as required for the conduits installed.
- D. Finish shall be ANSI-49 gray epoxy paint finish applied by cathodic electrodeposition over a corrosion resistant phosphate preparation.

2.5 CAST BOXES

- A. Cast boxes with threaded hubs, external mounting brackets or holes, and gasketed covers shall be used in the following locations:
 - 1. Exterior locations.
 - 2. Wet or damp locations.
 - 3. Shops, mechanical rooms, where exposed to mechanical damage.
 - 4. Exposed interior locations below 48 inch above floor where subject to damage.
 - 5. Where shown on Drawings.

2.6 STEEL BOXES

- A. Galvanized pressed steel boxes may be used wherever they are permitted by code, except in areas indicated in the preceding paragraph.
- B. Flush mounted, pressed steel boxes shall be equipped with external mounting brackets for attachment to framing members with screws or nails.
- C. Ceiling boxes and wall boxes for bracket lights shall be not less than 4 inch in diameter by 1 ¼ inch deep and shall have 3/8 inch malleable iron fixture studs if required.
- D. Grounding Screw: All stamped steel boxes shall have a drilled and tapped hole in the back of the box for a grounding screw.
- E. Accessories: Box covers, extension rings, bases, hanger bars, etc., for use in connection with the installation, shall be approved for use in the various applications.

2.7 TELECOMMUNICATION OUTLET BOXES

- A. Boxes for telecommunication outlets shall be a minimum of 4 inches square by 2 1/8 inches deep.
- B. Device rings for telecommunication outlets shall be single double-gang, minimum 5/8 inches deep, to provide a minimum internal finished depth of 2 3/4 inches.

2.8 INDOOR PULL AND JUNCTION BOXES

- A. Indoor pull and junction boxes shall conform to Article 314 of the NEC and the following requirements:
 - 1. Sheet metal boxes are approved for use in all dry, interior, nonhazardous locations.
 - 2. Boxes installed in wet locations shall be NEMA 3R, unless otherwise noted.

3. Special boxes, as noted on the Drawings, shall be installed in areas of specific service and/or hazards.
- B. Junction box extension rings will not be accepted on new boxes. Appropriate size boxes shall be used for each application.

2.9 TELECOMMUNICATION SYSTEM PULL BOXES

- A. Telecommunication system Pull Boxes shall also conform to ANSI/EIA/TIA 569-A and the BICSI Telecommunications Distribution Methods (TDM) Manual.
- B. Dimensions:
 1. Pull boxes for straight through pulls shall have minimum interior dimensions in accordance with the following Table:

	Size of Box			
Maximum Trade Size Conduit	Width (inches)	Length (inches)	Depth (inches)	For Each Additional Conduit Increase Width
1 Inch	4	16	3	2 inches
1 1/4 Inch	6	20	3	3 inches
1 1/2 Inch	8	27	4	4 inches
2 Inch	8	36	4	5 inches
2 1/2 Inch	10	42	5	6 inches
3 Inch	12	48	5	6 inches
3 1/2 Inch	12	54	6	6 inches
4 Inch	15	60	8	8 inches

2.10 TELECOMMUNICATION SYSTEM SPLICE BOXES

- A. Unless otherwise specified or noted on the Drawings, splice boxes shall not be used in interior horizontal pathway conduits or interior backbone pathway conduits.
- B. Where required in a building service entrance or campus backbone pathway system, splice boxes shall be provided in accordance with the requirements of ANSI/EIA/TIA-569-A - Commercial Building Standard for Telecommunications Pathways and Spaces and the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual.

2.11 OUTDOOR ABOVE-GROUND PULL AND JUNCTION BOXES

- A. Boxes exposed to rain or installed in wet locations shall be NEMA 3R unless otherwise noted.

- B. Outdoor pull and junction boxes and conduit bodies for use with galvanized conduits shall be made of galvanized ferrous metal or cast aluminum, with integral threaded hubs or Myers-type weathertight hubs of matching composition and finish.
- C. Outdoor pull and junction boxes for use with PVC or plastic-coated conduits shall be made of fiberglass, with matching gasketed covers secured with captive monel or stainless steel screws; Hoffman A-JFG series or accepted equal. Each metallic conduit entry (including liquidtight flex) shall be provided with a bronze bond bushing and NEC-sized copper bonding jumper inside the enclosure.

PART 3 - EXECUTION

3.1 CONDUIT USES PERMITTED

- A. Conduits shall be of the sizes shown on the Drawings or as required by the NEC, whichever is larger. Base sizes on using type XHHW for wire sizes #6 and smaller and type THHN/THWN wire for wire sizes #4 and larger. Unless otherwise noted, conduits installed in the following locations shall be of the types specifically identified only:
 - 1. Underground or encased in concrete - rigid steel, PVC-40 or IMC.
 - 2. Outdoors aboveground or damp locations - RMC, rigid aluminum, IMC or extreme temperature liquid-tight flexible steel conduit (where required).
 - 3. Dry indoor locations, concealed or exposed - RMC, rigid aluminum, EMT (where not susceptible to physical damage), flexible conduit where necessary, or IMC.
 - 4. Indoor locations, exposed, where susceptible to physical damage - RMC or IMC.
 - 5. Motor and equipment flexible connections - LFMC or FMC (when installed in plenum spaces).

3.2 RACEWAY INSTALLATION METHODS - GENERAL

- A. Concealed raceways: In occupied areas, conduit and raceways shall be concealed unless specifically noted otherwise. In service spaces (mechanical equipment rooms, electrical rooms, storage closets, etc.), approved raceways may be surface-mounted for connection to equipment in exposed surface mounted locations and in exterior locations as noted on the Drawings.
- B. Concealed raceways shall be routed as directly as possible with a minimum of bends. Concealed raceways above lay-in ceilings shall be installed a minimum of 12 inches above the ceiling grid.
- C. Exposed Raceways: Where allowed by this Specification or specifically noted on the Drawings, raceways may be mounted on the surface of walls, ceilings and other surfaces. Exposed raceways shall comply with the following:

1. Exposed raceways shall be run parallel or perpendicular to building lines and bent symmetrically or made up with standard elbows or fittings.
 2. Surface-mounted conduit, junction boxes, pull boxes, outlet boxes, etc. installed in finished areas shall be painted to match the surrounding surfaces.
 3. Connectors and fittings for raceways and conduits installed on the surface in exterior locations shall be suitable for and Listed for use in a wet location.
 4. Conduits installed in exterior locations shall be painted to match the exterior finish of the building surface to which they are attached. This shall include conduits attached via racks and stand-off brackets, or attached directly to the surface.
- D. Conduit and tubing shall be cut square and reamed smooth at the ends and all joints made tight. Conduit threads shall be lubricated with an approved thread lubricant.
- E. Raceway for power wiring shall not be installed in the floor slab beneath telecommunication rooms.
- F. Each conduit shall enter and be securely connected to a cabinet, junction box, pull box or outlet box by means of a locknut on the outside and a locknut/bushing on the inside, or by means of a liquid-tight, threaded, self-locking, cold-weld type wedge adapter. Connections shall be made wrench tight. Locknuts shall be the bonding type with sharp edges and shall be installed in a manner that will assure a locking installation. Locknuts and bushings or self-locking adapters will not be required where conduits are screwed into threaded connections. Conduit runs shall be protected from the entrance of foreign material prior to the installation of conductors.
- G. Conduit or tubing deformed or crushed in any way shall not be installed. Conduit shall be bent only with approved bender (hydraulic or hickey). Bending machines shall be used to make field bends in conduit of 1-1/4 inch size and larger. Torches shall not be used in making conduit bends.
- H. Raceways shall be spaced at least 6 inches from parallel runs of heating system pipes, flues, other high temperature piping systems, and other heat sources. This basic spacing shall be increased if necessary to ensure that raceways experience no significant temperature rise from external sources. Raceways shall not be embedded in any spray applied insulation, fireproofing, or other materials that would restrict heat dissipation.
- I. Pull wires shall be provided in spare and unused conduits. (Nylon "jet-line" or as approved.)
- J. Conduits stubbed up out of floor and terminating inside of an enclosure shall have insulating grounding bushings installed.
- K. Raceways penetrating vapor barriers or traversing from warm to cold areas shall be sealed on the inside with a non-hardening duct sealing compound to prevent the accumulation of moisture, and shall be taped airtight to the vapor barrier on the outside. Refer to Section 26 00 00 for additional requirements and limitations regarding penetration of vapor barriers. Larger conduits (2-1/2 inch and larger) shall be sealed with Polywater FST two part foam sealant or approved equal on warm indoor side of penetration.

- L. Raceways (particularly PVC) shall be provided with expansion joints where necessary to allow for thermal expansion and contraction. Set initial opening of expansion joints per manufacturer's instructions, to suit the ambient temperature at the time of installation.
- M. Provide flexible conduit connection at seismic joints to allow for displacement of conduit in all three axes. Provide appropriate lengths of flexible conduits at seismic joints and appropriate amounts of slack in conduit to allow movement of conduit/cabling in accordance with the design of the seismic joint. Slack shall be maintained in conduit after cabling is installed. Minimum lengths of flexible conduit and minimum amount of slack for various size conduits shall be as follows:
 - 1. 2 inch and greater: 4 foot length, 4-6 inches slack.
 - 2. 1-1/2 inch and smaller: 2 foot length, 3 inches slack.
- N. Flexible metal conduit with supplemental ground jumper shall be used for connection to vibrating equipment, or where installation conditions warrant its use with express permission. Flexible conduit shall not penetrate walls. Liquid-tight flexible conduit with supplemental ground jumper shall be used for motor and transformer connections (except utilize flexible metal conduit in plenum spaces). The ground jumper in flexible conduits shall be routed within the conduit.
- O. Length of flexible conduit shall not exceed 36 inches, except for lighting fixture whips and where specifically noted. Fixture whips shall not exceed 72 inches. Flexible conduit shall not penetrate walls or vapor barrier retarder/barrier.
- P. Electrical raceways may penetrate roofing membranes only where absolutely necessary. Submit intended locations to Contracting Agency for approval prior to installation. Such penetrations shall be flashed and sealed as required for mechanical piping penetrations of roof. Where practical, conduits stubbed up to roof mounted equipment shall be routed within the equipment curb supporting the equipment.

3.3 RACEWAY INSTALLATION METHODS – TELECOMMUNICATIONS SYSTEMS

- A. Installation methods for telecommunication system conduits shall comply with Installation Methods – General, above, unless superseded by more stringent requirements of this section.
- B. Telecommunications conduits shall comply with the requirements of TIA/EIA-569-A and the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual. Note that some of these requirements are more stringent than the requirements of the National Electrical Code.
- C. There shall be no more than two 90-degree bends between pull points in telecommunications conduit. Pull boxes added to conduit runs as a result of this requirement shall be in accordance with this Section. If it is not practical to install a pull box in the run due to field conditions, the conduit size shall be increased to the next trade size for each additional 90-degree bend. Offsets shall be considered as equivalent to a 90-degree bend.
- D. Inside radius of conduit bends shall be at least 6 times the internal diameter of the conduit for sizes up to 2 inch trade size; 10 times the internal diameter of the conduit for sizes larger than 2

inch trade size. Where bending machine shoes are not available with the required bending radius for a one-shot field bend, factory bent, large radius 90-degree elbows shall be provided. Conduits of all sizes for use as optical fiber raceways shall have a minimum inside bend radius of 10 times the internal diameter of the conduit.

- E. Conduits stubbed to cable trays shall be terminated within a maximum horizontal distance of 4 inches from the tray and in a vertical zone between 1 to 6 inches above tray. Conduits shall be supported from structure within a maximum horizontal distance of 12 inches from the tray. Conduits shall be provided with a grounding bushing and shall be bonded to the cable tray with a minimum 12 AWG copper conductor.
- F. Use of flexible conduit for telecommunications shall be kept to a minimum and shall be at the discretion of the Contracting Agency. Obtain prior written approval for the use of flexible conduit. Where required due to physical considerations, flexible metal conduit may be allowed in lengths not exceeding 4 feet. If used, flexible metal conduit shall be increased by one trade size for the application used (see Conduit Sizes).
- G. Conduits entering the telecommunications room or equipment room through the floor shall be terminated 4 inches above finished floor. Conduits entering the telecommunications room or equipment room from above shall be terminated 4 inches below the finished ceiling, but in no case shall the conduits terminate more than 12 inches above the cable pathway support or distribution frame.
- H. Conduit sleeves connecting vertically “stacked” telecommunications rooms shall be terminated 4 inches above finished floor. Conduits and cutout openings between floors shall be sealed with firestopping material that is reusable, to accommodate additions and deletions, moves and changes in the cabling system.
- I. Layout of conduits shall give consideration to nearby sources of electromagnetic energy such as electrical power wiring, large electric motors and generators, induction heaters, arc welders, variable frequency drives, etc. Maintain the greatest separation practicable between telecommunication raceways and sources of electromagnetic interference (EMI). A minimum of 5 inches of separation shall be maintained between telecommunication raceways and fluorescent lighting ballasts.
- J. Pull wires shall be provided in spare and unused conduits. (Nylon “jet-line” or as approved.)

- K. Maintain minimum separation from $\leq 480V$ power wiring in accordance with the following table:

Condition	Minimum Separation Distance		
	< 2 kVA	2-5 kVA	> 5 kVA
Unshielded power lines or electrical equipment in proximity to open non-metal telecommunications pathways	5 inches	12 inches	24 inches
Unshielded power lines or electrical equipment in proximity to a grounded metal telecommunications conduit pathway	2.5 inches	6 inches	12 inches
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal telecommunications conduit pathway	--	3 inches	6 inches

3.4 CONDUIT SIZES – GENERAL

- A. Minimum sizes for rigid steel, IMC, FRE, rigid aluminum and PVC-40 conduits shall be $\frac{3}{4}$ inch.
- B. Minimum size for EMT shall be $\frac{1}{2}$ inch.
- C. Minimum size for flexible conduits shall be $\frac{1}{2}$ inch , except fixture whips may be $\frac{3}{8}$ inch as allowed by the NEC.

3.5 CONDUIT SIZES – TELECOMMUNICATIONS SYSTEMS

- A. Minimum size for conduit runs to outlets is 1 inch.
- B. Unless indicated otherwise, individual conduit homeruns shall serve no more than one three telecommunications outlet.

3.6 OUTLET BOX INSTALLATION

- A. Outlet boxes shall be securely fastened in position and supported independently of the conduit system.
- B. Outlet boxes located in suspended ceiling system shall be fastened to ceiling “t-bar” system with bar-hanger rods manufactured for the purpose, or from hanger rods with solid supports from structure above. “T-bar” hanger rods shall be clipped to cross-members supported by the main ceiling support members. Outlet boxes supported from the suspended ceiling system shall be provided with one safety wire attached to the box or box support clip, or two safety wires attached to the bar hanger.

- C. Boxes shall be installed true to the building lines and at equal heights in conformity with mounting heights specified in other sections of the specification.
- D. Provide the best suitable box for each outlet requirement. Extension rings shall not be used on new construction except where needed to bring an outlet box out to 1/8 inch of the finished wall or ceiling line.
- E. Boxes shall have only the holes necessary to accommodate the conduits at point of installation. All boxes shall have lugs or ears to secure covers.
- F. Boxes shall be rigidly secured in position. Recessed boxes shall be so set that the front edge of the box shall be flush with the finished wall or ceiling line, or not more than 1/8 inch back of same. This requirement is more stringent than NEC requirements.
- G. Boxes shall be accessible.
- H. Provide boxes for each application that will not violate the fire rating of the wall, floor or ceiling assembly in which the box is installed.
- I. Do not place order for floor boxes without ensuring that the Contracting Agency has positively approved submittals for the specific cover types/styles colors necessary for all applications and locations.
- J. Recessed boxes shall not be placed back-to-back in adjacent rooms. They shall be offset at least 12 inches, or greater as required by codes and standards applicable to the specific construction.
- K. Boxes (electrical boxes, outlet boxes and telecommunication boxes, etc) penetrating fire rated walls, walls with vapor retarder/barriers, wall types that extend to structure or wall types that contain batts shall be sealed airtight with approved Firestop Putty Pads to reduce sound transmission, reduce air transmission and increase fire resistance. Mold putty pads around electrical junction boxes and conduits to form an airtight seal in accordance with manufacturer's installation instructions.

3.7 JUNCTION BOX AND PULL BOX INSTALLATION

- A. Junction and pull boxes shall be installed so that covers are readily accessible and adequate working clearance is maintained after completion of the installation.
- B. Select boxes properly sized per NEC for power and lighting applications.

3.8 TELECOMMUNICATIONS SYSTEM PULL BOXES

- A. Where a pull box is required in a 1 inch conduit run, outlet boxes as specified in this Section may be used. Where a pull box is required in a conduit run 1 1/4 inch or larger, or where required for multiple raceways, the box shall be sized in accordance with the Table in this Section.
- B. Pull boxes shall be located in straight-through sections of horizontal cabling pathways (conduits). Pull boxes shall not be used for angle pulls or to accomplish changes in direction of the pathway.

- C. Multiple raceways connecting to telecommunications system pull boxes shall penetrate box walls such that they are distributed evenly along the Box wall.

3.9 TELECOMMUNICATIONS SYSTEM JUNCTION BOXES

- A. Unless otherwise specified or noted on the Drawings, junction boxes shall not be used in interior horizontal pathway conduits or interior backbone pathway conduits. Where allowed, junction boxes shall be located in a readily accessible location. Junction boxes shall not be located in above ceiling spaces.
- B. Junction boxes for telecommunication shall be hinged covered cabinets, sized in accordance with the requirements of ANSI/EIA/TIA-569-A.
- C. Junction cabinets shall have a fire-treated plywood backboard suitable for mounting punch-down style terminal blocks, in accordance with 27 20 10 - Telecom Distribution System.

END OF SECTION 26 05 33

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SECTION 26 05 36

CABLE TRAY FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide a complete cable pathway support system as shown and specified including required connectors, supports, brackets, engineered seismic bracing, vertical and/or horizontal offsets, grounding, and hardware for a complete system.
- B. Related Sections
 - 1. 26 05 26 – Grounding and Bonding for Electrical Systems
 - 2. 26 05 29 – Hangers and Supports for Electrical Systems
 - 3. 27 20 10 – Telecom Distribution System

1.2 REFERENCES

- A. Underwriters' Laboratories, Inc.
- B. National Electrical Code.
- C. Canadian Standards Association.
- D. ANSI/EIA/TIA-569 - Commercial Building Standard for Telecommunications Pathways and Spaces.
- E. ASTM A 123 - Zinc (Hot Dip Galvanized Coatings on Iron and Steel Products.
- F. ASTM A 510 - General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel.
- G. ASTM B 633 - Electrodeposited Coatings of Zinc on Iron and Steel.
- H. ISO 9002.

1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.

1.4 SHOP DRAWINGS

- A. Work shall be laid out in advance. Shop Drawings shall be submitted to the Contracting Agency for approval before work begins.
- B. Work under this section has been indicated on the Drawings in locations which should allow installation without interfering with the work of other trades; however, exact finish locations cannot be indicated. Therefore, locations of work and equipment shall be verified to avoid interferences, preserve head room and keep openings and passageways clear. Review the plans for the work of all trades and coordinate adjustment of the work of the trades to achieve the best installation for the Owner without additional claims or charges. Shop Drawings shall reflect coordination of work under this Section.
- C. Submit a complete pathway layout drawn at 1/8-inch = 1 foot scale minimum including suspension points, offsets, fire-wall penetrations and other essential information. Layout shall be coordinated with mechanical ventilation, plumbing, and fire suppression contractors to ensure that the required access is unobstructed for its entire length. Locations shall be dimensioned with all obstructions shown and noted. Drawings shall include sections of corridors and of areas where obstructions require special coordination, showing the location in relation to work of other trades. Submit layout for approval.

1.5 QUALITY ASSURANCE

- A. Products shall be of the latest approved design as manufactured by a nationally recognized manufacturer and shall be listed by the Underwriters' Laboratory and bear the UL label.
- B. Alternative systems to the Basis of Design will be considered providing that sufficient documentation is provided to satisfy the Contracting Agency that the equipment meets the requirements of the specification.

PART 2 - PRODUCTS

2.1 WIRE MESH TYPE CABLE TRAY

- A. Cable tray shall be a continuous, rigid, welded wire mesh cable management system without sharp edges. Wire diameter shall be 0.177 inch (4.5 mm) minimum.
- B. Mesh sections shall have at least one (1) bottom longitudinal wire along entire length.
- C. Nominal Dimensions, unless otherwise shown on the Drawings:
 - 1. Mesh shall be in a 2 by 4 inch pattern or tighter.
 - 2. Depth: 4 inches.
 - 3. Width: 12 inches.

- D. The tray shall be made of Carbon steel wire (ASTM A 510, Grade 1008) with the following finish:
 - 1. Electro-plated Zinc galvanizing (ASTM B 633, Type III, SC-1) or Hot-dip galvanizing (ASTM A 123).
- E. Wire basket type cable tray shall be UL classified as an equipment grounding conductor. Provide grounding clip for continuous ground of cable management system.
- F. Basis of Design: Cablofil Wire Mesh, Cooper B-Line Flextray, Hubbell NextFrame Wire Basket Tray or as approved.

2.2 J-HOOKS

- A. Where specifically permitted on the Drawings, cables from individual outlets may be run from the conduit stub-out to the cable tray system using j-hooks.
- B. Size J-hooks for 50% spare capacity.
- C. No bridle rings are permitted.
- D. Equipment: Erico/Caddy CableCat, Panduit J-Mod, or as approved.

2.3 ACCESSORIES

- A. Grounding and Bonding Strap: Unless otherwise noted on the Drawings, provide braided ground strap to connect discontinuous sections of cable tray, e.g., at through-wall penetrations with tray terminated on each side of wall.

2.4 CABLE TRAY SUPPORTS

- A. Seismic supports and bracing shall be in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems and the manufacturer's engineered solution for the project's seismic zone. Where required or recommended by the tray manufacturer, the Contractor shall employ the services of a licensed Structural or Seismic Engineer to design the seismic bracing for the specific seismic zone requirements.

2.5 FIRE RATED ASSEMBLY PENETRATIONS

- A. Provide permanent fire stop system at all through penetrations of fire rated wall, floor and roof assemblies which meet the evaluation criteria set forth in ASTM Standard E-814 and UL Standard 1479 for fire tests of through penetrations.
- B. Fire stop materials, assemblies and installations shall be approved by Factory Mutual and shall be as published in the latest edition of the Underwriters Laboratories Fire Resistive Directory. Firestop Systems provided shall be acceptable to the Authority Having Jurisdiction.

- C. Penetration seal methods and materials shall have an Underwriters Laboratories fire rating equal to the wall or floor in which the openings are located. The penetration seal must allow future changes, such as addition or removal of cables, with no damage to the integrity of the seal. If the wall or floor penetration is for cable tray passage, the fire stop material shall have been tested by Underwriters Laboratories for use with both galvanized steel and/or aluminum cable tray. The penetration seal shall be unaffected by atmospheric conditions, water exposure, or constant high humidity. The fire seal shall be installed strictly according to the manufacturer/distributor published instruction.
- D. Unless otherwise submitted by the Contractor and approved by the Contracting Agency, floor through penetration assemblies shall consist of reusable frame-type multi-cable transit assemblies. Cable tray shall stop at or near the upper and lower surfaces of the floor assembly and a blocked out opening shall be provided for cable transit assembly. Separate grooved insert modules constructed of fire stop material shall be provided for each cable, sized for the cable diameter, and inserted into a bolted down compression frame.
- E. Equipment: STI EZ Path Fire Rated Pathway, or as approved.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Proceed with the installation only after Shop Drawings are approved by the Contracting Agency. If the Contractor proceeds without approval, relocation as directed by the Contracting Agency shall be at the Contractor's expense.
- B. Install pathways level, straight and true to building lines, unless otherwise noted on Drawings or required due to structural considerations or obstructions.
- C. Cable tray clearances:
 - 1. Maintain 12 inches minimum clearance above top of cable tray. Maintain 3 inches minimum clearance between top surface of ceiling tiles and lowest point on cable tray or cable tray support assembly. Maintain 6 inches minimum clearance to all sides of tray unless tray is placed at a height which requires greater clearance for workers to gain safe, convenient access to tray. Coordinate layout with work of other trades in advance of installation to provide required access with minimum number of offsets in cable tray runs.
- D. If during construction as-built conditions occur, such that cable tray becomes inaccessible for any reason, submit immediately to the Contracting Agency:
 - 1. The type and location of the obstruction, including the trades involved.
 - 2. The means proposed to maintain accessibility.
- E. Install cable tray in an accessible location, visible from the floor, with minimum length hanger rods to avoid cable tray tilting under eccentric loads. If tray tilts at any location, provide 1-1/2

inch pipe in compression over hanger rods, a bar stiffener at hanger rods, or other manufacturer recommended anti-tilt method of mounting tray. Provide stiffener bar at every other support, or in accordance with manufacturer's recommendations.

- F. Install and support cable tray systems in accordance with span load criteria, assuming 110% of maximum allowable cable-fill regardless of the number of cables installed under this Contract.
- G. Install cable tray to prevent sharp 90 degree bends in cables in any direction. Rises and drops shall be radiused, tees and crosses shall be flared or have radius fittings at junction points.
- H. Seismic supports and bracing shall be in accordance with Section 26 05 29 - Hangers and Supports for Electrical Systems and the manufacturer's engineered solution for the project's seismic zone.
- I. Center hung supports and center support tubes shall run full length of the rod to the structure. Tighten rod to place assembly in tension. Center supports suspended by rods shall have sufficient protective tubing over exposed all thread to protect the cable insulation from abrasion.
- J. Cable tray arranged in vertical configuration for rises and drops shall have standoff support from the wall or structural support surface the facilitate installation of cable support ties. Secure cables in trays with cable ties in accordance with the manufacturer's recommendations.
- K. Unless otherwise noted on the Drawings or allowed in the Specifications, above ceiling cable tray installations shall meet the following conditions:
 - 1. Cable trays shall not be installed in inaccessible ceiling areas such as those with lock-in type ceiling tiles.
 - 2. Cable trays shall not be installed above lay-in type ceilings at a finished height greater than 11 feet above finished floor.
- L. Unless otherwise noted on the Drawings, install cable tray and accessories to provide electrical continuity throughout system. Provide grounding and bonding straps to maintain electrical continuity at discontinuous connections.
- M. Follow manufacturer's instructions and details for separation of dissimilar metals including steel suspension rod to aluminum splice connectors or cable tray. Provide nylon bushings at joints, vinyl sleeve at hanger rods.
- N. Conduit Entries:
 - 1. Open Cable Tray: Conduits entering open cable trays shall terminate above the tray, within 3 inches laterally and 2 inches vertically of the top of the side rail. Conduits shall be bushed and supported within 6 inches of the termination. Provide a bonding connection from the conduit to the tray system.

- O. Coordinate installation of cable tray with cable installers for purposes of symmetric cable loading, supplemental bracing in cases where cable loading will be asymmetric, periodic tie down of cables, and division of tray to maintain required separation of systems.

END OF SECTION 26 05 36

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide identification of on all equipment, raceways, boxes and conductors.
- B. Section includes:
 - 1. Nameplates
 - 2. Labels
 - 3. Wire markers
 - 4. Conduit markers
 - 5. Miscellaneous Electrical Identification
- C. Related Sections: Divisions 26, 27 and 28 Sections.

1.2 SUBMITTALS

- A. Division 1 and Section 26 00 00 – Electrical General Requirements.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Electrical Distribution Equipment Labels and Nameplates
 - 1. Name equipment in accordance with Contract Documents.
 - 2. Nameplates shall be laminated plastic, 0.125 inch thick, with matte finish and square corners. Minimum lettering size as noted elsewhere in this section.

- a. Label and Nameplate Colors:

Normal Equipment: White letters on a black background.
 - b. Securely attach labels with threaded fasteners or pop-rivets. Adhesive attachment not acceptable.
 - c. Temporary markings not permitted on equipment. Repaint trims, housings, etc., where markings cannot be readily removed. Refinish defaced finishes.
3. Include item designation and branch circuit designation (panel and circuit number) on disconnects, starters, equipment and device nameplates, e.g., "FAN No. 4, Circuit LA-30").

2.2 WIRE AND CABLE MARKERS

- A. Wire and Cable Markers: Wrap on labels, cloth tape type wire markers or tubing type for all phase, neutral and ground conductors.

2.3 LABELS

- A. Adhesive film label with clear protective overlay: Machine printed, in black, by thermal transfer process or equivalent. Minimum lettering size as noted elsewhere in this section. Overlay shall provide a weatherproof and UV resistant seal for label.

2.4 POWER ONE-LINE DIAGRAM

- A. Laminated, approved print of the "As-Built" power distribution system. Install in accordance with Part 3.

PART 3 - EXECUTION

3.1 NAMEPLATE INSTALLATION

- A. Install nameplate parallel to equipment lines.
- B. Mechanically fasten nameplates using threaded fasteners or pop rivets.
- C. Mechanical fasteners shall have no sharp edges or points which can damage conductors or injure personnel.
- D. Temporary markings are not permitted on equipment. Repaint trims, housings, etc., where markings cannot be readily removed. Refinish defaced finishes.
- E. No labeling abbreviations are permitted without prior approval.

3.2 BRANCH AND DISTRIBUTION PANELBOARD NAMEPLATES

A. Nameplate shall contain the following information (minimum ½ inch height letters):

1. Line 1: Panel Name as noted on drawings and schedules.
2. Line 2: Voltage and Phase.
3. Line 3: Source from which panel is fed, "FED FROM: PANEL NH031".

3.3 NAMEPLATE LOCATIONS

A. Provide 1 inch minimum height letters on following equipment:

1. Service disconnect(s) (red background). Provide signage in accordance with Municipality of Anchorage Policy E.04.
 - a. Enclosures containing multiple service disconnects for utility power must clearly identify each switch as a service disconnect along with the load served.

B. Provide 1/2 inch minimum height letters on following equipment:

1. Service equipment Fault Current: Provide signage in accordance with NEC indicating maximum available fault current and date of fault current calculation.
2. Secondary feeder breakers in distribution equipment. Designation as required by load served.
3. Special equipment housed in cabinets, as designated on plans, on outside of door.
4. Equipment housed in equipment cabinets, as designated on plans, on inside of cabinet door.
5. Switchboards, motor control centers, transformers, as designated on plans, on outside of door or equipment.
6. Control or low voltage system panels such as Fire Alarm, Security, Video Surveillance, etc., with the following information:
 - a. Line 1: Unique panel name as shown on the shop drawings.
 - b. Line 2: System description such as Fire Alarm, Security, etc.
 - c. Line 3: Panelboard and circuit number from which the panel is fed if applicable.

C. Provide 1/4 inch minimum height letters on:

1. Disconnects, starters, VFDs and contactors:
 - a. Line 1: Load Served (Use nameplate designation for source).

- b. Line 2: Panelboard and circuit number from which the device is fed.
 - c. Line 3: Voltage, Phase, fuse size or circuit breaker size.
- 2. Lighting control relays, dimmer controls and remote lighting control equipment.
- 3. Switches and receptacles where item controlled is not visible from the switch, or as noted on Drawings.
- 4. External Power Sources: Provide 1/4 inch white letters on red background on all starters or controllers that receive power from an external source that is not de-energized by operating the associated disconnecting means.
- 5. Designated electrical equipment.

3.4 RECEPTACLE AND LIGHT SWITCH DEVICE PLATES

- A. Provide 3/16 inch minimum height letters on receptacle and light switch device plates:
 - 1. Provide adhesive label (black letter on clear background) indicating branch circuit designation (panel and circuit number) on receptacle and light switch device plates, e.g., "NPA-30"). Labels shall be printed not hand written.

3.5 TELECOMMUNICATION LABELING REQUIREMENTS.

- A. Provide machine printed labels for all telecommunication racks, cabinets, patch panels, cables, outlets, etc., in accordance with ANSI/TIA/EIA-606-B. Provide labeling nomenclature in accordance with information on the Drawings or Owner's labeling conventions. Submit labeling samples for all required applications.
- B. Machine Printed Label Requirements:
 - 1. PC Compatible.
 - 2. Can save and modify files.
 - 3. Fully integrated with AutoCAD.
 - 4. Editable Fonts and Sizes.
 - 5. Rotate Text and Objects.
 - 6. Vary Line Spacing.
 - 7. Ability to import graphical images.
 - 8. Capable for customization of layout.
 - 9. Re-positional labels.

C. Basis of Design:

1. Brady Electrical/Datacomm Worldwide (latest version of LabelMark).
2. Cable Management Software International (latest version of docIT).
3. Approved alternate.

D. Labeling and color coding identification for this project shall conform to TIA/EIA-606-B for a Class 1 Administrative System.

3.6 LABEL LOCATIONS

A. Provide 3/16 inch minimum height letters on the following equipment:

1. Fire Alarm Device Labels:
 - a. Provide label on exterior surface of each initiating device denoting the unique device address corresponding to the text annunciator description. For detectors, the label shall be affixed to the base and not to the detector itself. For pull stations, the label shall be affixed to the top of the device and not to the vandal proof cover.
 - b. Provide label on each remote test station indicating description and location of device being tested.
 - c. Provide label on telecom conductors at each end denoting FACP lines for use with the digital alarm communicator transmitter (DACT).

3.7 BRANCH CIRCUIT PANELBOARD CIRCUIT LABELING

- A. Branch Circuit Panelboard Directories: Provide neatly typed schedule (odd numbered circuits on left side or top, even on right side or bottom) under plastic jacket or protective cover to protect the schedule from damage or dirt. Securely mount on inside face of panelboard door. Define briefly, but accurately, nature of connected load (i.e., Lighting Room 201, Receptacles Janitor Room 155, Etc.) as approved. Sequentially numbered schedules shall not be used.
- B. Use final approved room numbers from finished construction (not necessarily as indicated on the drawings).
- C. Provide numbering for terminals on terminal strips in the terminal enclosure that identifies the origin, function and destination of each conductor.
- D. Install wire marker for each conductor inside panelboards (phase, neutral and ground conductors). Locate label within 6 inches of termination. Labels shall be visible with panel dead front installed.
- E. Dedicated branch circuit(s) feeding fire alarm control unit(s) shall be identified as "FIRE ALARM CIRCUIT" in accordance with NFPA 72. The circuit disconnecting means shall be identified with red marking.

- F. Provide updated circuit directory in existing panelboards that are modified. Install directory in panelboard in protective cover and submit electronically in the O&M Manual.

3.8 WIRE MARKER INSTALLATION

- A. Install wire marker for each conductor (phase, neutral and ground conductors) at panelboards, pull boxes, outlet and junction boxes, and each load connection. Locate label within 6 inches of termination in panelboards. Labels shall be visible with panel dead front installed.
- B. Wire markers are not required on conductors in a pull or junction box that contains only an individual branch circuit, however, source panel and circuit number shall be noted on pull or junction box cover as noted elsewhere in this section.
- C. Fire Alarm Circuits: Provide cable markers showing Notification Appliance Circuit (NAC) or Signaling Line Circuit (SLC) loop identification number at fire alarm junction boxes and pullboxes.
- D. Security System Cables: Install wire marker for each cable at cabinets, pull boxes, junction boxes, and each load connection. Wire ID number shall be as shown on security system shop drawings.
- E. Power Circuits: Panelboard name and branch circuit or feeder number.
- F. Control Circuits: Control wire number as indicated on schematic and/or shop drawings.
- G. Color Code:
 - 1. Color code phases, neutral, and ground per NEC requirements and Section 26 05 19 – Wire and Cable.
 - 2. Color code all low voltage system wiring in accordance with applicable Sections.

3.9 MISCELLANEOUS ELECTRICAL IDENTIFICATION

- A. System junction boxes: Color code raceway system junction boxes (except those in finished areas) by spray paint as follows:
 - 1. Fire Alarm – Red.
 - 2. Telecom/Video Surveillance – Blue.
 - 3. 208Y/120 Volt Power – White.
 - 4. Building Automation System (BAS) – Green
- B. Junction Boxes: Mark the circuit number(s) and panel source of wiring on all junction boxes with sheet steel covers. Mark with indelible black marker. On exposed junction boxes in finished areas mark on inside of cover.
- C. Conduits

1. Mark all conduits entering or leaving panelboards with indelible black magic marker with the circuit numbers of the circuits contained inside.
 2. Fire Alarm System: Paint fire alarm conduits with a 6 inch band 10 feet on center with red paint where installed in concealed accessible location (or provide red conduit in accordance with Section 26 05 19 – Low Voltage Electrical Power Conductors and Cables and Section 26 05 33 – Raceways and Boxes for Electrical Systems. Where raceway is installed in exposed locations it shall be painted to match the adjacent surface.
 3. Empty Conduits: Provide tags with typed description of purpose, and location of opposite end, wired to each end of conduits.
- D. Junction Boxes
1. Markings shall be made with indelible black marker.
 2. On exposed junction boxes in finished areas markings shall be on inside of cover.
 3. Mark the circuit numbers of wiring on all junction boxes with sheet steel covers.
 4. Mark all Special System junction boxes with sheet steel covers with appropriate system designation, e.g., "Intercom", "Clock", "Telecom", "Video Surveillance", etc. Fire Alarm System: Paint all fire alarm junction boxes inside and out with red paint where installed in concealed accessible location. Where installed in exposed locations paint boxes to match the adjacent surface.
- E. One-Line Diagram: Mount behind protective cover (1/8-inch minimum thickness clear Plexiglas) in accessible location at main switchboard.
- F. Exterior underground power, control, signal and communications lines.
1. Install continuous underground plastic line marker located directly above line at 6 to 8 inches below finished grade. Where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches provide additional markers.
 2. Install markers for both direct buried and conduit encased conductors.
 3. Label each underground conductor with its circuit number or identification tag.
- G. Provide a label at the fire alarm control panel that identifies the panelboard and circuit number that supplies the control panel. Provide a red label adjacent to the circuit breaker inside the panelboard that clearly identifies the circuit breaker that feeds the control panel in accordance with NFPA requirements.

3.10 CODE REQUIRED MARKINGS AND WARNINGS:

- A. Provide all placards, markings and identification systems required by Code and/or the Contract Documents, such as (but not limited to):
 - 1. Arc Flash.
 - 2. Series Rated Systems.
 - 3. Conductor insulation color identification.
 - 4. Special conductor identification and legends.
 - 5. Multiple services placards.
 - 6. Warning messages shall include an appropriate plain language imperative command, such as "DANGER HIGH VOLTAGE - KEEP OUT".
 - 7. Available Fault Current: Service equipment shall be legibly marked in the field with the maximum available fault current. The field marking(s) shall include the date the fault calculation was performed and shall be of sufficient durability to withstand the environment involved.

3.11 CLEARANCE STRIPING

- A. For electrical equipment located in areas with uncarpeted floors, the clearances dictated by NEC Article 110 shall be indicated by two inches wide colored striping on the floor.
- B. Striping shall be of a bright color (typically red or yellow) that contrasts with the floor color, and shall be applied by the most durable process that is commercially available for the particular floor finish. Examples are: epoxy paint on concrete floors, and colored tile segments in composition tile floors. Striping color and method shall be subject to approval by the Contracting Agency.
- C. On the floor immediately inside the striping, stencil in two inch block letters the statement: "ELECTRICAL CLEARANCE – NO STORAGE." For floor types where painted stenciling is not feasible or sufficiently durable, this message shall instead be posted on the wall below the equipment as an engraved nameplate of the type specified in this Section, with 1/2-inch lettering. Note the specific clearance requirements on the engraved nameplate.

END OF SECTION 26 05 53

SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general provisions, products, and methods of execution relating to branch circuit panelboards approved for use on this project. Type, size, ratings, etc., shall be as shown on the plans and in accordance with UL Standards 50 and 67.
- B. Related Sections:
 - 1. 26 05 26 – Grounding and Bonding for Electrical Systems
 - 2. 26 05 53 – Identification for Electrical Systems
 - 3. 26 28 00 – Low Voltage Circuit Protective Devices
 - 4. 26 43 00 – Surge Protective Devices

1.2 SPECIAL REQUIREMENTS

- A. Special features such as integral surge protective devices (SPDs), etc., shall be provided as required by this Section and as noted on the Drawings or on the panel schedules.
- B. Trims shall be furnished to be compatible with type of mounting.

1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.
- B. Submit for approval manufacturer's shop drawings to show weights, dimensions, mounting arrangements, interconnecting diagrams, schedules of overcurrent devices, voltage ratings, and specified accessories.

1.4 QUALITY ASSURANCE

- A. The panelboards shall be of the latest approved design as manufactured by a nationally recognized manufacturer and shall be listed by the Underwriters' Laboratory and shall bear the UL label.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

- A. The Basis of Design is equipment from Square D Company to set a standard for quality. Equipment from Cutler-Hammer, Siemens Energy & Automation, General Electric, or alternative systems will be considered providing that sufficient documentation is provided to satisfy the CONTRACTING AGENCY that the equipment meets the requirements of the Specifications, and matches the Basis of Design on all points which are pertinent to the Project.

2.2 CABINETS AND FRONTS

- A. Panelboard assembly shall be enclosed in a steel cabinet. Fronts shall include doors and have flush, brushed stainless steel, cylinder tumbler type locks with catches and spring-loaded door pulls. All panelboard locks shall be keyed alike. Fronts shall have adjustable, indicating trim clamps that shall be completely concealed when the doors are closed. Doors shall be mounted by completely concealed steel hinges. Fronts shall not be removable with door in the locked position. A circuit directory frame and card with a clear plastic covering shall be provided on the inside of the door. The directory card shall provide a space at least 1/4 inch high by 3 inch long or equivalent for each circuit. The directory shall be typed to identify the load fed by each circuit. Fronts shall be of code gauge, full finished steel with rust inhibiting primer and baked enamel finish. Cabinets shall be labeled in accordance with the Drawings and Section 26 00 00 - Electrical General Requirements.

2.3 SAFETY BARRIERS

- A. The panelboard interior assembly shall be dead front with panelboard front removed.

2.4 BUS ASSEMBLY

- A. Panelboard bus structure and main lugs or main breaker shall have current ratings as shown on the panelboard schedule. Bus structure shall allow 1, 2 and 3-pole breakers of various frame sizes to be mounted in any location and in any combination up to the capability of the panel.

2.5 SHORT CIRCUIT CURRENT RATING

- A. Each panelboard, as a complete unit, shall have a short circuit current rating (SCCR) equal to or greater than that shown on the panelboard schedule, or as necessary to comply with the requirements stated on the power one-line diagram. The SCCR rating shall not, in any case, be less than 10,000 Amps at 240 volts.

2.6 PROTECTION DEVICES

- A. Circuit breakers shall individually comply with Section 26 28 00 – Low Voltage Circuit Protective Devices. The type to be furnished shall be as shown on the plans. If no withstand rating is specified, minimum requirements shall be as necessary to comply with the preceding requirements.

2.7 NEUTRAL TERMINAL BAR

- A. Panelboards shall be equipped with an insulated neutral terminal bar.
- B. Panelboards with integral SPDs as noted on the Drawings or further specified shall be equipped with 200% rated neutrals and neutral lugs and shall be U.L. Listed as suitable for non-linear loads.

2.8 EQUIPMENT GROUNDING TERMINAL BAR

- A. Panelboards shall be equipped with an equipment grounding terminal bar to terminate equipment grounding conductors.

2.9 HANDLE LOCK-OFF EQUIPMENT

- A. Circuit breakers serving as the required disconnecting means for appliances or other equipment shall be equipped with equipment to allow the breaker to be padlocked in the "off" position.

2.10 INTEGRAL TRANSIENT VOLTAGE SUPPRESSION

- A. Provide panelboards with integral Surge Protective Devices (SPDs) as noted on the panel schedules or drawings in accordance with Specification Section 26 43 00 – Surge Protective Devices.
- B. Integral SPDs shall be factory installed in the panelboard.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify mounting arrangements for each location shown on the plans. Where cabinets are recessed, verify adequate thickness of wall and make arrangements for furring or trim as required. In general, conduits shall enter the top or bottom of panel.
- B. Provide additional wire gutters or pull boxes to facilitate orderly entry of conduits into cabinets. Bundle and support wires and arrange them in an orderly manner in the designated wire gutters.
- C. Panelboards shall not be used for pull boxes for wiring not terminating in the panelboard.

3.2 SPARE CONDUITS

- A. Provide spare conduits from flush mounted panels into accessible ceiling or floor spaces as follows:

No. of Poles (Spares + Spaces)	Spare Conduits
1 - 3	One 3/4 inch
4 - 6	Two 3/4 inch
7 or more	Two 3/4 inch, One 1 inch

3.3 PANELBOARD LABELS

- A. In addition to applicable NEC requirements for emergency systems, series rated applications, etc., label panelboards in accordance with Section 26 05 53 – Identification for Electrical Systems.
1. First line shall be panelboard name.
 2. Second line shall be voltage and phase.
 3. Third line shall be source from which panel is fed, "FED FROM: PANEL NH031".

END OF SECTION 26 24 16

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general provisions, products and methods of execution relating to line voltage wiring devices for use on this project.
- B. Related Sections
 - 1. 26 05 33 – Raceway and Boxes for Electrical Systems
 - 2. 265561 - Networked Lighting Control System

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.
- B. Do not place order for devices, plates, etc., without ensuring that the Contracting Agency has positively approved submittals for the specific colors necessary for all applications and locations. Note that the selection of one color for general use does not rule out the selection of other colors for special applications or for aesthetic reasons.

1.4 QUALITY ASSURANCE

- A. Manufacturers mentioned and catalog numbers specified are for establishment of type, configuration and quality. Other manufacturers and types may be submitted for approval.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Catalog numbers shown are Hubbell unless noted otherwise. Equal devices manufactured by Arrow Hart (by Cooper Wiring Devices), Pass and Seymour, Leviton and Bryant are acceptable. Provide all similar devices of same manufacturer.

2.2 SWITCHES

- A. Provide 20 AMP, 120V rated switches with UL listing for tungsten lamp loads or inductive loads without derating. Switches shall be as follows:

	20A Rated Switches
Single Pole	CAT. NO. 1221
Three-way	CAT. NO. 1223
Four-way	CAT. NO. 1224
Key Operated	CAT. NO. HBL1221-L
Momentary Cont.	CAT. NO. HBL1557
Double Pole	CAT. NO. 1222
Pilot Switch	CAT. NO. HBL1221-PL

- B. Other switch types shall be provided as called for on the Drawings or as required by the application.

2.3 RECEPTACLES

- A. Provide grounding type receptacles as follows, or as required to match equipment furnished in this or other divisions.

Single Phase, 3-Wire Devices		
20A-125V	CAT. NO. HBL 5362	NEMA #5-20R
20A-125V GFCI	CAT. NO. HBL GF-20LA	NEMA #5-20R
20A-125V Tamper Resistant	CAT NO. HBL 8300SG	NEMA #5-20R
20A-250V Single	CAT. NO. HBL 5461	NEMA #6-20R

- B. Outlets requiring ratings and configurations different from those listed above shall be provided as shown on the plans and/or required by the equipment served.

2.4 DEVICE COLOR

- A. Device color shall be white as approved by the Architect, unless otherwise noted. Submit device color for review. Receptacle and switch device color shall match telecom jack/outlet color.

2.5 DEVICE PLATES

- A. Device plates shall be made of stainless steel unless otherwise noted.
- B. Indoor device plates for surface mounted boxes shall be stainless or galvanized steel, with design to match the box and device type being used.
- C. Weatherproof outlet plates shall be of the safety outlet enclosure type that can be closed to remain weatherproof while in use. The outlet cover/enclosure shall be clearly marked "Suitable for Wet Locations While In Use" and "UL Listed". A gasket shall be provided between the enclosure and the mounting surface, and between the hinged cover and the mounting plate/base to ensure a proper seal. Enclosure shall be oversized depth, single-gang, vertical-mount, with non-locking latch, GFCI opening, cord openings, and cover; TayMac; Specification Grade or approved equal.
- D. Label receptacle and light switch plates in accordance with Section 26 05 53 – Identification for Electrical Systems.

2.6 PHOTOCELLS

- A. Outdoor Photocells
 - 1. Basis of design is Intermatic K4236C Stem and Swivel Mounting Photocell.
 - 2. Photocell shall have minimum of 2400 V open type spark gap arrestor to protect against voltage surges.
 - 3. Photocell shall be weatherproof or be provided with weatherproof case.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install wiring devices indicated complete with cover plates. Cover plates shall fit snugly against finished surfaces and line up true with adjacent building lines, and be symmetrical in location and appearance.
- B. Switches shall be installed so their handles move in a vertical plane.
- C. Door swings shall be checked and, if necessary, switches shall be relocated to place them on the strike side of the door.

- D. Unless otherwise noted on the drawings, receptacles shall be installed in the vertical position with the grounding pin down unless wording on the face of the device requires other mounting.
- E. Receptacles identified as Ground-Fault Circuit Interrupter (GFCI) type shall be provided as individual GFCI receptacles.

END OF SECTION 26 27 26

SECTION 26 28 00

LOW VOLTAGE CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Thermal Magnetic Molded Case Circuit Breakers.
2. Fusible switches and fuses.

B. Related Sections:

1. 26 24 16 – Panelboards
2. 26 43 00 – Surge Protective Devices

1.2 REFERENCES

A. The circuit breaker(s) referenced herein shall be designed and manufactured according to the latest revision of the following standards.

1. ANSI/NFPA 70 - National Electrical Code (NEC).
2. NEMA AB 1 - (National Electrical Manufacturers Association) Molded Case Circuit Breakers and Molded Case Switches.
3. UL 489 - (Underwriters Laboratories Inc.) Molded Case Circuit Breakers and Circuit Breaker Enclosures.
4. UL 943 - Standard for Ground Fault Circuit Interrupters.
5. UL 1053 – Ground Fault Sensing and Relaying Equipment.
6. CSA C22.2 No. 5 - (Canadian Standard Association) Molded Case Circuit Breakers, Molded Case Switches and Circuit Breaker Enclosures.
7. Federal Specification W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
8. Federal Specification W-C-865 - Fusible Switches.
9. IEC 60947 – Low Voltage Switchgear and Control Gear – Part 2: Circuit Breakers.

10. IEC 61000-4 Series – Electromagnetic Compatibility.

1.3 SYSTEM DESCRIPTION

- A. Provide overcurrent protective devices as specified herein and as shown on schedules and/or drawings.

1.4 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.
- B. Product Data: Submit product data showing material proposed. Submit sufficient information to determine compliance with the Drawings and Specifications. Submit product data for each type of overcurrent protective device, ground fault protector, accessory, and component indicated. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
- C. Provide outline drawings with dimensions, and ratings for voltage, amperage and maximum interruption. Include instructions for circuit breaker mounting, trip unit functions and adjustments, trouble shooting, accessories and wiring diagrams.
- D. Coordination data to check protective devices: Manufacturer shall provide electronic and hard copy time/current characteristic trip curves (and I_p & I^2t let through curves for current limiting circuit breakers) for each type of circuit breaker.
- E. Provide information required to verify compliance with the short circuit withstand and interrupting ratings, as shown on the Drawings or further stated in these Specifications.

1.5 QUALITY ASSURANCE

- A. Devices shall be the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with applicable standards and UL listings.
- B. Nationally Recognized Testing Laboratory (NRTL) Labeling: Electrical equipment and conductors installed in the State of Alaska must be "Approved," "Certified," "Identified," or "Listed" and "Labeled" to establish that the electrical equipment is safe, free of electrical shock and fire hazard, and suitable for the purpose for which it is intended to be used. The manufacturer shall have the specific authorization of one of the Occupational Safety and Health Administration (OSHA) approved Nationally Recognized Testing Laboratories (NRTLs) in accordance with the applicable national standards to label the equipment as suitable.
- C. The overcurrent protection device manufacturing facility shall be Registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9000 Series Standards for quality.

PART 2 - PRODUCTS

2.1 PRODUCT

- A. The Basis of Design is equipment from Square D by Schneider Electric to set a standard for quality. Equipment from Cutler-Hammer, Seimens Energy & Automation, General Electric, or alternative systems will be considered providing that sufficient documentation is provided to the Contracting Agency that the equipment meets the requirements of the Specifications, and matches the Basis of Design on all points that are pertinent to the Project.

2.2 MOLDED CASE CIRCUIT BREAKERS

A. General Characteristics:

1. 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.
2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which shall provide quick make, quick break contact action. The circuit breaker shall have common tripping of all poles.
3. The circuit breaker handle shall 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.
4. 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.
5. Each circuit breaker shall be equipped 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 (except Type QO/EDB/EGB/EJB).
6. MCCBs shall be able to receive a device for locking in the isolated position. MCCBs that serve as the main service disconnect shall be provided with a device for locking in the isolated position.
7. Electronic components shall withstand temperatures up to 221°F (105°C).
8. Circuit breakers shall be UL listed to accept field installable/removable mechanical type lugs (except Type (except Type QO/EDB/EGB/EJB/QB/QD/QG/QJ).
9. Lugs shall be UL listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 75°C rated wire or 90 C rated wire, sized according to the 167°F (75°C) temperature rating in the NEC.

B. Trip Unit:

1. General:
 - a. MCCBs with ratings up to 400 amperes shall be equipped with thermal magnetic trip units.
 - b. Circuit breakers with permanent trip units shall be UL listed for reverse connection without restrictive line and load markings and shall be suitable for mounting in any position.
 - c. The trip units shall not augment overall circuit breaker volume.
2. Thermal Magnetic (400 Ampere Frame and Below):
 - a. Basis of Design: PowerPact Q, H and J Frame, FA, LA, and LH as manufactured by Square D by Schneider Electric.
 - 1). General:
 - a) Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 104 F (40 C) ambient temperature. Circuit breaker frame sizes above 150 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker
 - 2). Type QO (for use in NQ Series Panelboards) and Type EDB/EGB/EJB (for use in NF Series Panelboards) as manufactured by Square D by Schneider Electric.
 - a) Breakers shall have two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP® indicator appearing in the clear window of the circuit breaker housing.
 - 3). Where indicated on drawings, Circuit breakers shall be equipped with a ground fault module (GFM) with 20 ampere to 200 ampere sensitivity level or earth leakage module (ELM) with sensitivity ranges between 30 mA and 3 amperes, or approved equal.

C. Accessories:

1. General:
 - a. Circuit breakers shall be equipped with UL listed electrical accessories as noted on the Drawings or schedules or they may be field installable.
2. Electrical Auxiliaries: Electrical auxiliaries, such as voltage releases (shunt and undervoltage releases) and indication switches as follows:
 - a. The addition of auxiliaries shall not increase the volume of the circuit breaker.

- b. Same field installable auxiliary contacts for signaling different functions, such as open/ closed position, fault signal, electrical fault (including electrical leakage) signal. Auxiliaries shall be common for the entire range,
 - c. Electrical auxiliaries shall be separated from power circuits,
 - d. Electrical auxiliaries shall be of the snap in type and fitted with terminal blocks,
 - e. Electrical auxiliary function and terminals shall be permanently engraved on the case of the circuit breaker and the auxiliary itself.
3. Handle Accessories:
- a. Provide circuit breaker handle accessories required for locking handle in the on and off position.

2.3 FUSIBLE SWITCHES

A. Fusible Devices

1. Fused Power Circuit Devices
- a. Individually fixed mounted bolted pressure switches through 4000 A.
 - b. Each device shall have power terminals to accommodate either cable or bolted bus connections.
 - c. The over current protective devices shall be of the fusible bolted pressure contact type as shown on the associated drawings.
 - d. Switches, with Class L fuse installed, shall be rated for use on systems capable of delivering not more than 200,000 rms symmetrical amperes at 600 VAC maximum. Switches shall have an interrupting rating of 12 times continuous ampere rating at 240, 480, and 600 VAC. Switches shall be 100% rated devices. Lugs shall be rated for use with 90° C wire insulation (sized according to the 75° C temperature rating in the NEC).
 - e. Switches shall have switch blades which are fully visible in the Open (off) position when the fuse access door is open. Bolted pressure contacts shall be made by providing an additional pressure or clamping action at both ends of the switch blade when the blades are fully closed. Switches having butt-type contacts are not acceptable.
 - f. Manual operated switches shall have quick-make, quick-break front operating mechanisms.
 - g. Provisions for locking the switch in the Open (off) and On (open) position with at least three padlocks shall be provided. Switches shall have dual fuse door interlock designed to prevent the fuse access door from being opened when the switch is Closed (on) and prevents the switch being turned ON while the fuse access door is

open. A means of bypassing the interlock by authorized personnel shall be provided to allow the switch to be inspected in the Closed position.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Installation shall be in accordance with reviewed product data, final shop drawings, manufacturer's written recommendations, and as indicated on the Drawings. Install circuit breakers in accordance with manufacturer's instructions, the National Electrical Code and applicable local codes.
- B. Size devices as shown and specified, or as required by the load being served.

3.2 ADJUSTMENTS

- A. Circuit breaker settings shall be adjusted to values as recommended by the manufacturer.

END OF SECTION 26 28 00

SECTION 26 28 16

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general requirements, products, and methods of execution relating to fusible and non-fusible disconnecting devices approved for use on this project.
- B. Related Sections:
 - 1. 26 05 19 – Low Voltage Electrical Power Conductors and Cables
 - 2. 26 05 26 – Grounding and Bonding for Electrical Systems
 - 3. 26 05 29 – Hangars and Supports for Electrical Systems
 - 4. 26 05 53 – Identification for Electrical Systems

1.2 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.

1.3 QUALITY ASSURANCE

- A. Devices shall be of the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with U.L. listings and the governing NEMA standards.
- B. Disconnects shall be of the same manufacturer as switchboards and panelboards.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

- A. Safety switches, fusible and non-fusible, shall conform to NEMA Standard KS1 for type HD (Heavy Duty) unless otherwise noted.
 - 1. Switch Interior: Switches shall have switch blades that are fully visible in the OFF position when the door is open. Switches shall be of dead front construction with permanently attached arc suppressers. Lugs shall be UL listed for copper and/or aluminum cables and be front removable.

2. Switch Mechanism: Switches shall have a quick-make and quick-break operating handle and mechanism that shall be an integral part of the box, not the cover. Switches shall have a defeatable dual cover interlock to prevent unauthorized opening of the switch door in the ON position or closing of the switch mechanism with the door open. The switch shall be capable of being locked in the OFF position with three (3) padlocks.
3. Enclosures: Switch enclosure shall be suitable for the environment in which the switch is mounted. NEMA 1 enclosure shall be code gauge, UL-98, sheet steel, treated with a rust inhibiting phosphate and finished in gray, baked enamel. NEMA 3R enclosure--same requirements as NEMA 1 except galvanized prior to painting.
4. Rating: Ampere, volt and horsepower ratings, as well as number of poles and presence of neutral bar shall be shown on the nameplate.

2.2 CIRCUIT BREAKERS

- A. Circuit breakers used as disconnects shall meet requirements specified in Section 26 28 00 – Low Voltage Circuit Protective Devices. Enclosures for same shall meet the requirements as specified above.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate details pertaining to size of motor and/or equipment, location and requirements to enclosure, ratings, etc., so as to provide the most suitable unit for the intended purpose.
- B. Provide nameplates for disconnects. Coordinate names with mechanical equipment lists.
- C. Where the rating of a fused disconnect exceeds the ampacity of the conductors being protected, a permanent label noting maximum fuse size shall be installed in a conspicuous location within the switch.
- D. Where recommended or required by the equipment manufacturer, or required by underwriters' laboratories, disconnects shall be the fusible type, fused in accordance with the equipment nameplate information.
- E. Provide code required disconnects. For equipment under the jurisdiction of the IMC, provide a disconnect within sight of the equipment.

END OF SECTION 26 28 16

SECTION 26 29 00

LOW VOLTAGE CONTROLLERS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes general requirements, products, and methods of execution relating to manual and magnetic motor starters provided in this and other Divisions. Overloads shall be furnished and installed in Divisions 26, 27 and 28.
- B. Related Sections:
 - 1. 26 05 53 – Identification for Electrical Systems

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA ICS 6 - Industrial Control and Systems: Enclosures.
 - 6. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. B. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.

1.4 QUALITY ASSURANCE

- A. Equipment shall be of the latest approved design as manufactured by a nationally recognized manufacturer and in conformity with the governing standards.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

- A. The Basis of Design is equipment from Square D by Schneider Electric to set a standard for quality. Equipment from alternative systems will be considered providing that sufficient documentation is provided to satisfy the CONTRACTING AGENCY that the equipment meets the requirements of the Specifications, and matches the Basis of Design on all points which are pertinent to the Project.

2.2 AC FRACTIONAL MANUAL STARTERS

- A. The manual starter shall consist of a manually operated toggle switch equipped with red pilot light and melting alloy type thermal overload relay.
- B. Thermal unit shall be one piece construction and interchangeable. Starter shall be inoperative if thermal unit is removed.

2.3 AC MANUAL STARTERS--LINE VOLTAGE TYPE

- A. Manual starters shall be constructed and tested in accordance with the latest published NEMA standards.
- B. The manual starters shall consist of a manually operated switch equipped with red pilot light and melting alloy type thermal overload relays in every phase conductor. Thermal units shall be one piece construction and the starter shall be inoperative if any thermal unit is removed.
- C. Starters shall be furnished in a NEMA 1 general purpose enclosure unless otherwise indicated on the plans or required by the conditions of the area in which they are installed.

2.4 AC MAGNETIC STARTERS--LINE VOLTAGE TYPE

- A. Motor starters shall be across-the-line magnetic type rated in accordance with NEMA standards, sizes and horsepower ratings.
- B. Starters shall be mounted in NEMA 1 general purpose enclosures unless otherwise indicated on plans or required by the conditions of the area in which they are installed.
- C. Starters shall be furnished with overload relays in every phase conductor and starters shall be inoperative if any overload unit is removed.

1. Overload relays shall be bimetallic type. Thermal units shall be of one-piece construction and interchangeable.
 - D. Starters through NEMA size five (5) shall be equipped with double break silver alloy contacts. Contacts shall be replaceable without removing power wiring or removing starter from panel.
 - E. Coils shall be of molded construction and shall be 120 VAC. Starters shall have a fused 120V control power transformer in enclosure, or alternatively on 120/208 or 120/240 volt systems, the power system neutral conductor may be utilized. In all cases, control power shall be disconnected by the starter disconnecting means, unless otherwise specifically approved.
 - F. Starters shall be suitable for field addition of at least four (4) auxiliary electrical interlocks of any arrangement, normally open or normally closed.
 - G. Starters shall have enclosure mounted red running pilot light and Hand-Off-Auto switch.
- 2.5 AC COMBINATION STARTERS WITH FUSIBLE DISCONNECT SWITCH OR CIRCUIT BREAKER
- A. Combination starters shall be manufactured in accordance with the latest published NEMA standards, sizes and horsepower ratings.
 - B. Disconnect switch combination starters shall consist of a visible blade disconnect switch and a motor starter.
 - C. Combination starters shall be mounted in NEMA 1 general purpose enclosures unless otherwise indicated on the plans or required by the conditions of the area in which they are installed.
 - D. The disconnect handle used on combination starters shall always be in control of the disconnect device with the door opened or closed. The disconnect handle shall be clearly marked as to whether the disconnect device is "on" or "off".
 - E. Magnetic starters provided under all Divisions of the Specifications shall be in accordance with this Section.

PART 3 - EXECUTION

3.1 COORDINATION

- A. Coordinate details pertaining to the motor control equipment with the Division of these specifications where the equipment is specified.

3.2 CONTROL WIRING

- A. Control wiring and control devices shall be provided under the Specification Division in which the controlled equipment is specified. Coordinate all related work.

3.3 CONNECTIONS

- A. Provide liquid tight flexible conduit connections to motors and other equipment subject to vibration where LFMC is an acceptable wiring method. Provide flexible conduit connections to motors and other equipment subject to vibration that is located in spaces used for environmental air (e.g. fan rooms). Minimum length 12 inches.

3.4 NAMEPLATES

- A. Provide engraved nameplates for all starters in accordance with Section 26 05 53 – Identification for Electrical Systems. Coordinate names with mechanical equipment lists.

END OF SECTION 26 29 00

SECTION 26 29 16
ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General purpose contactors.
 - 2. Lighting contactors.
- B. Related Sections:
 - 1. 26 05 53 – Identification for Electrical Systems

1.2 REFERENCES

- A. ANSI/NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- B. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
- C. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- D. ANSI/NFPA 70 - National Electrical Code.

1.3 QUALITY ASSURANCE

- A. Contactors shall be of the latest approved design as manufactured by a nationally recognized manufacturer and be Underwriters' Laboratory listed and bear the UL label.
- B. Contactors of each type provided shall include the features as indicated on the Drawings.

1.4 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.
- B. Submit for approval manufacturer's shop drawings to show dimensions, features, accessories, enclosures, mounting arrangements, interconnecting diagrams, schedules of all overcurrent devices, voltage ratings, and specified accessories.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 1.
- B. Accurately record actual locations of each contactor and indicate circuits controlled.

1.6 OPERATION AND MAINTENANCE DATA

- A. Submit under provisions of Division 1.
- B. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN

- A. The Basis of Design is equipment from Square D by Schneider Electric to set a standard for quality. Equipment from Cutler-Hammer/Westinghouse (Westinghouse design products only), Seimens Energy & Automation, General Electric, or alternative systems will be considered providing that sufficient documentation is provided to satisfy the CONTRACTING AGENCY that the equipment meets the requirements of the Specifications, and matches the Basis of Design on all points which are pertinent to the Project.

2.2 CONTACTOR FEATURES - GENERAL

- A. Enclosures:
 - 1. For other than Panelboard Lighting Contactors, enclosures shall be ANSI/NEMA ICS 6, Type 1 as indicated or as required to meet conditions of the installation. Panelboard Lighting Contactors shall be mounted within the Panelboard.
- B. Accessories:
 - 1. Provide the following accessories as indicated for each contactor:
 - a. Pushbutton: ON/OFF. NEMA ICS 2, heavy duty type.
 - b. Selector Switches: ON/OFF or HAND/OFF/AUTOMATIC. NEMA ICS 2, heavy duty type.
 - c. Indicating Lights: NEMA ICS 2, push-to-test type.
 - d. Auxiliary Contacts: field convertible, quantity indicated.
 - e. Other: as indicated.

- C. Coil Voltages: 120 volts, 60 Hz, or as indicated for each contactor. As required provide control circuit transformer mounted within contactor enclosure to power coil.
- D. Poles: As indicated or required for the specific application.
- E. Contact Rating: as indicated or as required to meet conditions of the installation.
- F. Size: As indicated or required by the load.
- G. Configuration: Provide types as indicated:
 - 1. Electrically held shall have continuously rated, encapsulated coils.
 - 2. Mechanically held shall be electrically operated with encapsulated coils. Standard coil clearing contacts shall be provided so that the contactor coils shall be energized only during the instance of operation.

2.3 GENERAL PURPOSE CONTACTORS

- A. Square D Company - 8502 Type S.
- B. Description: NEMA ICS 2, AC general purpose magnetic contactor.
- C. Coil: encapsulated type.
- D. Contacts: Totally enclosed, double break silver cadmium oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring.
- E. Wiring: Straight through wiring with terminals clearly marked.

2.4 MULTIPOLE LIGHTING CONTACTORS

- A. Square D Company - 8903 Type L & LX.
- B. Description: magnetic lighting contactor.
- C. Contact Rating: 20 amperes for all types of ballast and tungsten lighting, resistive heating, and motor loads.
- D. Contacts: Totally enclosed, double break silver cadmium oxide power contacts. Contact inspection and replacement shall be possible without disturbing line or load wiring. Contacts shall have clearly visible N.O. and N.C. contact status indicators.
- E. Wiring: Straight-through wiring with all terminals clearly marked.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.

3.2 SCHEDULE

- A. Refer to the Drawings for Contactor requirements.

3.3 NAMEPLATES

- A. Provide engraved nameplates for Contactors in accordance with Section 26 05 53 – Identification for Electrical Systems.

END OF SECTION 26 29 16

SECTION 26 43 00

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes requirements for the Surge Protective Devices (SPDs) devices for the protection of AC electrical circuits from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from inductive and/or capacitive load switching. The SPD devices shall be suitable for application in a Category C and B environment as described in ANSI/IEEE C62.41.
- B. Related Sections:
 - 1. 26 24 16 – Panelboards

1.2 REFERENCES

- A. U.L. compliance and labeling: Each complete suppression device shall be listed per U.L. 1449 (current edition) as a surge protective device.
- B. SPD shall be designed to allow installation in accordance with current National Electrical Code.
- C. ANSI/IEEE C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits, Category B and C.
- D. NEC Article 285 - Surge Protective Devices.

1.3 SYSTEM DESCRIPTION

- A. Provide labor, materials, equipment and services necessary for and incidental to the installation of the SPD System devices as specified herein. Installations shall be completed in accordance with this specification.
- B. Provide SPDs for panelboards as indicated on the panelboard schedules or drawings.

1.4 SPECIAL REQUIREMENTS

- A. Where this specification or Specification Section 26 24 16 - Panelboards specify a SPD device integral to a panelboard, the SPD shall be installed at the factory, delivered, and warranted by the electrical distribution equipment manufacturer.

- B. Trims for SPDs that are not integral to a panelboard shall be compatible with the type of mounting.

1.5 WARRANTY

- A. The SPD shall have a warranty period of five years, incorporating unlimited replacements of module if destroyed by transients during the warranty period.

1.6 SUBMITTALS

- A. Provide submittals for products in accordance with Section 26 00 00 - Electrical General Requirements and Division 1.
- B. Provide submittal data with the following information:
 - 1. Product data and manufacturer's installation instructions.
 - 2. Dimensional drawing of each suppressor type indicating mounting arrangements.
 - 3. UL 1449, current edition, VPR test data for all modes of SPDs.
 - 4. UL 1283, current edition. Noise Attenuation for SPDs.
 - 5. NEC Article 285 - Surge Protective Devices.
 - 6. UL Documentation verifying short circuit current rating (SCCR), Maximum Continuous Operating Voltage (MCOV) and Device Listing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers include: Advanced Protection Technologies, Current Technology, Liebert, Square D, or approved equal. The manufacturer shall be regularly engaged in the manufacture of SPDs for at least five years. Specific products are subject to approval.
- B. Where SPDs are specified as an integral part of distribution equipment, the manufacturer of the SPD shall be partnered with the distribution equipment manufacturer in providing a UL listed device.

2.2 SPDS GENERAL

- A. SPD shall be compatible with the electrical system voltage, current, configuration and intended application.
- B. SPD shall be parallel in design.

- C. SPD shall be modular in design and MOV based. Each MOV shall be rated at 50kA each.
- D. SPD shall have a maximum continuous operation voltage (MCOV) not less than 115% of the nominal RMS voltage continuously without degradation. For example, devices that use 130V MOVs for 120V systems are not acceptable.
- E. SPD shall provide both visual and audible indication of properly performing protection for each phase.
- F. SPD shall have UL1283 EMI/RFI filtering with minimum attenuation of -50dB@100kHz.
- G. SPD shall provide full cycle tracking circuitry to provide tight transient clamping regardless of the transient position on the sine wave.
- H. SPD modules shall be thermally fused and SPD shall be capable of safely interrupting the power system's available fault current.
- I. SPD shall incorporate a low impedance surge diversion platform for the surge current path. The surge current shall be symmetrically disbursed to all suppression elements to insure equal stressing and maximum performance of the suppression elements. The surge diversion platform shall provide equal impedance paths to each suppression element for shunting of high frequency surges. The surge current diversion modules shall be bolted directly to the platform to insure reliable low impedance connections. Small gauge round wiring or plug-in connections shall not be used in the path for surge current diversion.
- J. A surge counter shall be provided with the SPD. Surge counter shall utilize a non-volatile memory to retain the surge count in the event of a power loss.

2.3 BRANCH PANELBOARD SPD

- A. SPD shall be tested against ANSI C62.41.2 Category C high impulse and Category C low impulse transients.
- B. SPD shall be capable of surviving 5000 sequential ANSI C62.41 B impulses, without failure or degradation of UL 1449 voltage protection rating by more than 10%.
- C. SPD shall have a maximum single impulse current rating of 100kA per phase.
- D. SPD shall provide protection in the following modes and SPD shall have a U.L. 1449 voltage protection rating (VPR) as follows:

Nominal Voltage	Configuration	L-N	N-G	L-G	L-L
120/208	Grounded Wye	700	700	700	1200

- E. Provide overcurrent protection and a means of disconnect for the SPD. Overcurrent and disconnect devices shall be exclusively utilized for SPD. Size overcurrent protection in accordance with manufacturer's recommendations.

2.4 SPD INTEGRAL TO DISTRIBUTION EQUIPMENT

- A. SPD shall be Component Recognized in accordance with UL 1449, Standard for Safety, Surge Protective Devices.
- B. The SPD diagnostic monitoring devices shall be mounted on the front of the equipment enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Where indicated on Drawings, panel schedules or drawings; Provide SPDs integral to panelboards and in accordance with Specification Section 26 24 16 - Panelboards. Where SPDs are specified as an integral part of the distribution equipment, they shall be installed as follows:
 - 1. SPD shall be installed by and shipped from the electrical equipment manufacturer's factory.
- B. Where indicated on Drawings, panel schedules or drawings; provide SPDs external to the panels. Where SPDs are specified as external to the distribution equipment, they shall be installed as follows:
 - 1. Installation shall comply with all applicable State and National Electrical Codes and with manufacturer's recommendations.
 - 2. SPD shall be mounted directly adjacent to the protected panel. SPD shall be housed in a NEMA rated enclosure appropriate to the application, flush or surface mounted to match the panel to which it is connected. Provide flush mounting kits as required.
 - 3. All conductors of the SPD shall be grouped together up to their point of connection. Lead lengths shall be as short as possible and shall avoid sharp bends. Leads shall be kept to a maximum of 18 inches from the point of connection to the SPD. If due to field conditions this is not possible, Contractor shall submit proposed alternate location to the Contracting Agency for review prior to installation. All SPD conductors shall terminate with compression type lugs.

END OF SECTION 26 43 00

SECTION 26 50 00

LIGHTING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section describes general requirements, products and methods of execution relating to lighting fixtures lamps, ballasts, LEDs, LED drivers and related products approved for use on this project.
- B. The Fixture Schedule is a general guide to type, quality and other characteristics. Fixtures of equal or better performance and quality may be substituted, subject to approval.

1.2 RELATED SECTIONS

- A. 26 27 26 – Wiring Devices
- B. 26 55 61 – Networked Lighting Control System

1.3 QUALITY ASSURANCE

- A. The fixture shall be a standard catalog item as described on the Drawings and as made by a nationally recognized manufacturer.
- B. LEDs specified in this Section shall be as manufactured by Nichia, Samsung, or Cree.
- C. Drivers specified in this Section shall be as manufactured by Osram, GE, Advance, Phillips or endoLED, unless noted otherwise.

1.4 SUBMITTALS

- A. Provide submittals for all products in accordance with Section 26 00 00 and Division 1.
- B. Fixture mounting shall be clearly identified on submittal information and coordinated with architectural, features, assemblies, details and reflected ceiling plan.
- C. Fixtures with color selections shall be submitted for final color selection by Architect.
- D. Lamps, ballasts, LEDs, LED Drivers and related products are generally included in the fixture schedule on the plans. Verify that the fixture types submitted for approval contain components complying with the product specifications of this Section.

1.5 SHOP DRAWINGS

- A. Provide fabrication drawings that indicate fixture, type, kind, weight, lamp, LEDs, ballast, LED drivers, method of fitting and fastening parts together, location and number of sockets, and complete details of method of fitting suspension and fastening fixtures in place. Verify fixture dimensions with construction conditions prior to ordering fixtures.
- B. Provide wiring diagrams that indicate supply power and interconnections for lighting controls, equipment and light fixtures. Provide sufficient information to assemble and install equipment at the project site without further instructions.

1.6 WARRANTY

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Interior lighting fixtures: 36 months from date of Substantial Completion.
 - 2. Exterior lighting fixtures: 60 months from date of Substantial Completion.
 - 3. Controls mounted on or integral to lighting fixtures: 60 months from date of Substantial Completion.
 - 4. LEDs and LED Drivers: 60 months from date of Substantial Completion.
 - 5. Emergency Battery Drivers: 60 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide fixtures in conformance with the Fixture Schedule, with all required flanges and supports. Lighting fixtures shall be provided complete with all suspension, trim, mounting, and operating accessories normally considered necessary for a complete, functional, and safe installation, whether specifically called for in the Contract Documents or not.

2.2 LIGHT EMITTING DIODE (LED) FIXTURES

- A. LED fixtures shall comply with Illuminating Engineering Society (IES) LM-79 guidelines.
- B. Fixture shall have an LM-79 photometric test report from a DOE CALiPER NVLAP accredited laboratory.
- C. Fixture shall utilize components (i.e. LEDs, driver, fixture housing, etc) included in LM-79 test.
- D. Fixture shall have lumen maintenance testing with minimum test duration of 10,000 hours.

- E. Manufacturer stated end of life shall be at 70% light output. Operating life shall be no less than 50,000 hours.
- F. Color temperature, and color rendering index (CRI) shall conform to the lighting fixture schedule shown on the Drawings.
- G. Fixture power factor shall be greater than 0.9 over all input voltages.
- H. Total Harmonic Distortion (THD) shall be less than 20% over all input voltages.
- I. Fixture components shall be lead free, mercury free and RoHS compliant.

2.3 FULLY RECESSED FIXTURES

- A. Fixtures shall have thermal protection conforming to NEC and shall so be identified as thermally protected unless fixture is:
 - 1. Identified for use and installed in poured concrete, or
 - 2. Identified as suitable for installation in cavities where the thermal insulation will be in direct contact with the fixture.

2.4 LIGHT EMITTING DIODES (LEDS)

- A. LEDs shall comply with Illuminating Engineering Society (IES) LM-80 guidelines.
- B. Manufacturer stated lamp end of life shall be at 70% light output. Lamp operating life shall be no less than 50,000 hours.

2.5 BALLAST/DRIVER DISCONNECTING MEANS

- A. In indoor locations, luminaires that ballasts(s) or LED Driver(s) shall have a disconnecting means either internal or external to each luminaire to disconnect simultaneously from the source of supply all conductors of the ballast and LEDs/LED boards, including the grounded conductor in accordance with National Electrical Code (NEC) Article 410.
 - 1.

2.6 LED DRIVERS

- A. LED drivers – Non Dimming
 - 1. Input: 120-277V, 50/60Hz (100-305V with tolerances)
 - 2. Frequency: 47 - 63Hz
 - 3. Efficiency: >90% at full load at nominal working voltage

4. Power Factor: >0.9 over all input voltages
5. Total Harmonic Distortion: <20% overall all input voltages
6. Output: Class 2 LED/55V max, Current range (adjustable) 150mA to 1,400mA
7. UL recognized
8. Phillips, GE, Osram, eldoLED or approved equal.
9. Drivers and controls shall be compatible.

B. LED drivers – Dimming

1. Input: 120-277V, 50/60Hz (100-305V with tolerances)
2. Frequency: 47 - 63Hz
3. Efficiency: >90% at full load at nominal working voltage
4. Power Factor: >0.9 over all input voltages
5. Total Harmonic Distortion: <20% overall all input voltages
6. Output: Class 2 LED/55V max, Current range (adjustable) 150mA to 1,400mA
7. Flicker-free dimming down to 1% with full on/off.
8. 0-10V drive compatible with both sink and current source controllers.
9. UL recognized
10. Phillips, GE, Osram, eldoLED or approved equal.
11. Drivers and controls shall be compatible.

2.7 EMERGENCY LIGHTING DRIVER – LED

A. Provide emergency lighting ballasts for LED fixtures with the following features:

1. Shall be capable of operating at the specified lumen output for a minimum of 90 minutes.
2. Universal input (120-277 VAC)
3. Compatible with the LED fixture and driver intended for use with.
4. High-temperature long-life, nickel cadmium battery. Electronic charger with 24 hour or less recharge time.
5. Charge indicator lamp and test switch.

6. Equipped with self-testing/self-diagnostic circuitry.
7. UL listed.
8. When used with dimmable drivers/fixtures circuitry/programming to restore light output to specified lumens in emergency mode shall be provided.

PART 3 - EXECUTION

3.1 GENERAL

- A. Drivers shall be installed per manufacturer's recommendations.
- B. Fixtures with integral drivers shall have the driver installed and prewired at the factory.
- C. Tandem wiring harnesses internal fixture wiring shall be factory assembled and installed in multiple fixtures which share a common driver. All wiring harnesses shall include an integral copper grounding conductor and be approved for use in air plenums.

3.2 INSTALLATION

- A. Install fixtures level, plumb and true. Align rows accurately in three dimensions.
- B. Support suspended acoustical ceiling fixtures according to the requirements of the IBC and Section 26 0529 as well as any local amendments.
- C. Fixture pendants, canopies, blank sections, corners, tees and other such accessories shall be finished to match their respective fixture.
- D. Refer to applicable details on architectural drawings for specific mounting requirements for all fixtures with special mounting requirements such as linear fixtures.
- E. For linear fixture systems, verify fixture dimensions and mounting type with other trades prior to installation.
- F. Utility Rooms: Surface ceiling mount fixtures in rooms/areas with ceilings. In areas without ceilings pendant fixtures down to bottom of structure. In areas with mechanical equipment, ductwork and piping, pendant fixtures down to bottom of mechanical ductwork or piping as appropriate. Fixture pendants shall be rigid (threaded hangar rods) and shall be sway braced where pendants exceed 24 inches in length.
- G. Provide an unswitched circuit connection for the following:
 1. Exit signs
 2. Emergency lighting units (ELUs)
 3. Emergency fixtures

- 4. Emergency night lights
- 5. Fixtures with emergency battery LED drivers
- H. Clean all fixtures and lenses prior to final acceptance.

3.3 FIRE-RESISTIVE CONSTRUCTION

- A. Refer to Section 26 00 00 Electrical General Requirements.

END OF SECTION 26 50 00

SECTION 26 55 61

NETWORKED LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Networked lighting control systems.

B. Related Sections:

1. 26 27 26 - Wiring Devices
2. 26 25 00 – Lighting Fixtures

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

1. C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

B. International Organization for Standardization (ISO)

1. 9001:2000 – Quality Management Systems.

C. National Electrical Manufacturers Association (NEMA)

D. Underwriters Laboratories, Inc. (UL)

1. 1472 (1996) - Solid-State Dimming Controls.
2. 924 (2003) - Emergency Lighting and Power Equipment

E. Federal Communications Commission (FCC) rules – Part 15 (Class B): Radio Frequency Devices

1.3 SYSTEM DESCRIPTION

A. Modular dimming control with LED drivers: Factory assembled dimming control, interfaces, and modules. Low voltage wall stations, control interfaces, and sensors.

1.4 SUBMITTALS

- A. Provide Submittals for all products in accordance with Section 26 00 00 and Division 1.
- B. Shop Drawings/Submittals shall include but not limited to:
 - 1. Layouts of photocells, occupancy sensors and networked devices necessary for a complete working system.
 - 2. Wiring diagrams or typical details showing the connection of all system parts and showing necessary electrical provisions to accommodate the intent of the design.
 - 3. Installation sheets with complete product information.
 - 4. Manufacturer Start-up Instructions and requirements.
 - 5. Manufacturer's warranty certificate.

1.5 QUALITY ASSURANCE

- A. The components shall be of the latest approved design as manufactured by a nationally recognized manufacturer and be listed in the Underwriters' Laboratory and bear the UL label.

1.6 WARRANTY

- A. Warrant all components, parts, and assemblies against defects in materials provided under this contract, and workmanship, for a period of one (1) years after Final Acceptance of this work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of Design is equipment from Sensorswitch/nLight to set a standard for quality. Equipment from alternate manufacturers is acceptable provided that it meet the requirements of the specification.

2.2 GENERAL

- A. Control Devices under this section are shown diagrammatically on the drawings and additional Class 1 and/or Class 2 wiring may be required for a complete system. It shall be the responsibility of the contractor and system vendor to determine the quantity and type of cable/wiring required for the complete and proper operation of the system. System design is based upon intelligent controls and/or lighting fixtures interconnected with CAT5 cables.
- B. Provide all material, labor and programming for a complete and properly working system that complies with listed sequences of operation.

- C. Proper product adjustment, testing, training and commissioning coordination shall take place in compliance with this document as well as applicable energy codes and listed sequences of operation.

2.3 SYSTEM SPECIFICATIONS AND OPERATION

- A. The lighting control system specified in this section shall provide a combination of time-based, sensor-based (both occupancy and daylight), and/or manual lighting control.
- B. The system shall be capable of turning lighting loads on/off as well as dimming lights (if lighting load is capable of being dimmed)
- C. All system devices shall be individually addressable and shall be networked together via CAT5 cable in a daisy chain fashion enabling digital communication.
- D. Individual lighting zones shall be capable of being segmented into sufficient channels of occupancy, photocell, and switch functionality to comply with advanced configurations and sequences of operation.
- E. The system architecture shall be capable of enabling stand-alone groups (rooms) of devices to function or global functionality as necessary to meet all sequences of operation.
- F. System shall be capable of operating a lighting control zone according to several sequences of operation. System shall be able to change a spaces sequence of operation according to a time schedule so as to enable customized time-of-day, day-of-week utilization of a space. Operating modes shall be utilized only in manners consistent with local energy codes.
- G. Time of day capabilities shall meet local code requirements or at a minimum a 10 hour backup, astronomic time function and Holiday function.
- H. Devices located in different lighting zones shall be able to communicate occupancy, photocell, and switch information via the CAT5 network as required to alter time delays, disable/enable functions, remotely monitor activity, etc.
- I. The system architecture shall facilitate remote operation via a computer connection.
- J. Networked Interior lighting controls shall consist of lighting control modules, relays, intelligent light fixtures and associated input devices that operate in default capacity even if network connectivity to the greater system is lost.
- K. A networked UL 924 compliant emergency control device shall be used that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF/Dim control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON and FULL if dimmed until normal power is restored. Upon restoration of normal power, lighting shall function as specified in default mode, which includes dimming.

2.4 OCCUPANCY SENSORS

- A. Occupancy based controls shall consist of passive Infrared or dual-technology occupancy sensors connected via a CAT5 network in larger, multi-zone spaces such as classrooms. In small offices, occupancy based controls shall include dual technology, single or multi-zone wall switch type occupancy sensors.
- B. Dual technology sensors shall consist of Passive Infrared as a primary technology and Microphonic or Ultrasonic as a secondary technology.
- C. Occupancy-based controls for interior lighting shall provide automatic shut-off control as indicated for manual-on or automatic-on lighting as designated by code or sequence of operation.
- D. Sensors covering 1 lighting zone with 1 lighting level shall be manual on, auto off. Where multiple lighting levels are indicated (bi-level control), sensors shall be auto on to 50%, manual on to 100%, auto off.
- E. Occupancy sensors shall provide complete and proper volumetric coverage of each room within the coverage limits of the devices provided, in accordance with the manufacturer's published coverage limits. Unless otherwise indicated, the coverage pattern shall provide detection of desk activity (hand motion) for over 90% of the room area minimum, as required to accommodate all occupancy habits of single or multiple occupants at any location within each room.
- F. Where sensors are to be protected by wire guards, provide wire guards that fit over the devices to be protected. Wire guards for wall-mounted sensors shall secure to the wall, and shall not be attached to the sensor itself.

2.5 WALL CONTROLS

- A. Wall Control Stations for individual rooms or spaces shall be Class 2 devices networked with CAT5 and shall include on/off/dim or scene functions to initiate the proper sequence of operation for the space.
- B. Graphic Wall Control Stations shall be Class 2 devices networked with CAT5 and shall include:
 - 1. Scene functions to initiate the proper sequence of operation for the space.
 - 2. 3.5" Full-color Touch Screen (Diagonal)
 - 3. Up to 16 On/Off/Dim Controls and up to 16 Scene Controls.
 - 4. Front Accessible Micro-USB Connector for Simple Laptop Connectivity.
 - 5. Capable of mounting in a Single Gang Switch Box

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to beginning rough-in for the automatic lighting controls a pre-installation meeting is mandatory for all parties involved in the lighting control system installation, including the System Installer, the manufacturer's Factory Authorized Representative and the Owner's Representative if desired. All parties shall review the automatic lighting control shop drawings, the manufacturer's installation instructions, applicable regulations and any site conditions pertinent to installation of the automatic lighting controls. Verify placement of sensors and installation criteria.

3.2 INSTALLATION

- A. Install equipment in accordance with the manufacturer's instructions in the locations indicated on the Drawings. Proper judgment shall be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
- B. Locate and aim occupancy sensors as required for complete and proper volumetric coverage within the range of coverage of controlled areas per the manufacturer's recommendations. Rooms shall have 90% minimum coverage to completely cover the controlled area. Coverage shall accommodate all occupancy habits of single or multiple occupants at any location within the room. The locations and quantities of sensors shown on the Drawings are diagrammatic and indicate only the minimum quantity and placement of sensors that are to be provided. Provide additional sensors if required to properly and completely cover the respective room.
- C. Provide quantity and layout of occupancy sensors to properly meet coverage and intended sequence of operation. Locations shall be carefully selected to ensure that coverage patterns are unobstructed.
- D. Wiring shall be arranged as shown on the shop drawings. Wiring and cable shall be installed in raceways, except low-voltage cables where concealed above accessible ceilings consisting of removable tiles. Raceways shall be bonded to the power system ground.
 - 1. CAT5 cables connect control devices in uninterrupted continuous runs without intermediate splices.
 - 2. Cables shall maintain a separation of at least 610 mm (24 in) from all heat sources and from ballasts, transformers, dimmers and other sources of electromagnetic interference. Where two (2) or more cables run in parallel, they shall be bundled with cable ties
 - 3. Cables run exposed in ceiling cavities shall be supported by means of suitable cable support devices from the building structure. They shall not lie upon the ceiling or other systems, nor shall they be supported from the ceiling frame, ceiling suspension wires, conduits, pipes, ductwork or lights. Supports shall be spaced no further apart than 5 ft on center. Type and spacing of supports shall ensure that cable will not kink or sag.

4. Care shall be exercised during cable installation not to damage cable insulation. Damaged cables shall be removed and replaced.
 5. For each cable that terminates at a ceiling device, provide 305 mm (12 in) of slack cable, neatly coiled, to facilitate future modifications. Terminations shall be made in a neat and workmanlike manner.
 6. Terminate the manufacturer's recommended cable type to the appropriate termination point (RJ45 jack, etc.). Do not use CAT 5 cable for terminating to blocks.
 7. Cabling for 0-10V dimming control shall be installed in raceway, except where installed above accessible ceiling.
- E. Provide identification for control devices (Device ID #'s) per manufacturer's instructions.
- F. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
- G. Ensure that daylight sensor placement minimizes sensors view of electric light sources; ceiling mounted and fixture-mounted daylight sensors shall not have direct view of luminaires.
- H. Provide adequate slack in flexible raceway and wiring to allow occupancy sensors to be relocated to an adjacent ceiling tile in any direction.

3.3 SYSTEM STARTUP

- A. Notify the Owner's Representative at least two (2) weeks in advance of the date of each test, to allow witnessing of the tests if desired.
- B. Supply tools, instruments, gauges, testing equipment, protective devices and safety equipment for adjustment, testing and demonstration as needed.
- C. Prior to system testing, prepare a list of the devices to be tested, together with the associated location of each device and device identification (bar code number, ID, etc.). Include space to indicate test response for each device.
- D. During adjustment and testing, carefully record all settings and all test results, including expected test results, actual test results, and corrective actions taken. Records shall be submitted to the Contracting Agency and included in the Operating & Maintenance Manuals. Settings of devices from software is acceptable documentation
- E. Initial Set-up: Verify that wiring is correctly connected to each device. Adjust controls to function as specified under the sequence of operation. Settings shall comply with direction received from the Contracting Agency and/or sequence of operation. Default to Illuminating Engineering Society (IES) recommended light levels if information is not available at time of initial set up.
- F. Verify sensor placement, aiming, calibration and settings to ensure trouble-free operation. Final calibration of daylight harvesting sensors and controls shall be delayed until room finishes have

been completed and window treatments have been installed and are operable. Lower blinds and set the blades perpendicular to the window before calibrating day lighting controls.

- G. For each room with day lighting controls calibration shall be performed on a day with sufficient daylight. Additional visits shall be scheduled as necessary if conditions are not correct for calibration. Follow manufacturer recommendations.
- H. Program sequences of operation that include time functions to operate at times selected by the Contracting Agency.

3.4 FIELD TESTING:

- A. Test all system features for proper function. Tests to be performed shall include, but not be limited to, the following:
 - 1. Verify the sequence of operation for each device.
 - 2. Verify the setting and accuracy of each timing function in each device.
 - 3. Verify that each manual override control functions properly.
 - 4. Verify that occupancy sensors do not remain actuated due to normal conditions (e.g., air movement).
 - 5. Verify that occupancy sensors are actuated by hand motion within the entire area of coverage.
 - 6. Verify that occupancy sensors actuate when a person enters the area of coverage. The sensing unit's coverage area shall be restricted if required to avoid sensing people or extraneous influences in adjacent areas or corridors.
 - 7. Measure the illumination level in daylight zones equipped with daylight harvesting controls.
 - 8. Correct any deficiencies discovered as a result of the above testing, and completely retest the work affected by such corrections as part of the required installation and testing.

3.5 TRAINING

- A. After the system has been completed, tested and is operating properly, the manufacturer's representative shall demonstrate by actual usage, the proper operation of each system device and function in the presence of the Owner's Representative. Demonstration shall include repetition of selected field tests, as well as additional adjustment or testing required to demonstrate that the system performs in accordance with the operational description as specified herein and the Owner's operational requirements.
- B. The training shall be conducted after the Operating and Maintenance Manuals for the project are completed and available for use during the training session.

- C. Conduct two (2) hours minimum of training for the Owner's maintenance personnel in the operation and maintenance of the lighting controls and applicable software. Training time shall be extended as necessary to satisfy the Owner's Representative that all pertinent topics have been adequately covered.
- D. Maintain a training sign-in sheet, upon which participants in the training session, including the instructors, shall record their names. The training sign-in sheet shall be dated.
- E. On-site training shall follow a written training plan, prepared in advance. The training plan shall outline the topics to be covered, the publications to be used, and the training schedule.
- F. The training shall be conducted by technicians who are thoroughly familiar with the equipment and its features, and also with the Project. The training shall include instruction, field demonstration, and over-the-shoulder hands-on exercises. As a minimum, the training shall cover, but not be limited to, the following topics:
 - 1. General overview of lighting controls, including purpose and principle of operation.
 - 2. Location of lighting control components.
 - 3. Interpretation of equipment output devices, such as indicators and status contacts.
 - 4. Control adjustments and settings.
 - 5. Operation of system controls, including over-ride switches.
 - 6. Recommended maintenance procedures and intervals.
 - 7. Operation of system software.
- G. At the conclusion of the training session, obtain written sign-off from the Owner's Representative. Insert a copy of the sign-off form and the training sign-in sheet into the Operating and Maintenance Manuals. Submit another copy of the training sign-in sheet to the Contracting Agency.

3.6 INITIAL SCENE SETTINGS

- A. Program the initial lighting control scenes as indicated on the Drawings.
- B. Coordinate final descriptions and scenes with Owner prior to programming.

END OF SECTION 26 55 61

SECTION 27 20 10

TELECOM DISTRIBUTION SYSTEM (TDS)

PART 1 - GENERAL

1.1 DESCRIPTION AND GENERAL SPECIFICATIONS

- A. Provide the equipment, materials, and labor to install the systems shown on the Drawings and specified herein. This shall include (but not be limited to) provision of all, raceways, sleeves, boxes, gutters, line and low voltage wire and cable, patch cords, pull ropes (in unused conduits), terminal modules, panels, outlets, jacks, splices, connections, cable management, labeling, testing and all other material, equipment, and labor required to make the systems fully operational.
- B. The intent of this Specification is to place in working order a complete, fully tested and documented Category 6A system complying with the Codes and Standards referenced herein.

1.2 RELATED SECTIONS

- A. 26 05 19 - Low Voltage Electrical Power Conductors and Cables
- B. 26 05 33 - Raceways and Boxes for Electrical Systems

1.3 COORDINATION

- A. The necessity to coordinate this work with the Serving Utility, Owner and the Contracting Agency is emphasized. The Contractor shall be responsible for any omissions, delays and additional cost due to lack of coordination or approval from the same.
- B. Coordinate work with other contractors and trades. The layout and installation of the systems shown on the Drawings and specified herein shall be coordinated such that all special requirements for telecommunications systems shall be provided and incorporated into the project. The systems to be coordinated shall include (but are not limited to) electrical raceway, grounding, fire rated assembly, lighting, power distribution, control and instrumentation, and labeling of cables, terminations, outlets, jacks, etc. Report all conflicts to the Contracting Agency.

1.4 CODES AND STANDARDS

- A. Where a Nationally Recognized Testing Laboratory (NRTL) listing or classification exists for a product and the product is suitable for the purpose specified and indicated, the product shall bear the appropriate marking indicating the listing or classification.
- B. Where a UL Standard is in effect, equipment shall:
 - 1. Meet that Standard.

2. Bear the UL Label.

1.5 SUBMITTALS

- A. The following shall be submitted in accordance with Section 26 00 00 - Electrical General Requirements and Division 1 in sufficient detail to show full compliance with the specification:
 1. Manufacturer's Catalog Data shall be submitted for the following items. Data shall include a complete list of parts, special tools, and supplies.
 - a. Copper Cable.
 - b. Information Jacks and Outlets.
 - c. Patch Panels.
 - d. Patch Cords and other accessories.
 2. Manufacturer's Installations Instructions.
 3. Labeling System: Coordinate with Contracting Agency for Owner's labeling conventions. Submit Project labeling system for approval.
 4. Manufacturer's Warranty as specified elsewhere in this Section, including all warranty provisions and procedures for Owner to follow to obtain warranty service.
- B. DELETE SUPERFLUOUS INFORMATION FROM SUBMITTAL DATA, SUCH AS MODEL NUMBERS AND OPTIONS FOR EQUIPMENT CONTAINED ON MANUFACTURER'S DATA SHEETS BUT NOT USED ON THIS PROJECT.
- C. One copy of approved Submittal Procedures shall be kept at the job site.

1.6 REFERENCE CODES AND STANDARDS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only, latest edition. The reference codes and standards are minimum requirements.

Reference	Title/Revision
ANSI/ICEA	Publication S-80-576
ANSI/IEEE C2	National Electrical Safety Code
ANSI/NFPA 70	National Electrical Code
ANSI/T1E1.7/92-004R	Electrical Protection Applied to Telecommunications Network Plant at Entrances to Customer Structures or Buildings

Reference	Title/Revision
ANSI/TIA/EIA-568-C.1	Commercial Building Telecommunication Cabling Standard Part 1: General Requirements
ANSI/TIA/EIA-568-C.2	Commercial Building Telecommunication Cabling Standard Part 2: Balanced Twisted-Pair Cabling Standards
ANSI/TIA/EIA-569-B	Commercial Building Standards for Telecommunications Pathways and Spaces
ANSI/TIA/EIA-571	Environmental Considerations for Telephone Terminals
ANSI/TIA/EIA-606-B	Administration Standard for Commercial Telecommunications Infrastructure
ANSI/TIA/EIA-607	Commercial Building Grounding and Bonding Requirements for Telecommunications
ANSI/TIA/EIA-854-2001	A Full Duplex Ethernet Specification For 1000Mbps (1000base-Tx) Operating Over Category 6 Balanced Twisted-Pair Cabling
BELLCORE TR-EOP-000063	Bellcore Network Equipment Building Systems Generic Equipment Requirements
BICSI	Telecommunications Distribution Methods Manual
CFR 47 Part 68	Connection of Terminal Equipment to the Telephone Network
FCC Part 15	Radio Frequency Devices
FCC Part 68	Connection of Terminal Equipment to the Telephone Network
IEEE	LAN Standards: 802.3; 802.4; 802.5; 802.6
IEEE C62.41	Recommended Practice on Surge Voltages in Low-Voltage Surge Protective Devices
IEEE C62.42	Guide for the Application of Gas Tube Arrester Low-Voltage Surge Protective Devices
IEEE Draft P1250 (D4)	Guide on Service to Equipment Sensitive to Momentary Voltage Disturbances
IEEE Std 1100	Recommended Practice for Powering and Grounding Sensitive Electronic Equipment (Emerald Book)
IEEE Std 142	Recommended Practice for Grounding of Industrial and Commercial Power Systems (Green Book)
IEEE Std 241	Recommended Practice for Electric Power Systems in Commercial Buildings (Gray Book)
IEEE Std 446	Recommended Practice for Emergency and Stand-by Power Systems for Industrial and Commercial Applications (Orange Book)
NTP 638 - 3031 - 300 STD	Northern Telecom Practice "Bonding and Grounding QCF-Type Bond Clamps Description and Installation"
UL 1283	Electromagnetic Interference Filters
UL 1449	Transient Voltage Surge Protection
UL 1459	Standard for Telephone Equipment

Reference	Title/Revision
UL 1950	Standard for Information Technology Equipment, Including Electrical Business Equipment
UL 467	Grounding and Bonding Equipment
UL 497	Protectors for Paired Conductors for Communication Circuits
UL 497A	Secondary Protectors for Communication Circuits
UL 497B	Protectors for Data Communication and Fire Alarm Circuits
UL 910	Safety Test for Flame-Propagation and Smoke Density Values for Electrical and Optical- Fiber Cables

1.7 OPERATING CONDITIONS

- A. The electronic equipment designed for office environments and Telecommunications Rooms shall be rated for continuous operation under ambient environment conditions of 10 degrees C (50 degrees F), to 30 degrees C (85 degrees F) and 35 to 65 percent relative humidity, non-condensing.

1.8 QUALITY ASSURANCE

- A. Perform all Work in accordance with all regulatory rules and regulations as well as references in this specification.
- B. Perform all Testing in accordance with ANSI/TIA/EIA-568-C specifications and submit all printed reports.

1.9 QUALIFICATIONS

- A. The telecommunications work specified in this Section is acknowledged to require special skills mastered by education, experience, or both. Bidders for telecommunications work described in this Section shall be specialty telecommunications contractors, who may be a division of the Divisions 26, 27 and 28 Subcontractor.
- B. Contractor Certification:
 - 1. This subcontractor shall be a certified installer of the cabling system, pre-qualified by the Manufacturer.
- C. Personnel and Equipment:
 - 1. Specialty subcontractors shall have direct access to all tools and test equipment required to complete the telecommunications work when the work is bid.

2. The specialty subcontractor's project superintendent (in office) and foreman (field) shall have five years experience at the superintendent and foreman levels, respectively, on completed telecommunications projects of like magnitude and complexity.

1.10 REGULATORY REQUIREMENTS

- A. All Work shall conform to the requirements of NFPA 70 and all local amendments.
- B. All Work shall conform to the requirements of all Federal, State and Local Electrical and Telecommunications Regulations.

1.11 SPECIAL WARRANTY

- A. The warranty shall extend from the date of Substantial Completion to the longer of twenty (20) years or the length of the Extended Warranty offered by the successful manufacturer.
- B. The warranty shall be extended to the Owner via the manufacturer through a single point of contact and shall be fully backed by the manufacturer.
- C. The Extended Product Warranty and System Assurance Warranty for this wiring system shall be provided consisting of the following:
 1. Extended Product Warranty - The Extended Product Warranty shall ensure against product defects, that all approved cabling components exceed the specifications of ANSI/TIA/EIA 568-C and ISO/IEC IS 11801-B, exceed the attenuation and NEXT requirements of ISO/IEC IS 11801-B for cabling links/channels, and that the installation will exceed the loss and bandwidth requirements of ISO/IEC IS 11801-B for links/channels. The warranty shall apply to all passive Telecommunication Distribution System (TDS) components.
 2. System Assurance - The System Assurance shall cover the failure of the wiring system to support any existing application, as well as additional application(s) introduced in the future by recognized standards or user forums that use the ANSI/TIA/EIA 568-C or ISO/IEC IS 11801-B component and link/channel specifications for cabling.
 3. All communications system components shall be rated for end-to-end system Category 6A or greater performance levels on all pair combinations and warranted to support any existing or future applications which are designed to operate over a 500 MHz horizontal channel (as defined in ANSI/TIA/EIA 568-C.2.1), to include support of the following applications. Performance shall be guaranteed under the Special Warranty at 100 meters (328 feet):
 - a. IEEE 802.3 10Base-T, 100Base-TX and 100Base-T4.
 - b. IEEE 802.5 16 Mbps token ring.
 - c. IEEE 802.12 Demand Priority Access Control.
 - d. Asynchronous Transfer Mode (ATM) data transmission at 155 Mbps.

- e. IEEE 802.3ab 1000Base-T.
 - f. ANSI/TIA/EIA-854-2001 "A Full Duplex Ethernet Specification For 1000mbis/S (1000base-TX) Operating Over Category 6 Balanced Twisted-Pair Cabling".
 - g. Future applications that become certified under the applicable standards as noted above.
4. Extended Product Warranty - The Extended Product Warranty and the System Assurance shall cover the replacement or repair of defective product(s) and labor for the replacement or repair of such defective product(s).
- a. In the event this specialty subcontractor is unable to perform, goes out of business or ceases to exist, the manufacturer shall be responsible for identifying a new contractor to assume the warranty work.
 - b. Manufacturers shall bear full responsibility for the work of their certified installer, including all aspects of the design and installation.
 - c. In the event this specialty subcontractor fails to provide satisfactory warranty support, the manufacturer shall be responsible for taking all necessary remedial steps including finding a new contractor to provide warranty work.
5. System Certification - Upon successful completion of the installation and subsequent inspection, the customer shall be provided with a numbered certificate, from the manufacturing company, registering the installation.
- D. Warranty programs approved as meeting the specified warranty are listed below. Final approval is subject to review and approval of the warranty:
- 1. Commscope Systimax 360 Program
 - 2. Commscope Uniprise 20 Year Extended Warranty
 - 3. Belden IBDN GX

1.12 TERMINOLOGY

- A. "TDS" shall refer to the Telecommunication Distribution System cabling and hardware infrastructure internal and external to a building or buildings used to transmit voice, video and data, etc.
- B. "Stations" shall refer to individual telephone or computers, or remote peripherals of those systems (e.g., printers, facsimile machines, modems, etc.
- C. "Outlets" shall refer to the group of receptacles or jacks at the location where the stations connect.
- D. "Jacks" or "Ports" shall refer to the individual receptacles where phones, computers, etc. connect.

- E. "Station Cables" shall refer to the horizontal cables connecting patch panels or terminal blocks in the Telecommunications Rooms to the stations.
- F. "Pathways" shall refer to conduits, sleeves, cable-trays, distribution rings, etc., which are employed to route backbone and stations cables between equipment rooms, telecommunications rooms, stations, outlets, etc.
- G. "Backbone Cables", "Riser Cables" or "Tie Cables" shall refer to copper cables 25-pair or more and optical fiber cables 6-strand or more, connecting main cross-connect facilities, intermediate cross-connect facilities and telecommunications rooms. These cables may include outside plant cables between buildings and riser cables between floors.
- H. "Communication Equipment Rooms" (CER) shall refer to a special-purpose room that provides space and maintains a suitable operating environment for large communications and/or computer equipment. Main rooms may be referred to as an MDF room. Intermediate rooms may be referred to as IDF room.
- I. "Telecommunications Rooms (TR)" shall refer to a floor-serving facility for housing telecommunications equipment, cable terminations and cross-connect wiring. This is the point at which station cables terminate. It may also be referred to as an IDF.
- J. "Terminal Blocks" shall refer to multiple punch down cable terminations.
- K. "Patch Panels" shall refer to rack or frame mounted multiple punch down cable terminations with RJ-45 style, 8P8C jacks on the face for "plug and play" cross connect capability.
- L. "Cable Management" shall refer to rings, troughs, gutters etc., mounted in conjunction with telecommunications distribution equipment and terminal blocks, for the orderly routing of cables, patch cords, etc.
- M. "LEC" shall refer to the Local Exchange Carrier providing telephone service to the facility.

1.13 STORAGE AND HANDLING

- A. Care shall be exercised in handling materials during construction. Damaged materials shall be repaired or replaced as directed by the Contracting Agency.

PART 2 - PRODUCTS

2.1 GENERAL

- A. All materials shall be as specified, first quality, manufacturer's current production.
- B. The Basis of Design for copper cabling, connecting hardware, and related hardware in this section is Commscope Systimax 360 GigaSPEED X10D 91B Series cabling with Commscope Systimax 360 X10D hardware with a CommScope Systimax Category 6A Extended Warranty as standards for quality and performance. The burden of proof is on the Contractor to demonstrate that all

performance and warranty requirements are met. All manufacturers other than those listed in this section will be rejected without review.

- C. The approved cabling products manufacturers and products are:
 - 1. Commscope Systimax 360 GigaSPEED X10D 91B Series Cable
 - 2. Commscope Uniprise Ultra 10G Series Cable 20 Year Extended Warranty
 - 3. Belden IBDN GX
- D. The approved connecting hardware manufacturers and products are:
 - 1. Commscope Systimax 360 GigaSPEED X10D patch panels and related hardware
 - 2. Commscope Uniprise Ultra 10G patch panels and related hardware
 - 3. Belden IBDN 10GX Series patch panels and related hardware
- E. Products shall provide the standard of performance required under Part 1 and the Special Warranty above.

2.2 IDC TERMINAL MODULES

- A. Connecting blocks shall match cables punched down under block, i.e., 5-pair for 5-pair color scheme, 4-pair for 4-pair cable, 3-pair for 3-pair cable, etc. When six pair are used 2-3 pair connecting blocks shall be used. For 25-pair or larger, use the 5-pair for 5-pair color scheme. All hardware shall be rated for ANSI/TIA/EIA 568-C Category 6A ratings and installed in accordance with ANSI/TIA/EIA 568-C guidelines. Blocks shall be color coded according to drawings and documented in accordance with ANSI/TIA/EIA 606-B. Blocks shall be identified using clear label holders and labels. Blocks shall be UL Listed.
- B. Insulation Displacement Terminal Modules: Termination blocks shall be modular and scalable up to 500 pair termination assemblies. Provide a retaining trough between every column of termination blocks.
- C. Terminal Modules shall be Type 110 mounting blocks and associated parts and shall support the system Category of the permanent channel hardware installed.

2.3 PATCH PANELS

- A. Patch Panels: Modular jack panels shall be in 24 or 48 port configurations as shown on the Drawings. Modular jack panels installations shall contain a retaining trough between every panel. Modular Jack Panels shall be wired for T568A configuration.

- B. The terminations shall have the following characteristics:
1. Wire Insulation Supported:
 - a. Size: 0.05 inches Diameter Over Dielectric maximum for top of connecting block
0.07 inches Diameter Over Dielectric maximum for bottom of connecting block
 - b. Types: All plastic insulants (including PVC, irradiated PVC, Polyethylene, Polypropylene, PTFE Polyurethane, Nylon, Teflon)
 - c. Termination Type: Insulation displacement, dry, gas tight
 2. Wire Size Supported:
 - a. Solid Wire Ranges: 22-26 AWG, Re-termination >200
 - b. Stranded (7 Strands) Wire Ranges: 22-26 AWG, Re-termination: >200
 - c. Wire Insertion force (24 AWG): 13-28 lb. (59-127 Newtons)
 - d. Wire pullout force (24 AWG): 2.2 lb. (9.7 Newtons)
 - e. Wire retention force (24 AWG): Horizontal 8 lb., Vertical 2 lb.
 3. Electrical Specifications:
 - a. Meet or exceed performance defined by ANSI/TIA/EIA-568-C.2, for Category 6A component, link and channel performance.
 - b. UL Listed.
- C. Designation labels for each jack shall be provided for front/rear labeling of each patch panel. All cables shall be terminated in numerical sequence and labeled as to outlet number and jack position (A, B, C, D). Provide color-coded inserts (“icons”) for all jacks at patch panels and at each outlet.
- D. Equipment:
1. Category 6A: High Density Modular Patch Panels
 2. Comply with FCC Part 68.
 3. ISO 9001 Certified Manufacturer.
 4. Equipment: Commscope Systimax GigaSPEED X10D 1100GS6 Category 6A patch panels

2.4 INFORMATION OUTLETS/JACKS

A. Outlet Requirements:

1. Configure single gang outlet information outlets in single, duplex, triplex, quad-plex jack arrangement, as indicated on the Drawings.
2. Provide outlet faceplates with both top and bottom labeling positions.
3. Provided blank module inserts for all unused module locations. Jack module arrangement is shown on the Drawings.
4. Provide full set of color coded snap-in icons for workstation outlets for use by Owner to mark jacks for analog and digital telephones, two unique classes of data, etc. Store icons in clear plastic bags in each IDF/MDF.
5. Equipment: Commscope Systimax GigaSPEED X10D MGS600 Information Outlet

B. Jack Requirements:

1. Jacks for Voice and Data:
 - a. Communications jacks shall consist of multi-position 8-pin modular (8P8C) jacks, utilizing T568A termination style.
2. Category 6A Jacks:
 - a. Jacks shall be manufactured by the same manufacturer as the modular patch panels.
 - b. All Jacks shall conform to ANSI/TIA/EIA 568-C Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section and shall meet or exceed the following electrical and mechanical specifications:
 - 1). Electrical Specifications: Jacks shall meet or exceed performance specifications for the Channel as defined by ANSI/TIA/EIA-568-C.
 - 2). Mechanical Specifications:
 - a) Plug Insertion Life: 750 insertions.
 - b) Contact Force: 3.5 oz (99.2 g) minimum using FCC-Approved modular plug.
 - c) Plug Retention Force: 30 lb (133 N) minimum between modular plug and jack.
 - 3). Temperature Range: -40° to 150°F (-40° to 66°C).
 - 4). Comply with FCC Part 68.

- 5). ISO 9001 Certified Manufacturer.
- 6). Equipment: Commscope Systimax GigaSPEED X10D MGS600
Information Outlet

2.5 PATCH CORDS

- A. Provide factory assembled Category 6A Modular Patch Cords for each assigned port on the patch panel. All cords shall conform to the requirements of ANSI/TIA/EIA 568-C Commercial Building Telecommunications Cabling Standard, Horizontal Cabling Section, and be part of the UL LAN Certification and Follow-up Program. Cords shall be equipped with an 8 pin modular connector on each end and the minimum length patch cord shall be provided in each instance, to make an orderly, manageable connection between the patch panels or equipment being cross-connected.
- B. All patch cords shall be round, and consist of 24-AWG copper, stranded conductors, tightly twisted into individual pairs.
- C. Patch cords shall be manufactured by the manufacturer of the patch panels and jacks and meet or exceed the Channel performance defined by ANSI/TIA/EIA-568-C.
- D. UL or ETL Verified for ANSI/TIA/EIA 568-C Electrical Performance.
- E. The patch cord shall have exclusion features to prevent accidental polarity reversals and split pairs.
- F. UL Listed for Fire Safety.
- G. ISO 9001 Certified Manufacturer.
- H. FCC Compliant.

2.6 HORIZONTAL CABLES

- A. General:
 1. Data cables shall be extended between the station location and its associated TR and shall consist of 4 pair, 24 gauge, UTP, and shall be terminated on the 8 pin modular jacks provided at each outlet. Cable jacket shall comply with Article 800 NEC for use as a plenum cable. The 4 pair UTP cable shall be UL Listed Type CMP (plenum).
 2. Provide cables with four FEP insulated conductor pairs (4/0 configuration)
 - a. Category 6A UTP, 4 Pair
 3. All cables shall conform to the ANSI/TIA/EIA 568-C Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL LAN Certification and Follow-up Program.
 4. Electrical Specifications:

- a. DC resistance: $28.6 \Omega/1,000 \text{ ft}$ ($9.38 \Omega/100 \text{ m}$), maximum.
 - b. DC resistance unbalance: 5%, maximum.
 - c. Mutual capacitance @ 1 MHz: maximum pF/ft: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.
 - d. Delay skew: ns/100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.
 - e. Worst pair attenuation, dB/100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.
 - f. NEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.2.
 - g. PSNEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.2.
 - h. ELFEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.2.
 - i. PSELFEXT, dB at 100m [328 ft.]: meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.2.
 - j. Worst Pair Structural Return Loss (SRL), dB at 100m (328 ft.): meet or exceed the performance values specified in ANSI/TIA/EIA-568-C.2.
5. Cables shall meet or exceed Category 6A performance specifications for the Channel as defined by ANSI/TIA/EIA-568-C.2.
6. Environmental:
 - a. Storage temperature: 68° F to 122° F (20° C to 50° C).
 - b. Installation Temperature: 32° F to 122° F (0° C to 50° C).
 - c. Operating Temperature: 14° F to 140° F (-10° C to 60°).
7. UL or ETL Verified for Category 6A Electrical Performance.
8. UL Listed for Fire Safety.
9. ISO 9001 Certified Manufacturer.
10. Equipment: Commscope Systimax 360 GigaSPEED X10D 91B Series Cable, plenum rated (CMP).

2.7 DEVICE COLOR

- A. Device color white unless otherwise noted. Confirm exact color with Architect, submit for review.

2.8 DEVICE PLATES

- A. Device plates shall be stainless steel, unless otherwise noted. Confirm exact color with Architect, submit for review.

2.9 LABELING

- A. Provide machine printed labels for all patch panels, cables, outlets, etc., in accordance with ANSI/TIA/EIA-606-B. Provide labeling nomenclature in accordance with information on the Drawings or Owner's labeling conventions. Submit labeling samples for all required applications.
- B. Machine Printed Label Requirements:
 - 1. PC Compatible.
 - 2. Can save and modify files.
 - 3. Fully integrated with AutoCAD.
 - 4. Editable Fonts and Sizes.
 - 5. Rotate Text and Objects.
 - 6. Vary Line Spacing.
 - 7. Ability to import graphical images.
 - 8. Capable for customization of layout.
 - 9. Re-positional labels.
- C. Basis of Design:
 - 1. Brady Electrical/Datacomm Worldwide (latest version of LabelMark).
 - 2. Cable Management Software International (latest version of docIT).
 - 3. Approved alternate.
- D. Labeling and color coding identification for this project shall conform to TIA/EIA-606-B for a Class 3 Administrative System.

2.10 UNSPECIFIED EQUIPMENT AND MATERIAL

- A. Any item of equipment or material not specifically addressed on the Drawings or in this document and required to provide a complete and functional TDS installation shall be provided in a level of quality consistent with other specified items.

PART 3 - EXECUTION

3.1 GENERAL

- A. Provide, connect and test all equipment and materials for the systems herein specified and shown on the Drawings. All wiring shall be neatly tied or laced in cabinets and terminated on terminal strips provided for the purpose. Each cable shall be identified by an approved marking system at each end.
- B. Outlet/Jacks shall be identified with machine printed labels. Hand lettered labels shall not be used.
- C. Provide labels and color-coded inserts for each jack at patch panels, in accordance with TIA/EIA-606-B.
- D. Provide full set of snap-in icons for workstation outlets for use by Owner to mark jacks for analog and digital telephones as two unique classes of data. Store icons in clear plastic bags in each IDF/MDF.
- E. Wherever materials, methods or placements of materials and equipment for the communications work is provided by other Subcontractors or the Owner, it shall be the responsibility of this specialty Subcontractor to coordinate that work and assure that it is provided in such a manner as to enhance the final system operation.
- F. Test the systems, demonstrate operation to the Contracting Agency and provide training as specified.
- G. Work under this section shall be closely coordinated with work under other sections of the project.

3.2 CODES AND PERMITS

- A. Apply and pay for all fees, permits, and obtain serving utility and governmental approvals.
- B. Coordinate all work with the serving utility.
- C. Raceway fill requirements for communications systems shall be in accordance with ANSI/TIA/EIA-569-B and BICSI.
- D. NEC bending radius of all communications ducts, raceways, cable trays, etc., shall be increased to not less than the installed cable manufacturer's recommendations, and the applicable ANSI and BICSI Standards.

E. Communications work shall be in complete accordance with the following:

1. National Electrical Code (NEC), latest legally enacted edition.
2. Regulations of the State Fire Marshal.
3. National Fire Protection Association (NFPA) Codes.
4. All state, county and local codes and ordinances.

3.3 DELIVERY AND STORAGE

- A. Materials and Equipment shall be stored with protection from mechanical damage, weather, humidity and temperature variation, dirt and dust, and other contaminants.
- B. Materials shall be inspected and inventoried promptly upon receipt.
- C. Cables shall be tested immediately upon receipt and received or rejected and returned based upon testing or visual inspection.
- D. Report and record all serial numbers received and/or rejected.
- E. All inspection and testing shall be performed under the observation of the Contracting Agency at the Contracting Agency's option. Provide three (3) working days advance notice of tests.

3.4 LAYOUT

- A. All work shall be laid out in advance. Shop drawings shall be submitted to the Contracting Agency for approval before work begins. Maximum height for terminal blocks and patch panels shall be 6 feet-6 inches, minimum height shall be 1 foot-6 inches. Cables shall be racked and supported in a workmanlike fashion. All work shall be labeled according to ANSI/TIA/EIA 606-B, and color coded according to BICSI Standards. In the absence of details on the drawing governing the layout of terminations, the following guidelines shall apply.
 1. All horizontal cables from a common outlet shall terminate sequentially (in groups) on the same patch panel.
 2. Pairs from each cable shall be terminated sequentially from left to right, top to bottom starting with the lowest assigned number at the upper left hand corner of the frame.
- B. Keep up to date "As-built" record drawings at each job site detailing the layout of all data racks and telephone, data and trunk terminations, including a typed listing of cables/rooms served by each terminal block and patch panel. Refer to Section 26 00 00 - Electrical General Requirements for other Record Document requirements.
- C. Layout Shop Drawings shall be prepared using CAD. Final approved Shop Drawings shall be updated with precise "as-built" conditions and shall be submitted with the Operations and Maintenance Manuals. File format shall be AutoCAD "DWG" or "DXF."

3.5 CABLE INSTALLATION

- A. Cable shall be installed in conduit concealed in wall and stubbed to the ceiling space where it will be routed to the nearest cable tray via j-hooks.
- B. If cable dimensions shown are exceeded, all cable pathways and supports shall be resized to maintain the original fill ratios based on the dimensions shown.
- C. Follow cable manufacturer's specification regarding handling methods, retaining/support methods, bending radius and maximum pulling tension limitations.
- D. Telecommunication cables shall not be installed in the same raceway as power cables.
- E. Cables shall be installed in a neat and orderly manner and shall not cross or interlace other cables except at breakout points.
- F. Cables in vertical trays shall be individually retained with straps at a maximum of 6 feet on center.
- G. Tie wraps shall not deform the cable insulation when tightened.
- H. All cables shall be routed to minimize EMI and RFI interference. All cable shall be routed according to the following table. Spacings are minimum for all Category 3 and higher cable.

Minimum Separation of Telecommunications pathways
from 480 volt or less power lines

Condition	<2 kVA	2-5 kVA	>5 kVA
Unshielded power lines or electrical equipment in proximity to telecommunications open or nonmetal pathways.	5 in	12 in	24 in
Unshielded power lines or electrical equipment in proximity to telecommunications grounded metal conduit pathways	2.5 in	6 in	12 in
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a telecommunications grounded metal conduit pathway	N/A	3 in	6 in
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to telecommunications open or nonmetal pathways.	2.5 in	6 in	12 in
Mechanical ductwork, metal floors and other metallic planes to telecommunications open or nonmetal pathways.	2 in		
Mechanical ductwork, metal floors and other metallic planes to telecommunications open or grounded metal conduit pathways.	0 in		

Minimum Separation of Telecommunications pathways from 480 volt or less power lines			
Condition	<2 kVA	2-5 kVA	>5 kVA
Fluorescent or HID Lighting Fixtures	5 in	5 in	5 in

3.6 LUBRICANT

- A. Pulling lubricant, shall be used to minimize pulling tension and prevent sheath damage when pulling cables into ducts and conduits. Lubricant shall be applied to the cable sheath with a lubricator. When pulling has been completed, the exposed cable ends shall be wiped clean of lubricant.
- B. Lubricants shall be compatible with and intended for use with plastic-sheathed cables. Soap and grease type lubricants shall not be allowed.
- C. All equipment and the pulling set shall be checked to minimize interruptions once pulling begins. Cable shall be pulled without stopping until the required amount of the cable has been placed. When the pulling operation is halted before the pull is completed, the tension of the pulling line shall not be released. When pulling is resumed, the inertia of the cable shall be overcome by increasing the tension in small steps a few seconds apart until the cable is in motion. Cable shall be paid from the top of the reel by rotating the reel in the feed direction at the rate of pull. Cable shall not be stripped off the reel by pulling.

3.7 SEAL

- A. Ducts in which cable is placed shall be sealed with urethane foam duct seal. This material shall be inserted between the cable and the duct and in all unused ducts, in order to prevent damage to the cable sheath and to prevent the entrance of dirt or water into the manhole or vault.

3.8 DAMAGE AND DEFECTS

- A. Use a tension monitoring device to ensure that the maximum pulling tension that may be applied to the cable to be pulled into a conduit section is not exceeded. Provide replacement cable if cable manufacturer's maximum pulling tension is exceeded at any time during a pull.
- B. Cable shall be carefully inspected for sheath defects or other irregularities as it is paid out from the reel. When defects are detected, pulling shall stop immediately and the cable section shall be repaired or replaced at the discretion of the Contracting Agency. A system of communications shall be maintained between pulling and feed locations so that pulling can be stopped instantly, when required.
- C. Cable shall be hand guided through intermediate manholes and into the next duct section when making pull-throughs. Proper rigging shall be used in the intermediate manhole to keep the pulling line and cable aligned with the exit duct to prevent the line or cable from rubbing against the edge of the duct. Cables in pull-through manholes shall be set up and racked before the cable ends in adjacent manholes are set up and racked.

- D. Cable ends pulled into manholes, vaults, or terminal locations that are not to be racked or otherwise permanently positioned immediately shall be tied in fixed positions to prevent damage to the cables and provide adequate working space.
- E. Adequate care shall be exercised when handling and storing reels of cable to prevent damage to the cable. Cable with dents, flat spots, or other sheath distortions shall not be installed.

3.9 DISTRIBUTION RINGS AND CABLE SUPPORTS

- A. Layout distribution rings in accordance with the contract drawings and cable spacing requirements. Set rings so that taps or changes in direction do not exceed 45 degrees.
- B. Mount J-hooks on appropriate mounting hardware suitable for the specific application. Mount securely to the building structure. Maximum support spacing shall be 4 feet on center.
- C. Coordinate the layout of cableways with all other trades. Report conflicts to Contracting Agency for resolution by the Contracting Agency.

3.10 TERMINATION MODULES

- A. Layout terminal blocks as indicated on drawings with spacing as recommended by manufacturer.
- B. Ground all metal back frames with #6 insulated copper to the Chassis Ground System (CGS). Use Cool Amp bolted connections or Cadweld connections.

3.11 CROSS-CONNECTIONS

- A. Cross-Connections at and/or between all terminal hardware shall be provided to form a complete and functioning system.
- B. Patch Cords shall be used to make all Cross-Connections.
- C. Cross-Connections from Terminal Modules color coded White to Terminal Modules color coded Blue shall be 4-pair wide and serve a single jack or termination in the horizontal distribution. Green shall be 4-pair wide and serve a single jack or termination in the Security Access Control System horizontal distribution.

3.12 INTERCONNECTIONS

- A. Interconnections at all terminal hardware shall be provided to form a complete and functioning system.
- B. Equipment cables shall be interconnected to horizontal cabling on Termination Modules color coded blue.
- C. Equipment cables shall be interconnected to for Security Access Control System horizontal cabling on Termination Modules color coded green.

3.13 TERMINATIONS

- A. Cables shall be marked with wire markers at both ends, and terminals on terminal blocks or patch panels shall bear the cable number. Trunk cables shall be neatly marked with "From-To" information.
- B. Wire twist shall be maintained to within 0.25 inch of the termination.

3.14 TERMINATION MODULES

- A. Install per manufacturer's recommendations.
- B. Protection modules shall conform to NEC 800 and be installed per manufacturer's recommendations.

3.15 COMPLETION AND TESTING

- A. Telecommunications System test reports shall be submitted to and approved by the Contracting Agency. The test reports shall certify that the Telecommunications Distribution System is complete, passes all test criteria, is fully operational, and that all work has been witnessed as specified.
- B. After installation and test of each system is complete, each system and the entire system shall be demonstrated and tested for proper operation. The Contractor shall schedule a demonstration with the following representatives present:
 - 1. Contractor's representative.
 - 2. Manufacturer's representative for each major communications subsystem.
 - 3. Contracting Agency's representative.
- C. The Contractor shall provide all forms, instrumentation and test equipment, loads, and other consumables required to demonstrate the systems to the Contracting Agency's satisfaction.
- D. Incoming Inspection Tests:
 - 1. Inspect all materials for damage.
- E. Patch Cord Testing:
 - 1. All patch cords shall be tested and shown to comply with the applicable Category cord requirements of TIA/EIA-568B.
 - 2. Compliance shall be proven by testing patch cords alone (i.e., not by inserting the patch cords into a channel).
 - 3. Cord performance shall be measured on-site by either using either the TIA method delineated in Annex J or by using a cord-test adapter and a hand-held LAN cable tester.

Cord compliance may be demonstrated by actual test reports supplied by the patch cord manufacturer.

F. Final Inspection Tests:

1. Testing of all copper wiring shall be performed prior to system acceptance. 100 percent of the horizontal and riser wiring pairs shall be tested. Link testing of all copper cabling shall be performed. Complete, end to end test results shall be submitted to the Contracting Agency.
 - a. Category 6A cable runs shall be tested for conformance to the specifications of EIA/TIA 568-C.2, Category 6A. Testing shall be done with a ANSI/TIA/EIA 568-C ETL verified Level II-E test set, with accuracy per Proposed TIA Level III standards.
 - 1). Test shall include all requirements of ANSI/TIA/EIA 568-C, including wiremap, length, characteristic impedance, insertion loss, ambient and impulse noise, NEXT, PSNEXT, FEXT, ELFEXT, PSELFEXT, return loss, ACR, PSACR, Propagation Delay and Delay Skew.
 - 2). Supported test frequency shall be 1-500 MHz to provide re-certification capability beyond Category 6A requirements.
 - 3). "Full Plot" storage shall store entire test, and be capable of uploading saved data and re-characterizing cables against new or evolving performance standards. Testers only saving worst case data are not acceptable. Test data shall be saved and provided to the Owner in neatly bound hardcopy and electronic format compatible with ScopeData Pro® software. Provide a copy of the software with the data.
 - 4). Reports shall be graphic, showing test results plotted against standards. Reports shall include a pass/fail summary of all network types specified.
 - 5). Any cables not meeting the requirements of the standard shall be brought into compliance at no charge to the Owner.
 - 6). Tester shall be equal to Agilent Technologies (HP) WireScope 350, Fluke DSP-4000, or IDEAL LANTEK 6P.
2. Test all cable with an approved cable tester in the presence of the Contracting Agency, at the Contracting Agency's option. Provide three (3) working days advance notice of tests. Record cable numbers on data test reports. Submit reports to Contracting Agency.
3. Test all cables from both ends.
4. Re-test all cable disturbed after testing, at the direction of Contracting Agency.
5. Spare unterminated cable shall be temporarily terminated for testing.

G. Replace all rejected materials.

3.16 OPERATING AND MAINTENANCE MANUALS

- A. Prepare manuals describing the servicing and maintenance requirements for the equipment being provided as required in this Section of these specifications.
- B. Information contained in the manuals shall consist of catalog data on each item, together with parts lists, wiring diagrams, test reports, description of routine maintenance required, suggested frequency of maintenance and recommended practices, and shall be 8-1/2 inches by 11 inches in size. Catalog pages and data in manuals shall be neat, clean copies. Drawings shall be accordion folded to above size. An index shall be provided which shall list all contents in an orderly manner. Include corrected shop drawings in the maintenance manuals. Each copy of the instruction manual shall be adequately labeled for identification and shall include plastic tabs coordinated with the index.
- C. Provide "Step-by-step" instructions for interpreting and utilizing the cable, outlet, jack and equipment identification system, including instruction for use of jack icons.
- D. Refer to "Submittals" requirements of this Section for additional O&M requirements.

3.17 INSTRUCTION AND TRAINING

- A. Provide detailed instructions to the Owner on how to obtain warranty service under the Special Warranty.

END OF SECTION 27 20 10

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SECTION 28 23 10

IP CLOSED CIRCUIT TELEVISION

PART 1 - GENERAL

1.1 DESCRIPTION AND GENERAL SPECIFICATIONS

- A. Provide the equipment, materials, and labor to install the systems shown on the Drawings and specified herein. This shall include (but not be limited to) provision of all cameras, software licenses, programming, raceways, wire, cable, cabinets, boxes, line and low voltage wire and cable, patch cords, terminal modules, panels, outlets, jacks, connections, cable management, labeling, testing and all other material, equipment, and labor required to make the systems fully operational.
- B. The intent of this Specification is to place in working order a complete, fully tested and documented IP Closed Circuit Television System for viewing, recording, and retention of IP based video. The IP Closed Circuit Television System shall comply with the Codes and Standards referenced herein and with the manufacturer's installation instructions and requirements.

1.2 DEFINITIONS

- A. Contractor: Within this section of the specifications, "Contractor" shall mean the Security Contractor performing this portion of the work.
- B. Provide: Within this section of the specifications, "provide" shall mean to furnish and install.
- C. NVRS – Network Video Recording System
- D. RU – Rack Unit (1-3/4 inches of rack or cabinet space)
- E. IPTV – Internet Protocol Closed Circuit Television

1.3 PROJECT SUMMARY

- A. The project consists of the installation of surveillance cameras, conduit, cabling, and network switches at the University of Alaska's University Lake Building Annex (ULA) in Anchorage, Alaska. Provide the cameras, related conduit, related cabling, and additional licenses for the existing Expert edition of the Milestone XProtect Video Management System Software as necessary to form a fully functioning system.
- B. IP cameras shall be used to capture the live video images of the areas under surveillance and shall stream digitized video signals over Category 6A cable to Ethernet network switches in the Main Telecom Room and the Satellite Telecom Rooms.

1.4 WORK INCLUDED

- A. The Contractor shall furnish all labor, equipment, wiring, supplies, materials, and programming necessary for the installation of a complete and operational Network Video Recording System in accordance with these Specifications, the drawings, and the terms and conditions of the Contract, except as specifically noted otherwise. Contractor shall be responsible to provide all system programming, test and checkout, and training for the work specified herein and detailed on the drawings.
- B. The work of this section shall include, but not be limited to furnishing and installing the following:
 - 1. Indoor, Fixed Digital (IP) Color Cameras
 - 2. Varifocal Lens
 - 3. Camera Housings
 - 4. Camera Mounts
 - 5. Licenses for the existing Expert edition of the Milestone XProtect Video Management System Software owned by UAA. This software is licensed on a per camera basis. Provide the necessary additional licenses to provide and install the cameras shown on the floor plans. Coordinate additional specific requirements with the Contracting Agency prior to construction.
 - 6. Network switches
 - 7. Provide Category 6A UTP patch cords for interconnecting Category 6A horizontal cables to cameras in accordance with Specification Section 27 20 10 Telecom Distribution System.
 - 8. Provide Category 6A UTP patch cords used interconnecting Category 6A horizontal cables at telecom patch panels to the Ethernet network switches and Network Video Recording System Server in accordance with Specification Section 27 20 10 Telecom Distribution System.
 - 9. Provide fiber optic cable patch cords used to interconnect the Ethernet network switches to the fiber optic backbone cables in accordance with Specification Section 27 20 20.
 - 10. Electrical boxes and raceways at device locations and equipment cabinets as necessary for mounting devices and interconnecting equipment
 - 11. Firestopping pathways that penetrate fire-rated walls, floors, and ceilings.
 - 12. All ancillary materials, including cable, wire and connectors necessary to provide a complete and operational system
 - 13. Grounding and bonding of installed equipment

1.5 RELATED SECTIONS

- A. Section 27 20 10 - Telecom Distribution System

1.6 REFERENCES

- A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or regulations referenced in this section.
- B. H.264/MPEG-4 Part 10 Video Compression Standard
- C. M-JPEG 10 Video Compression Standard
- D. IEEE 802.3ab Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Gigabit Ethernet Network
- E. IEEE 802.3af Power-over-Ethernet (PoE) Standard
- F. IEEE 802.3g Wireless LAN Standard
- G. IEEE 802.1Q VLAN Trunking Protocol
- H. IEEE 802.1 Quality of Service (QoS)
- I. ASTM E-814 Fire Tests of Through-Penetration Fire Stops.
- J. UL 1479 Fire Tests of Through-Penetration Firestop.
- K. 2008 NFPA 70 - National Electrical Code (NEC).

1.7 COORDINATION

- A. Coordinate the work of this section with the Contracting Agency as required to ensure that the entire work of this project will be carried out in an orderly, complete and coordinated fashion.
- B. Supply all necessary supervision and coordination of information to any contractor or subcontractor who is performing work to accommodate the work of this section and minimize interferences.
- C. Coordinate the exact mounting location and Field of Views (FOV) for each camera with the Contracting Agency prior to installation.
- D. The locations of IP Closed Circuit Television System equipment are diagrammatically expressed on the drawings. Exact locations of items of work shall be field coordinated. Report major discrepancies between locations of devices on the drawings and within the field to the Contracting Agency within three days.

1.8 INTENT OF DRAWINGS

- A. The drawings are diagrammatic unless detailed dimensions are included. Drawings show close approximate locations of equipment and devices. Exact locations are subject to the approval of the Contracting Agency.
- B. Anything mentioned in the specifications and not shown in the drawings, or shown in the drawings and not mentioned in the specifications, shall be of like effect as if shown and mentioned in both. In case of differences between the specifications and drawings, the stricter provision, as determined by the Contracting Agency, shall govern. Omissions from the drawings or specifications, or the incorrect description of details of work which are evidently necessary to carry out the intent of the drawings and specifications, shall not relieve the Contractor from performing such work.

1.9 SUBMITTALS

- A. Product Data and Shop Drawings
 - 1. Submittals shall include product data literature and shop drawings. Submittals shall include adequate descriptive literature, catalog cut sheets, shop drawings and other data necessary for the Contracting Agency to ascertain that the proposed equipment and materials comply with specification requirements.
 - 2. Product data submittals shall consist of catalog cut sheets, technical data sheets, manufacturer specifications, brochures and/or diagrams necessary to illustrate a product, material or system for some portion of the work. Product data literature is required on all items of material and equipment and should be clearly marked, identifying specific items proposed.
 - 3. Shop drawings shall include floor plans showing the exact locations of cameras and detailed elevation views of layouts within the Main Telecom Room and the Satellite Telecom Rooms showing equipment cabinets. All shop drawings shall be created using AutoCAD, version 2010 minimum.
 - 4. Prior to assembling or installing the work, prepare and submit shop drawings and product data literature for review and approval by the Contracting Agency.
- B. Calculations
 - 1. Bandwidth Calculations: Provide bandwidth calculations for the digital cameras using the frame rates, resolution and video compression standards specified and submit to the Contracting Agency for review and approval prior to construction. These bandwidth calculations will be used to verify that the specified backbone cable and related infrastructure will meet the required needs of the system.
 - 2. Recording Storage Calculations: Provide recording storage calculations for the system using the total number of digital cameras, frame rates, resolution and video compression standards specified and submit to the Contracting Agency for review and approval prior to

construction. These storage calculations will be used to verify that the specified storage will meet the minimum required storage retention time as specified below.

- C. The Contractor shall not purchase any materials or equipment prior to receipt of appropriately reviewed and approved Submittals from the Contracting Agency.
- D. Review of product data shall not relieve the Contractor from responsibility for deviations from the drawings or specifications, unless the Contractor has, in writing, called attention to such deviations at the time of submission and secured written approval.
- E. The Contractor shall develop and submit complete Submittals and do so in a timely manner. By failing to do so, the Contractor agrees to be fully responsible for any and all damages which might be incurred by the Contractor's failure to do so.
- F. Submittals shall include four (4) copies of Product Data Submittals and Shop Drawings.
- G. Product Data Submittals and Shop Drawings shall be submitted forty (45) days from the date of notice to proceed.

1.10 REGULATORY REQUIREMENTS

- A. All Work shall conform to the requirements of NFPA 70 and all local amendments.
- B. All Work shall conform to the requirements of all Federal, State and Local Electrical and Telecommunications Regulations.

1.11 QUALITY ASSURANCE

- A. All equipment shall meet or exceed the minimum requirements of NEMA, ASME, ANSI and Underwriters Laboratories.
- B. All material and equipment furnished shall be new and unused and free from defects. Equipment shall be clean and free of damage or corrosion, and shall be of the best quality obtainable for the purpose intended.
- C. Any specified item of equipment or material shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item are not permitted, unless specifically noted otherwise and approved in writing by the Contracting Agency.
- D. System hardware and software components shall be produced by a manufacturer regularly engaged in the production of Closed Circuit Television Systems and Network Video Recording System equipment for a minimum period of 5 years.
- E. Perform all Work in accordance with all regulatory rules and regulations as well as references in this specification.

1.12 CONTRACTOR QUALIFICATIONS

- A. The IP Closed Circuit Television System work specified in this Section is acknowledged to require special skills mastered by education, experience, or both. Bidders for the work described in this Section shall be specialty contractors, who may be a division of the Divisions 26, 27 and 28 Subcontractor.
- B. The installing Contractor shall be a company specializing in the design, installation, and testing of electronic security systems and specifically IP Closed Circuit Television and NVRS systems.
- C. The installing Contractor shall have a minimum of three years of experience in this specialized field and shall have completed a minimum of three projects similar in scope to this project.
- D. All Work shall be performed by qualified individuals having at least three (3) years experience installing and/or maintaining IP Closed Circuit Television and NVRS systems. The qualified individuals shall have completed installation of at least two (2) systems of 25 cameras or more within the past five (5) years. Submit evidence of successful installation, Contracting Agency training and maintenance for a minimum of the previous five years. Provide listing of projects with verifiable references with names and telephone numbers. Qualified individuals shall be factory trained for the systems being provided as part of this Contract. Submit evidence of successful factory training no later than 30 days from Notice to Proceed.

1.13 WARRANTY

- A. All work shall be guaranteed to be free from defects. Any defective materials or workmanship shall be replaced or repaired as directed by the Contracting Agency for the duration of the stipulated guarantee period.
- B. The Contractor shall warrant all labor, workmanship, and materials provided under this Contract for a minimum period of 1 year from date of Substantial Completion or as specified elsewhere in these specifications.
- C. If items supplied as part of this project have longer warranties, the Contractor shall match the longer warranty duration from the date of Substantial Completion.
- D. If other individual Specification Sections require longer warranty, the Contractor shall match the longer warranty duration from the date of Substantial Completion.
- E. The Contractor shall guarantee in writing all phases of the work against defective materials and workmanship. Should a failure occur within the warranty period, the Contractor shall provide all labor and materials necessary to restore the system to its' full and operating condition at no cost to the Contracting Agency.

1.14 MAINTENANCE AND SERVICE

- A. General Requirements: Provide services and equipment necessary to maintain the entire IP Closed Circuit Television System system in an operational state as specified for a period of 1 year after

Substantial Completion of the system. Provide all necessary material required for performing scheduled maintenance or other nonscheduled work.

B. Response Times: For the warranty period the following response times shall be maintained:

1. The initial call to the Contractor shall require the type of call to be classified as critical or non-critical. The nature of the problem and the effect on school operations will be the deciding factor in classifying the problem. For the purpose of defining the priority of the call, the Contractor shall have personnel accessible to UAA ITS personnel via phone call-back within one (1) hour of initial call.
 - a. Non-critical Items: These are defined as failures or problems that do not affect the overall safety, security, or operation of the school.
 - b. Critical Items: These are defined as failures or problems that do effect the overall safety, security, or operation of the school. The failure of a primary server would be an example of a critical item requiring immediate remedy.
2. Non-critical items: The Contractor shall diagnose and remedy the problem during normal working hours of the next working day. The initial response shall be the morning of the next day if received before noon or by the noon the next day if received before close of business. Normal business hours are defined as 8 AM to 4 PM Monday through Friday.
3. Critical Items: Critical items require the Contractor to respond in an expedition manner. The Contractor shall be on-site within four (4) of the initial call. These calls will possibly need to be responded to outside of normal business hours.

C. If the Contractor fails to respond to the service request within the specified time, the Contracting Agency will have the right to repair the system without invalidating the warranty. In the event the Contracting Agency affects repairs because of Contractor non-response, the Contractor will be charged for the repair cost.

D. Software: Provide the necessary additional licenses to provide and install the cameras shown on the floor plans. Coordinate additional specific requirements with the Contracting Agency prior to construction.

1.15 RECORD DOCUMENTATION

A. Record documentation shall include:

1. Operation and Maintenance (O&M) Manuals. (Hard and soft copy)
2. Complete set of record as-built shop drawings. (Hard and soft copy)
3. Installed camera serial numbers (Hard and soft copy)
4. Installed network switch(es) serial numbers (Hard and soft copy)

B. Operation and Maintenance (O&M) Manuals.

1. Upon completion of the project, submit a complete set of product data sheets for all products installed. Product data sheets shall be clearly marked, identifying the specific items installed.
2. Where applicable, submit operations manuals and maintenance manuals for active and passive components of the installed systems.
3. Submit four (4) identical sets of O& M Manuals.

C. Record Drawings

1. Maintain a complete set of contract drawings. Use this set of drawings for showing as constructed installation of systems and equipment. Plans shall include, but not be limited to, showing exact location and heights of devices, and appropriate identification. Detail drawings shall show exact locations of equipment racks, cross-connects, and any other pertinent details.
2. Where any material, equipment, wiring or system components are installed differently from that shown, show such differences clearly and neatly.
3. This set of drawings shall be kept up to date as the job progresses and shall be made available for inspection by the Contracting Agency at all times.
4. Upon completion of the project, incorporate this set of drawings with as constructed details into the Shop Drawings using AutoCAD, version 2010. Submit four (4) full-size sets of drawings and the AutoCAD drawing files on DVD to the Contracting Agency

1.16 IP CLOSED CIRCUIT TELEVISION SYSTEM SCOPE OF WORK

- A. Provide IP cameras, related conduit, and related cabling at the locations shown on the drawings.
- B. Provide additional software licenses.
- C. Camera Power Cabling
 1. Interior cameras shall be powered over the Category 6A cable provided in accordance with Specification Section 27 20 10 Telecom Distribution System from Power-over-Ethernet (PoE) compliant Ethernet network switches provided in accordance with this Specification.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Protect all materials and equipment from damage during storage at the site and throughout the construction period. Equipment and materials shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain. If items are damaged, do not install, but take immediate steps to obtain replacement.
- B. Acceptable Manufacturers and Substitutions
 - 1. Named manufacturers are the basis of design for this system.
 - 2. The Contractor may submit a request for approval of equal products or materials. The request shall include product literature and a complete compliance checklist with individual specification paragraph performance requirements. The request shall be submitted to the Contracting Agency for review and possible approval within the specified time before the bid.
 - 3. No requests for substitutions shall be considered after the bid opening.

2.2 INDOOR FIXED IP CAMERA

- A. General
 - 1. Cameras shall be IP based and fully integrated and managed through a system software package.
 - 2. Cameras shall feature a built-in digital motion detector with alarm output.
 - 3. Minimum Specifications:
 - a. Type A
 - 1). Compression: H.264 and Motion JPEG
 - 2). Resolution: 1280x960 pixels.
 - 3). Frames Per Second:
 - a) 30 fps in all resolutions
 - 4). Image Sensor: 1/3" Progressive scan RGB CMOS
 - 5). Lens: F1.6 varifocal 2.5-10mm, DC-iris, Focus range: 0.3 m to infinity.
 - 6). PoE compliant: 802.3af
 - 7). Mounting: Ceiling/wall mounted dome enclosure

- 8). Enclosure: dome
 - 9). Power: Power over Ethernet (PoE) from Ethernet network switches
 - 10). Connectors: Ethernet 10BaseT/100BaseTX, RJ-45
- b. Type B
- 1). Compression: H.264 and Motion JPEG
 - 2). Resolution: 1920x1080 pixels.
 - 3). Frames Per Second:
 - a) 30 fps in all resolutions
 - 4). Image Sensor: 1/3" Progressive scan RGB CMOS
 - 5). Lens: F1.4 varifocal 3-10.5mm, DC-iris, Focus range: 0.3 m to infinity.
 - 6). PoE compliant: 802.3af
 - 7). Mounting: Ceiling/wall mounted dome enclosure
 - 8). Enclosure: dome
 - 9). Power: Power over Ethernet (PoE) from Ethernet network switches
 - 10). Connectors: Ethernet 10BaseT/100BaseTX, RJ-45
- c. Type C
- 1). Compression: H.264 and Motion JPEG
 - 2). Resolution: 4 each 1920x1080 pixels.
 - 3). Frames Per Second:
 - a) 15 fps in all resolutions
 - 4). Image Sensor: 4 each 1/2.8" Progressive scan RGB CMOS
 - 5). Lens: F2.0 varifocal 2.8-6mm, DC-iris, Focus range: 0.3 m to infinity.
 - 6). PoE compliant: 802.3af
 - 7). Mounting: Ceiling/wall mounted dome enclosure
 - 8). Enclosure: dome
 - 9). Power: Power over Ethernet (PoE) from Ethernet network switches

- 10). Connectors: Ethernet 10BaseT/100BaseTX, RJ-45
- d. Type D
 - 1). Compression: H.264 and Motion JPEG
 - 2). Resolution: 2592x1944 pixels.
 - 3). Frames Per Second:
 - a) 12 fps in all resolutions
 - 4). Image Sensor: 1/3.2" Progressive scan RGB CMOS
 - 5). Lens: F2.8 1.3mm, DC-iris, Focus range: 0.3 m to infinity.
 - 6). PoE compliant: 802.3af
 - 7). Mounting: Ceiling/wall mounted dome enclosure
 - 8). Enclosure: dome
 - 9). Power: Power over Ethernet (PoE) from Ethernet network switches
 - 10). Connectors: Ethernet 10BaseT/100BaseTX, RJ-45,
4. Provide a 64 GB microSDXC card with each camera.
5. Acceptable Manufacturers
 - a. Axis Communications
 - 1). Type A: Model P3224-V MKII or approved equal
 - 2). Type B: Model P3225-V MKII or approved equal
 - 3). Type C: Model Q3707-PE or approved equal
 - 4). Type D: Model M3007-PV or approved equal

2.3 IP CLOSED CIRCUIT TELEVISION SYSTEM CAMERA WIRING

- A. Interior cameras: Provide one telecommunication horizontal cable to each camera in accordance with Specification Section 27 20 10 Telecom Distribution System.

2.4 CATEGORY 6A PATCH CABLES

- A. Provide in accordance with Specification Section 27 20 10 Telecom Distribution System.

2.5 NETWORK VIDEO RECORDING SYSTEM SOFTWARE

- A. UAA currently has an Expert edition of the Milestone XProtect Video Management System Software. This software is licensed on a per camera basis. Provide the necessary additional licenses to provide and install the cameras shown on the floor plans. Coordinate additional specific requirements with the Contracting Agency prior to construction.

2.6 CABINET MOUNTED UPS

- A. Product Model: APC Smart-UPS RT Series or approved equal.
- B. Provide in each IP Closed Circuit Television System cabinet the number of rack mount UPSs as noted on the drawings. The UPSs' shall have the following operating and rating characteristics:
 - 1. Continuous Rating: 1500VA / 1050 Watts
 - 2. Input
 - a. Input Frequency: 60Hz
 - b. Input Connection: Receptacle, NEMA 5-20R
 - 3. Battery: Internal battery system as required to provide 10 minutes of backup power.
 - 4. Communications and Management
 - a. Interface Port: DB-25 RS-232, Contact Closure
 - b. Audible alarm: Yes
 - c. Smart Slot: 1 with pre-installed smart slot card
 - 5. Environmental
 - a. Operating Environment: 32 - 104° Fahrenheit
 - b. Operating Relative Humidity - 0 - 95%
- C. Specified UPS sizes are based on the product reference standards, specified system design, and anticipated telecommunication room (TR) equipment loads. Provide UPSs, based on the Contractor's final system design, sized at 25% future power output expansion for a backup run time of one half hour at maximum load.

2.7 CABINET MOUNTED POWER DISTRIBUTION/SURGE SUPPRESSION STRIPS

- A. Provide cabinet mounted power distribution strips/surge suppression strips for mounting in the equipment cabinets furnished in accordance with Specification Section 27 20 10 Telcom Distribution System.

2.8 SPECIAL EQUIPMENT

- A. Special hardware, software, tools, test equipment, programming or initialization equipment needed to modify or maintain any part of the IP Closed Circuit Television System or its components shall be provided as part of the IP Closed Circuit Television System.

2.9 UNSPECIFIED EQUIPMENT AND MATERIAL

- A. Any item of equipment or material not specifically addressed on the Drawings or in this document and required to provide a complete and functional NVR System shall be provided in a level of quality consistent with other specified items.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all equipment in strict accordance with the manufacturer's recommendations.
- B. The installation shall comply with the requirements of NEC, OSHA and the rules, regulations and requirements of the FCC.
- C. The installation shall also comply with federal, municipality, and state laws, ordinances, regulations, and codes applicable to the installation.
- D. The Contractor shall ground all IP Closed Circuit Television System equipment installed to the grounding bus bars provided in the IP Closed Circuit Television System or telecom equipment cabinets.
- E. All wiring at cameras shall be concealed and not exposed. The Contractor shall install wiring through camera mounts and housing or conduit / flexible conduit where required.
- F. Provide labels on installed equipment. Labels shall be permanent, waterproof, and readable from one foot with permanent lettering and shall not be removable by normal cable handling or normal operations.
 - 1. Screws for all junction boxes, pull boxes, and camera mounts and enclosures shall be tamper resistant.
 - 2. Cameras will be labeled in the building from East to West or North to South depending on building orientation. For example, if the building is oriented lengthwise east to west then the east most camera on the first floor would be labeled "ULA 1-1". Coordinate additional specific requirements with UAA ITS prior to shop drawing submittal.

3.2 CAMERA LOCATION SURVEY

- A. Survey each camera location using a portable camera(s) with a variety of suitable lenses, monitor(s) and a portable power supply to power the equipment. Supply all required equipment

and wiring for the survey. The camera survey must take place with both UAA ITS personnel and UPD personnel in attendance. Schedule the survey a minimum of two weeks in advance.

- B. Camera heights are not typically indicated on the drawings. Perform a Field Verification Survey with the Contracting Agency to verify the exact mounting locations, heights, and camera field-of-views for each camera prior to installation. Submit printed camera field of view pictures to the Contracting Agency for review and approval prior to mounting cameras.
- C. Prepare forms to document information, such as names of participants, date of survey, camera location information, desired field of view, lenses selection, proposed mounting configuration and any other information as may be required.
- D. Incorporate data from survey into installation of cameras.

3.3 CONFIGURATION AND PROGRAMMING

- A. Provide all software, software licenses for a complete and fully operational IP Closed Circuit Television System system, including but not limited to, software installation, all system interfaces graphics development, camera and related hardware installation, conduit and cabling installation, camera aiming, and camera focusing. UAA ITS will program the cameras.
- B. Identify and request from the Contracting Agency any additional data needed to provide a complete and operational IP Closed Circuit Television System. Submit request to the Contracting Agency 30 days prior to programming the system. The Contracting Agency shall provide in writing to Contractor 14 days prior to programming any additional details for configuring the system.
- C. Configure the system according to the specifications and drawings and any additional Contracting Agency requirements. The parameters to configure include, but are not limited to:
 - 1. Camera Field of Views from the camera survey
- D. Provide additional licenses for UAAs' Milestone XProtect Video Management System Expert Edition.
- E. Program and configure the Client Video Management software on the Monitoring/Control Workstations to enable users to view live and recorded video and control future PTZ cameras. Programming shall include, but not be limited to:
 - 1. Setting passwords protection on the client software
 - 2. Setting access levels such as administrator, operator or viewer.
 - 3. Monitor modes such as multi-camera display, full screen view or camera sequencing
- F. Create, develop, and install all graphics required to make the system operational.
 - 1. Graphics shall have sufficient level of detail for personnel to operate the system.

2. Supply hard copy, color examples at least 8½ inches by 11 inches in size, of each type of graphic to be used for the completed IP Closed Circuit Television System.
 3. Provide examples of the video annotation used for camera identification.
 4. The graphics examples shall be submitted to the Contracting Agency for review and approval at least 30 days prior to the Contractor programming the system.
- G. Include in the Bid all required costs for four hours of software modifications based on additional Contracting Agency input and direction from the Contracting Agency at time of system acceptance.

3.4 TESTING

A. Preparation

1. Prior to Final Acceptance Testing the Contractor shall inspect items of equipment and systems to ensure that:
 - a. Installation is in accordance with manufacturer's instructions and recommendations.
 - b. No defective items have been installed and there are no loose connections.
 - c. System software and firmware are completely installed and fully operational.
2. The Contractor is required to provide and submit evidence of their completion of the manufacturer's checklists or test procedures prior to receiving approval to proceed with Cutover for new software installations.
3. Cabling is properly labeled, neat, and properly secured.
4. Power supplies are correct voltage, phasing, and frequency.
5. Grounding and transient protection systems are properly installed.
6. System documentation is complete, accurate, and has been properly submitted.

B. Test Plan

1. The Contractor shall prepare a Test Plan. The approved Test Plan shall serve as the basis for the detailed test procedures used in the field.
2. The Test Plan shall:
 - a. Include an overall testing schedule for tests to be performed.
 - b. Describe the schedule and method by which the Contractor shall perform testing of the system.

- c. Describe the types of test equipment, software, hardware, and simulators, proposed for each testing phase.
 - d. Define and detail the test methodology for verifying the system requirements, satisfying the performance and availability criteria, and satisfying the Specifications.
3. The Contractor shall update the Test Plan as necessary and obtain the Contracting Agency's written acceptance of the Test Plan prior to beginning any testing.

C. Testing

1. Provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing.
2. Written notification of planned testing shall be given to the Contracting Agency at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific Test Plan.
3. Ensure that test procedures confirm each specification statement and manufacturer requirement has been met or exceeded. An actual demonstration of each system function and a simulation of each system failure shall be provided.
4. An acceptance test period of thirty days shall begin at the start of the acceptance test. Any system failure during the acceptance test period will suspend the acceptance test. The thirty-day test period will restart when the required repairs have been made and certified.
5. Perform all tests in the presence of the Contracting Agency. The Contracting Agency reserves the right to accept any portion or activate any phase prior to acceptance of entire system.
6. The field testing shall as a minimum include:
 - a. Verification that the video and signal or control cabling has been installed, tested, and approved.
 - b. Verification that the IP Closed Circuit Television System is fully functional.
 - c. Operation of all electrical, mechanical and software controls and verification that the control performs the designed function.
 - d. Verification that all other ancillary and remote video equipment is functioning properly.
 - e. Verification that video equipment with alarm indicators annunciate alarms properly and under the correct conditions.

3.5 FIRESTOPPING

- A. Firestop, per the applicable codes, all fire-rated walls, floors or ceilings penetrated when installing the devices provided under this Specification Section.
- B. Provide fire resistant UL approved firestopping systems to restore fire ratings to all wall, floor or ceiling penetrations. Firestopping systems must be UL classified and meet NEC and MOA.
- C. All firestopping materials shall be installed in accordance with the manufacturer's directions and recommendations.

3.6 DEMONSTRATIONS AND TRAINING

- A. Provide demonstrations and training in accordance with Section 01 79 00 – Demonstrations and Training

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SECTION 28 31 00

ADDRESSABLE FIRE ALARM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This specification provides the requirements for the installation, programming and configuration of intelligent addressable Fire Alarm and Emergency Voice/Alarm Communications (EVAC) System for this project.
- B. Provide all permits, labor, equipment, materials and services to furnish and install fully tested functional, UL Listed, code compliant, intelligent addressable Fire Alarm and EVAC System as outlined in this Section and on the Contract Drawings.
- C. The systems supplied under this specification shall utilize modular low voltage design with direct wired, node to node, peer-to-peer network communications. The system shall utilize independently addressed fire initiation and detection devices, input/output control modules, audio amplifiers, communications, notification and annunciation appliances as described in this specification.
- D. The systems and equipment supplied under this specification shall be provided by the same company, and shall be tested and cross listed as compatible to ensure that a fully functioning addressable Fire Alarm EVAC system are provided.
- E. The system drawings show the intended of coverage and suggested device locations. Final device quantity, location, and AHJ approval are the responsibility of the contractor.
- F. The final system shall be complete, tested, and ready for operation as described elsewhere in this specification, before owner acceptance.

1.2 RELATED SECTIONS

- A. 26 00 00 - Electrical General Requirements
- B. 27 20 10 - Telecom Distribution System

1.3 SCOPE

- A. Base Bid
 - 1. The scope of work includes providing a new addressable Fire Alarm and Emergency Voice Alarm Communications System (EVACS) for the building.

2. Provide modifications and new work including, but not limited to; fire alarm and EVAC control panel, programming, modules, enclosures, power supplies, batteries, wiring, cabling, conduit/raceway, device J-boxes and pull boxes, field devices/appliances, terminal cabinets, mounting boxes, accessories and miscellaneous items required for a fully tested functional, UL Listed, code compliant system.
3. Provide connections and programming for communications with the existing UAA campus-wide EST/Edwards FireWorks graphical command & interface system.
4. The Fire Alarm and EVAC system shall be provided and tested for interior building audibility of 15 dBA over ambient condition per NFPA 72 and ANSI. EVAC system intelligibility shall be provided and tested to ensure Common Intelligibility Standard (CIS) rating of 0.7 or Sound Transmission Index of 0.5 in all areas designated on the drawings to have intelligible audio.
5. System units, devices, appliances and equipment shall be located in accordance with plans.
6. Provide programming of Fireworks Server including graphics update to support the networked fire alarm panel reconfiguration shown in the drawings and the graphic map of the project building.

1.4 REFERENCES

- A. The equipment and installation shall comply with the current provisions of the following Codes and Standards:

1. National Electric Code, Article 760.
2. National Fire Protection Association Standards:

NFPA 72	National Fire Alarm Code
NFPA 101	Life Safety Code
3. Local and State Building Codes.
4. Local Authorities Having Jurisdiction (AHJ).
5. Underwriters Laboratories Inc.

- B. The system and components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:

UL 864/UOJZ, APOU	Control Units for Fire Protective Signaling Systems.
UL 268	Smoke Detectors for Fire Protective Signaling Systems.
UL 268A	Smoke Detectors for Duct Applications.
UL 217	Smoke Detectors Single Station.
UL 521	Heat Detectors for Fire Protective Signaling Systems.

UL 228	Door Holders for Fire Protective Signaling Systems.
UL 464	Audible Signaling Appliances.
UL 1638	Visual Signaling Appliances.
UL 38	Manually Activated Signaling Boxes.
UL 346	Waterflow Indicators for Fire Protective Signaling Systems.
UL 1971	Standard for Signaling Devices for the Hearing Impaired.
UL 1481	Power Supplies for Fire Protective Signaling Systems.
UL 1711	Amplifiers for Fire Protective Signaling Systems.
UUKL	Smoke Control Equipment

- C. Americans with Disabilities Act (ADA).
- D. International Standards Organization (ISO).
 - 1. ISO-9000.
 - 2. ISO-9001.

1.5 DEFINITIONS AND ABBREVIATIONS

A.

ACU	Autonomous Control Unit.
ADA	Americans with Disabilities Act.
AFF	Above Finished Floor.
AHJ	Authority Having Jurisdiction.
Approved	Unless otherwise stated, materials, equipment or submittals approved by the Authority or AHJ.
CCS	Central Control Station
Circuit	Wire path from a group of devices or appliances to a control panel or transponder.
Class A B C D E or Y	Circuit Pathway Designation and Performance as defined in Chapter 12 NFPA 72 (2010)
CPU	The central computer of a multiplex fire alarm or voice command control system.
ECS	Emergency Communication System.
EVACS	Emergency Voice/Alarm Communications System.
FACP	Fire Alarm Control Panel.

FCC	Fire Command Center.
FM	FM Global (Factory Mutual)
FSCP	Firefighter's Smoke Control Panel.
HPSA	High Power Speaker Array.
HVAC	Heating Ventilating and Air Conditioning.
IDC	Initiating Device Circuit.
LCD	Liquid Crystal Display.
LED	Light Emitting Diode.
MN	Mass Notification.
MNEC	Mass Notification Emergency Communications.
NAC	Notification Appliance Circuit.
NFPA	National Fire Protection Association.
NICET	National Institute for Certification in Engineering Technologies
NRTL	Nationally Recognized Testing Laboratory
PTR	Printer.
RCP	Remote Control Panel.
SLC	Signaling Line Circuit.
UAA	University of Alaska Anchorage
UL or ULI	UL or ULI: Underwriters Laboratories, Inc.
UL Listed	UL Listed: Materials or equipment listed and included in the most recent edition of the UL Fire Protection Equipment Directory.
Zone	Zone: Combination of one or more circuits or devices in a defined building area, i.e. 3 speaker circuits on a floor combined to form a single zone.

1.6 AUTHORITY HAVING JURISDICTION (AHJ)

- A. The Municipality of Anchorage (MOA) has jurisdiction over the premises for Fire Alarm and EVAC system Plan Reviews, Inspections & Code Enforcement.

1.7 QUALITY ASSURANCE

A. Qualifications of Contractor

1. The Contractor shall have successfully installed similar system fire detection, evacuation and visual signaling control components on a previous project of comparable size and complexity. The Contracting Agency reserves the right to reject any control components for which evidence of a successful prior installation performed by the Contractor cannot be provided.
2. The Contractor shall have in house engineering and project management capability consistent with the requirements of this project. Qualified and approved representatives of the system manufacturer shall:
 - a. Perform the detailed engineering design of central and remote control equipment.
 - b. Produce panel and equipment drawings and submittals, and operating manuals.
 - c. Coordinate system installation requirements, and final system testing and commissioning in accordance with these specifications.
3. The installation of the system shall conform to the State of Alaska regulations.
4. The Manufacturer shall be a nationally recognized company specializing in fire alarm systems and shall employ factory trained, NICET certified technicians. The Manufacturer shall maintain a service organization in Alaska and have a minimum of 5 years of experience in the fire alarm industry.
5. The installer shall be a company specializing in the installation of fire alarm systems and be factory certified by the Manufacturer for their system. The installer shall have a minimum of 3 years of experience installing fire alarm systems. The installation shall be fully field verified by a factory trained and authorized technician and hold a NICET Level III certification.

1.8 SUBMITTALS

- A. Provide shop drawings and submittals for products in accordance with this Section, Section 26 00 00 - Electrical General Requirements, Division 1 requirements and as required by the AHJ:
 1. Submit complete one-line risers and point-to-point wiring diagrams prepared especially for this installation.
 2. Device riser diagram shall include:
 - a. Control panels, addressable devices, and notification appliances.
 - b. Proposed device description above each addressable device.
 - c. Discrete device address that corresponds to addresses shown on the floor plans.

- d. Shall provide wire specifications, and wire identification for all conductors depicted on the riser diagram.
 - e. All circuits and shall have identifiers that shall correspond with those required on the control panel and floor plan drawings. End-of-line resistors (and values) shall be depicted.
3. Provide floor plans for all areas. Floor plans shall indicate accurate locations for all control and peripheral devices. drawings shall be no less than 1/8-inch scale. if individual floors need to be segmented to accommodate the 1/8-inch scale requirements, key plans and break-lines shall be provided on the plans in an orderly and professional manner.
 - a. All addressable devices shall be shown. Coordinate the device address with the same device shown on the riser diagram.
 - b. Identify all notification appliances with a circuit and item number. Coordinate the circuit and item number with the same device shown on the riser diagram.
 - c. Show all raceways, marked for size, conductor count with type and size, showing the percentage of allowable National Electric Code fill used.
 - d. Areas required to meet intelligibility requirements shall be clearly identified. Wide area mass notification system plot drawings shall identify all project areas that must meet intelligibility requirements as well as environmentally sensitive areas on or off of the project site where system output shall be minimized.
4. Submit a fire alarm system function matrix that illustrates alarm input/out events in association with initiation devices. Matrix summary shall include system supervisory and trouble output functions and sequence of operation.
5. Submit proposed alarm and evacuation messages (Fire Alarm EVAC system).
6. Submit conduit layout drawings of the system, indicating type, size and number of conductors, conduits and junction boxes.
7. Submit calculations verifying standby battery capacity per NFPA 72, including manufacturer's published current consumption data for equipment on the System.
8. Submit calculations verifying that notification appliance circuits voltage drops do not exceed the manufacturer's set limits and as further specified in this Section.
9. Submit for approval manufacturer's catalog information with complete description of panel mounted and remote equipment.
10. DELETE SUPERFLUOUS INFORMATION FROM SUBMITTAL DATA, SUCH AS MODEL NUMBERS AND OPTIONS FOR EQUIPMENT CONTAINED ON MANUFACTURER'S DATA SHEETS BUT NOT USED ON THIS PROJECT.

- B. Submit three (or other quantity as requested) of the Fire Alarm Shop Drawings to the Authority Having Jurisdiction (AHJ). Obtain a written statement of Approval of the proposed system. This Approval shall be obtained prior to submitting to the Contracting Agency.

1.9 OWNER'S MANUALS

- A. Furnish complete sets of Operation and Maintenance Manuals and other information necessary for the operation and maintenance of the system in accordance with Division 1 requirements. Provide number of sets as required in Division 1, however if not specified, provide a minimum of two (5) complete sets.

1.10 WARRANTY AND SERVICE

- A. Warranty all components, parts and assemblies against defects in materials and workmanship for a period of 12 months from date of final completion. Warranty service shall be provided by a trained specialist of the equipment manufacturer. The specialist shall be based in a fully-staffed branch office located within a reasonable distance from the job site.
- B. Service availability: The supplier shall have sufficient stock on hand and have a fully equipped service organization capable of guaranteeing response time within 2 hours of service calls, 24 hours a day, 7 days a week to service completed systems.
- C. The Engineered Systems Distributor of the Fire Alarm EVAC System Equipment specified herein shall provide a copy of their certificate of successful completion of an authorized Training Course given by the Manufacturer of the Fire Alarm EVAC System Equipment.

PART 2 - PRODUCTS

2.1 BASIS OF DESIGN AND PRODUCT SUBSTITUTIONS

- A. These specifications are based on the EST3 fire alarm and EVAC system and equipment from Edwards/EST to set a standard for design and quality.
- B. Equipment manufactured by Simplex is an acceptable substitution provided the following provisions are met:
 - 1. If equipment of another manufacturer is to be submitted for approval as equal, the contractor shall, at the time of bid, list all exceptions taken to these specifications, all variances from these Specifications and all substitutions of operating capabilities or equipment called for in these specifications and forward said list to the engineer. Any such exceptions, variances or substitutions not listed at the time of bid and are subsequently identified in the submittal, shall be grounds for immediate disapproval without comment. Final determination of compliance with these specifications shall rest with the engineer, who, at his discretion, may require proof of performance.

2. Alternate product submissions shall provide proof of no less than three (3) factory authorized and certified manufacturer's distributors within 60 miles of the project job site. These distributors shall provide installation support, shall have a service organization capable of 24 hour emergency call service and shall have been contracted and delivered no less than five (5) similar projects using the submitted product over the past year. Alternate submissions without the required references shall be rejected.
3. Alternate product submissions based upon use of a product line considered proprietary in its distribution, design, application software, or ongoing maintenance and repair shall not be acceptable. Proof of a product's non-proprietary nature shall be the burden of the contractor at the time of bid, and shall be in the form of written documentation. The determination of a product's compliance to this requirement shall be exclusively that of the engineer.
4. All products used shall be of a single manufacturer. All products shall be listed by the manufacturer for their intended purpose. Submission of notification appliances, auxiliary relays, or documentation from other than a single manufacturer shall not be acceptable and will be grounds for immediate disapproval without comment.
5. A global graphic command system meeting the performance of the Edwards/EST Fireworks system shall be provided for remote monitoring and control of the fire alarm and EVAC systems by UAA personnel. The system shall be a complete operating system and shall include; software, server, programming interconnections and training for UAA personnel.
 6. Note: It is understood the Simplex equivalent global graphic command system is the Simplex True Alarm networked graphical interface control system.
7. Refer to Specification Section 26 00 00 - Electrical General Requirements; 1.3 Definitions and 1.5 Submittals F.4. for additional requirements and obligations concerning substitutions.

2.2 GENERAL

- A. Equipment furnished for this project shall be new and unused. Components and systems shall be designed for uninterrupted duty. Equipment, materials, accessories, devices, and other facilities covered by this specification or noted on contract drawings and installation specifications shall be suited for the intended use and shall be provided by a single manufacturer. If the equipment provided under this Specification is provided by different manufacturers, then that equipment shall be recognized as compatible by both manufacturers, and "Listed" as such by Underwriters' Laboratories.
- B. System installation and operations shall be verified by the manufacturer's representative and a verification certificate presented upon completion. The manufacturer's representative shall be responsible for an on-site demonstration of the operation of the system and initial staff training as required by the Contracting Agency.
- C. The system shall be capable of detecting the electrical location of each Signature intelligent device including new and existing devices. It shall be possible to display the intelligent device map on the laptop PC.

- D. It shall be possible for authorized service personnel using a Program/Service Tool or laptop PC to change the personality/function of a Signature Series Device to meet changes in building layout or environment. System changes shall be verified by the manufacturer's representative and a verification certificate presented upon completion.

2.3 AUTOMATIC ALARM OPERATIONS

- A. Upon the alarm activation of any area smoke detector, heat detector, manual pull station or sprinkler waterflow, the following functions shall automatically occur:
 - 1. Upon alarm, the system shall sound the evacuation signals and activate visual strobes throughout the building.
 - 2. The visual strobe shall continue to flash until the system has been reset.
 - 3. All automatic events programmed to the alarm point shall be executed and the associated outputs activated.
 - 4. The system shall remain in the alarm mode until all initiating devices are reset and the fire alarm panel is manually reset and restored to normal.
 - 5. The internal audible device shall sound at the control panel.
 - 6. The alarm event shall be displayed on the graphical workstation.
 - 7. The LCD Display shall indicate all applicable information associated with the alarm condition including: zone, device type, device location and time/date.
 - 8. Remote or local annunciator LCD/LED's associated with the alarm zone shall be illuminated.
 - 9. The system shall shut down air supply fans throughout the building. Shutdowns shall be hardwired from the Fire Alarm System (i.e., not implemented via building automation controls) and immediate acting, and shall not be overridden by Hand-Off-Auto switches or other controls.
 - 10. Upon alarm initiated by the sprinkler flow switch(es), the system shall also sound the exterior sprinkler bell and sound the evacuation signals throughout the building. The sprinkler bell shall be supplied by a non-silenceable supervised notification circuit.
 - 11. Transmit signal to the central monitoring station with site identification.
- B. Operation of each alarm input device shall show on the LCD display at the main Control Panel. Each Intelligent device shall annunciate individually.
- C. LCD display on Fire Alarm Control Panel shall be programmed to give English-language description of each device by type, identifying number, and location. Example: "Sprinkler Zone 1 Flow Switch #01 (Storage Room)." Use actual room numbers, where available.

- D. LCD display messages shall be approved by the Authority Having Jurisdiction and the Owner prior to equipment ordering and programming.: Changes required by the AHJ or the Owner shall be implemented without increase in the Contract Amount.
- E. The system shall be capable of displaying events by type (fire alarm, pre-alert, supervisory, and trouble). At the same time, the system shall sound a momentary audible signal for each event occurrence; flash an LED when an unacknowledged event exists, and, update the display to annunciate the total by type.
- F. The system shall print the event on each printer connected to the system with the time and date, type, condition, and a user defined message.
- G. The system shall display operational status of each signal circuit to inform the emergency user of the system status.
- H. System activity/events shall be documented and logged into system history.

2.4 FIRE ALARM AND EVAC PANELS AND EQUIPMENT

- A. The Fire Alarm EVAC System shall include the following features and shall support the following operations in each installed cabinet or node of the system:
 - 1. Up to 10 Signature Series Intelligent Device loops.
 - 2. Up to 125 Intelligent Smoke Detectors and 125 Intelligent Modules per Signature Device Card (SDC).
 - 3. Up to 120 Hardwired input/output Circuits.
 - 4. Up to 342 Manual Control (Input) Switches.
 - 5. Up to 456 LED Annunciation Points.
 - 6. Up to 63 Remote Display Units.
 - 7. Multi-Priority, token passing, peer-to-peer network connection of up to 64 system nodes wired as Class B (Style 4).
 - 8. Ground fault detection by panel, by Signature Data Circuit, and by device module.
 - 9. Ability to download all system applications programs and “firmware” from a computer through a single point in the system.
 - 10. True Distributed Intelligence, including microprocessor-based Detectors and Modules.
 - 11. A.C. Power Trouble Delay adjustable from 4 Hours to 10 Hours.
 - 12. Removable, Interlocked terminal blocks for the connection of the field wiring to the Fire Alarm Control Panel.

13. Electronic Addressing of Field Devices.
 14. Advanced Power Management.
 15. Dead Front Construction.
- B. System Common Controls and Emergency User Interface: The Fire Alarm/EVAC System control panel shall include means for emergency communications and shall include the following system annunciation and control functions:
1. System Annunciation and Control Functions:
 - a. Hands free Emergency Operation. The first and last highest priority event on the system shall be displayed automatically and simultaneously.
 - b. Control Panel Internal Audible Signal shall have four programmable signal patterns, to allow for the easy differentiation between Alarm, Supervisory, Trouble and Monitor conditions within the installed system.
 2. Discrete "System Status" LEDs:
 - a. Power Status LED - Green LED shall illuminate when AC power is present.
 - b. Test Status LED - Yellow LED shall illuminate when any portion of the system is in the test mode. A programmable timer shall cause the system to automatically exit the test mode after a period of system inactivity. This Test LED shall function in a local or in a group mode.
 - c. CPU Fail Status LED - Yellow LED shall illuminate when the panel controller has an internal failure.
 - d. Ground Fault Status LED - Yellow LED shall illuminate when ungrounded wiring connected to the cabinets' power supply has continuity to ground. This feature shall function in either a local or group mode.
 - e. Disable Status LED - Yellow LED shall illuminate whenever any point or zone in the installed system is manually disabled.
 3. Discrete Common Control Switches with associated Status LEDs:
 - a. Reset: Depression of the Reset Switch shall start the system reset operation. The associated Yellow LED shall have three flash rates during this operation to inform the user of the progress status of the reset cycle. The LED shall flash fast during the smoke detector power down sequence, then it shall flash slowly during the restart phase, and shall illuminate steadily for the restoral phase. The LED shall go out completely when the system is back to normal mode. Each phase, as well the overall reset cycle shall be programmable to perform other functions.
 - b. Alarm Silence: Depression of the Alarm Silence Switch shall turn off all (audible) Notification Appliance Circuits. The associated yellow LED illuminates when the

Alarm Silence function is active, whether by the Alarm Silence Switch, or by an integral software timer. Subsequent activation of the Alarm Silence Switch shall resound the signals. Activation of the Alarm Silence switch shall be programmable to perform other functions.

- c. Panel Silence: Depression of the Panel Silence Switch shall turn off the systems' internal audible signal when configured as a 'local' system. The associated yellow LED illuminates when the panel silence feature is activated.
 - d. Drill Switch / LED: Depressing the DRILL switch activates the fire drill function. Yellow LED indicates that the fire drill function is active. The Drill Switch shall also be programmable to perform system functions other than the Drill Function.
4. Other Operator Control Switches:
- a. Previous Message Switch: Pressing the Previous Message Switch shall scroll the display to show the preceding message in the selected queue. Holding the Previous Message Switch and pressing any queue select switch moves to the top of the respective queue event list. Scrolling through event messages may be done by the operator at any time.
 - b. Next Message Switch: Pressing the Next Message Switch shall scroll the display to show the following message in the selected queue. Holding the Previous Message Switch and pressing any queue select switch moves to the bottom of the respective queue event list. Scrolling through event messages may be done by the operator at any time.
 - c. More Details Switch: Pressing the More Details Switch shall show the address and 42 character location message of the active device on display. If a zone is active, pressing the switch displays the address and message of active devices within the zone. When multiple devices are active, the "Previous/Next" message switch may be used to scroll through the messages.
5. The System Main Liquid Crystal Display: The Liquid Crystal display shall provide the means to inform the System Operator with detailed information about the off-normal status of the installed Fire Alarm EVAC System. The Main Display shall automatically respond to the status of the system, and shall display that status on a 24 line by 40 character backlit alpha-numeric Graphical Liquid Crystal Display. The following status functions shall be annunciated by the Main Liquid Crystal Display:
- a. When the Fire Alarm EVAC System is in the "Normal" Mode, the LCD displays: The current Date and Time. A Custom System Title. A summary total of the Alarm History of the system.
 - b. With the Fire Alarm EVAC System in the Alarm Mode, the LCD shall automatically reconfigure into four logical windows.
 - c. Systems Status Window: The LCD shall show the system time, and the number of active points and disabled points in the system in this section of the LCD Display.

- d. **Current Event Window:** The LCD shall show the first active event of the highest priority in reverse text to highlight the condition to the Emergency Operator. The top line of the reversed text shall show the sequence number in which the displayed event was received, as well as its event type. The second and third lines of reversed text shall display an identification message related to the displayed event. The display shall be capable of displaying the next 6 alarm events in order of their occurrence and if there are more than seven active points the system will indicate the latest alarm point in the last viewing queue on the display; allowing first responders to see where the alarm started, where it has traveled to and what the last alarm point is at a glance.
- e. **Last Event Window:** The LCD shall show the most recent, highest priority event received by the system.
- f. **Type Status Window:** The LCD shall show the total number of active events in the system, by event type. There shall be four different System Event Types which shall be displayed, "Alarm Events", "Supervisory Events", "Active Trouble Events", and "Active Monitor Events".
- g. **System Message Processing:** In order to simplify, and to clarify the System Status information which is given to the Emergency Operator, the Main LCD shall include queues for each of the System Event Types. The Main LCD shall allow the Emergency operator access to the System Status information contained within those queues by pressing an associated queue select switch. Whenever there is an unacknowledged event in any of the System Event queues, the associated Status LED shall flash. Viewing each event listed in a queue shall acknowledge all events in that queue, and shall cause the associated LED to illuminate steady.
- h. Messages contained in the System Event queues shall be accessible for review by the Emergency Operator using the "Previous/Next" message switch. It shall be possible to route additional event information to a printer.
- i. **Maintenance Menu:** The Main LCD shall also allow the System Operator to access system maintenance functions through a four level password system. The authorized System Operator shall be able to access the following functions:
 - 1). **System Status:** The system shall allow the operator to determine the status of individual system components, including active points, disabled points, and active points by panel.
 - 2). **Enable:** The system shall allow the operator to restore a disabled point (device) in the system, allowing that point (device) to operate as originally intended by the application program of the system. Additionally, the system shall allow the operator to restore any group function, Panel, system module, "software - defined zone", operator control, or time control function.
 - 3). **Disable:** The system shall allow the operator to disable any point (device) in the system, inhibiting that point (device) from operating as originally intended by the application program of the system. Additionally, the system

shall allow the operator to disable any group function, Panel, system module, “software - defined zone”, operator control, or time control function within the system.

- 4). Activate: The system shall allow the operator to manually turn on any system output point, or system function. Alternate Smoke Detector sensitivity, message routing within the system and check-in group timings shall be modifiable with this simple command from the control panel.
 - 5). Restore: The system shall allow the operator to restore the primary (application program defined) operation to the Smoke Detector sensitivity and the message routing functions with this simple command from the control panel.
 - 6). Control Output: The system shall allow the operator to manually command and control relays and LEDs. Relays shall be able to be commanded to “Latch”, to energize as a “High Priority”, or as a “Low Priority”, to “Energize”, or to “De-Energize”.
 - 7). LEDs shall be able to be commanded to “Latch”, to energize as a “High Priority”, or as a “Low Priority”, to turn “On“, to turn “Off”, to “Slow Blink”, or to “Fast Blink”.
 - 8). The system shall provide the operator with system reports which give detailed description of the status of certain system parameters for corrective action, or for preventative maintenance programs. The system shall provide these reports via the Main LCD, and shall be capable of being printed on any of the connected system printers.
 - 9). The system shall provide a report which gives a sensitivity listing of detectors which have less than 75% environmental compensation remaining.
 - 10). The system shall provide a report which provides a sensitivity listing of any particular detector.
 - 11). The system shall provide a report which gives a listing of the sensitivity of all of the detectors on any given panel in the system, or any given SDC loop within any given panel.
 - 12). The system shall provide a report which gives a chronological listing of up to the last 1740 system events.
 - 13). The system shall provide a listing of the firmware revision listings for the installed network components in the system.
6. Program: The system shall allow the authorized operator to perform the following system functions:
- a. Set the System Time.

- b. Set the System Date.
 - c. Set (Change) the System Passwords.
 - d. Restart the System.
 - e. Set the Dates for the System Holiday Schedule.
 - f. Clear the Chronological System History File.
 7. Test: The system shall allow the authorized operator to perform test functions within the installed system. Test functions shall be defined by the authorized operator to be performed on a per cabinet, circuit, or service group basis.
- C. Local Control/Display Annunciator:
 1. Each Fire Alarm/EVACS control panel installed shall include local Control and Display Annunciator. The Local Control and Display Annunciator shall include:
 - a. Integral membrane style, tactile push-button control switches, for the control of system functions, and LEDs with programmable (software-controlled) flash rates and slide-in labels for annunciation of system events.
 - b. LCD display modules, local push-to-talk microphone, and control and display modules configured for emergency voice, paging and communications operations.
 2. Coordinate specific control functions to be provided at each display annunciator with Contracting Agency.
- D. System Operations Interface:
 1. SDC Card: The Signature Device Card (SDC) shall be the interface between the Fire Alarm Control Panel and the Signature Series Detectors and Modules. The communications format between the SDC and the Signature Series Devices shall be 100% digital. Communications to devices shall incorporate BROADCAST POLLING and DIRECT ADDRESS SEARCH to ensure the fastest reporting of off-normal conditions to the system human interface layer.
 2. It shall be possible to wire the SDC as Class A (Style 6 or Style 7) or Class B (Style 4) without twisted or shielded wire. It shall be possible to wire branch circuits (T-Taps) from Class B Circuits.
 3. The associated controller (3-SSDC), through the SDC, shall provide the ability to set the sensitivity and alarm verification of each of the individual intelligent detectors on the circuit. It shall be possible to automatically set the sensitivity of individual intelligent detectors during day and night periods.
 4. It shall be possible for the SDC to address all intelligent devices connected to it without having to set switches at the individual devices.

5. It shall be possible to obtain a mapping report of all devices connected to the circuit for confirmation of “as-built” wiring. The map shall show physical wiring of T-Taps, device types, and the panel addresses of devices connected to the circuit. The SDC shall be capable of reporting unexpected additional device addresses and changes to the wiring in the data circuit. A specific trouble shall be reported for any off-normal non-alarm condition.
 6. The SDC shall be able to report the following information on a per intelligent device basis:
 - a. Device Serial Number.
 - b. Device Address.
 - c. Device Type.
 - d. Current Detector Sensitivity Values and the Extent of Environmental Compensation.
 - e. Any of 32 possible trouble codes to specifically diagnose faults.
 7. Should a Signature Driver Controller CPU fail to communicate, the Signature circuit shall go into the standalone mode. The circuit shall be capable of producing a loop alarm if an alarm type device becomes active during standalone mode.
- E. Hard Wired NAC Circuits:
1. Provide where indicated on the plans supervised hard-wired Notification Appliance Circuits (NAC) for the control of 24Vdc EST Genesis Series Signaling Appliances. The NAC shall be wired Class B (Style Y).
- F. System Programmable Operations: System Message Processing and Display Operations.
1. The Fire Alarm EVAC System shall allow Network Routing to be configured to any or all nodes (cabinets) in the network.
 2. The system Printer ports shall be configurable to display any or all of the following functions:
 - a. Alarm.
 - b. Supervisory.
 - c. Trouble.
 - d. Monitor.
 - e. Service Group.
 3. Each LCD Display on each node (cabinet) in the system shall be configurable to show the status of any or all of the following functions anywhere in the system:

- a. Alarm.
 - b. Supervisory.
 - c. Trouble.
 - d. Monitor.
4. The system shall provide the capability to label each of the system points with up to 256 characters of location message. The first 42 characters shall be directed to the LCD while the entire message shall be sent to the printer.
 5. The system shall have the capability to provide up to 128 logical Counting AND Groups. Each group shall have a programmable 'activation' number. Whenever the number of active devices in an AND Group reaches the activation number, the AND Groups' rules will execute. It shall be possible to 'overlap' AND groups by having devices appear in more than one group.
 6. The system shall have the ability to define a minimum of 128 Matrix Groups with up to 250 points each. For each matrix, it shall be possible to define a 'radius' and an 'activation' number. The radius number defines the proximity between detector locations. When two detectors activate at or within the value of the 'radius' or whenever the number of active devices reaches the activation number the Matrix Group activates. It shall be possible to 'overlap' Matrix groups by having devices appear in more than one group.
 7. The system shall include the ability to define an alternate set of device commands which may be used in combination with the system test command for the testing of the connected Signature Series Smoke Detectors. This function shall disable the normal alarm command for each of the members of the group, so that the testing process does not result in an activation of the building evacuation signals, auxiliary relays or central station connections.
 8. The system shall include Time Control functions which have the ability to control any system output or function, or initiate any system operational sequence as a function of the Month, Day of Week, Date, Hour, Minute, or Holiday.
 9. The system shall include up to 600 software defined Logical Zone Groups which may group any input from any Signature Data Circuit, or other Initiating Device Circuit, in order to control a system output or function, or initiate any system operational sequence. A device or IDC may be a member of one Logical Zone Group. Each of these zones shall have an associated message.
 10. The system shall provide the ability to download data from the Signature Series Detectors to a PC while the system is online and operational in the protected premises. The downloaded data may then be analyzed in a diagnostic program supplied by the system manufacturer.

G. Integrated Audio:

1. Provide a master one-way emergency audio control unit as part of the main fire alarm control panel. The system shall be capable of delivering multi-channel audio messages simultaneously over copper and/or fiber media.
2. Audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.
3. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store up to 32 minutes of pre-recorded audio messages digitally as WAV files. These messages shall be automatically directed to various areas in a facility under program control. The unit shall have the capacity to store up to 200 individual audio messages and to simultaneously play back seven (7) different messages in addition to live page message.
4. During non-alarm conditions, the control unit shall continuously distribute a default audio message to all amplifiers, providing total audio path supervision. To enhance system survivability, each remote FACP cabinet containing an amplifier shall play the default audio message in the event of a fire AND a control network system failure.
5. The one-way emergency audio control shall provide control switches to direct paging messages as follows:
 - a. "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.
 - b. "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
 - c. "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.
 - d. "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
6. The system shall automatically deliver a preannounce tone of 1000 Hz for three seconds when the emergency operator presses the microphone PTT key. A 'ready to page' LED shall flash during the preannounce phase, and turn steady when the system is ready for the user's page delivery. The system shall include a page deactivation timer which activates for 3 seconds when the emergency user release the microphone talk key. Should the user subsequently press the microphone key during the deactivation period a page can be delivered immediately. Should the timer complete its cycle the system shall automatically restore emergency signaling and any subsequent paging will be preceded by the pre-announce tone. A VU display shall indicate voice level to the emergency operator.
7. The one-way audio control unit shall be capable of supporting up to 64 remote microphone inputs and a line level audio input.

8. The fire alarm control panels shall support remote cabinets with zoned amplifiers to receive, amplify and distribute messages through speakers over supervised circuits.
9. The master one-way emergency audio control unit shall be an Edwards 3-ASU.

H. Audio Amplifiers:

1. Provide as minimum one twenty (20) watt audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.
2. Each audio power amplifier shall have integral audio signal de-multiplexers, allowing the amplifier to select any one of eight digitized audio channels. The system software shall direct the channel selection. Up to 8 multiple and different audio signals shall be able to be broadcast simultaneously from the same system network node.
3. Each amplifier output shall include a dedicated, supervised selectable 25/70 Vrms speaker circuit that is suitable for connection of emergency speaker appliances. Each amplifier shall also include a notification appliance circuit rated at 24Vdc @ 3.5A for connection of visible (strobe) appliances. This circuit shall be fully programmable and it shall be possible to define the circuit for the support of audible, visible, or ancillary devices.
4. Standby Audio amplifiers shall be provided that automatically sense the failure of a primary amplifier, and automatically program themselves to select and de-multiplex the same audio information channel of the failed primary amplifier, and fully replace the function of the failed amplifier.
5. In the event of a total loss of audio data communications, all amplifiers shall default to the local "EVAC" tone generator channel. If the local panel has an alarm condition, then all amplifiers shall sound the EVAC signal on their connected speaker circuits.
6. In the event of a loss of the fully digitized, multiplexed audio riser, the audio amplifiers shall automatically default to an internally generated alarm tone that shall be operated at a 3-3-3 temporal pattern.
7. Audio amplifiers shall automatically detect a short circuit condition on the connected speaker circuit wiring, and shall inhibit itself from driving into that short circuit condition.

I. DACT Dialer

1. The system shall provide off premise communications capability using a digital alarm communications transmitter (DACT) for sending system events to multiple central monitoring station (CMS) receiver.
2. The system shall provide the CMS with point identification of system events using Contact ID or SIA DCS protocols.
3. In the event of a panel CPU failure during a fire alarm condition, the DACT degrade mode shall transmit a general fire alarm signal to the CMS.

J. FireWorks Communications Interface Cards:

1. Provide one NETCOM-1S Card for Ethernet connection to the UAA WAN.
2. Provide one 3-RS232 Card to interface the Ethernet Card to the Fire Alarm Control Panel.

2.5 INTELLIGENT DETECTORS

- A. The System Intelligent Detectors shall be capable of full digital communications using both broadcast and polling protocol. Each detector shall be capable of performing independent fire detection algorithms. The fire detection algorithm shall measure sensor signal dimensions, time patterns and combine different fire parameters to increase reliability and distinguish real fire conditions from unwanted deceptive nuisance alarms. Digital filters shall eliminate signal patterns that are not typical of fires. Devices not capable of combining different fire parameters or that do not employ digital filters shall not be acceptable.
- B. Each detector shall have an integral microprocessor capable of making alarm decisions based on fire parameter information stored in the detector head. Distributed intelligence shall improve response time by decreasing the data flow between detector and Analog loop controller. Detectors not capable of making independent alarm decisions shall not be acceptable. Maximum total Analog loop response time for detectors changing state shall be 0.5 seconds.
- C. Each smoke detector shall be capable of transmitting pre-alarm and alarm signals in addition to the normal, trouble and need cleaning information. It shall be possible to program control panel activity to each level. Each smoke detector may be individually programmed to operate at any one of five (5) sensitivity settings.
- D. Each detector microprocessor shall contain an environmental compensation algorithm that identifies and sets ambient "Environmental Thresholds" approximately six times an hour. The microprocessor shall continually monitor the environmental impact of temperature, humidity, other contaminants as well as detector aging. The process shall employ digital compensation to adapt the detector to both 24 hour long-term and 4 hour short-term environmental changes. The microprocessor shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value. Differential sensing algorithms shall maintain a constant differential between selected detector sensitivity and the "learned" base line sensitivity. The base line sensitivity information shall be updated and permanently stored at the detector approximately once every hour.
- E. The intelligent Analog device and the Analog loop controller shall provide increased reliability and inherent survivability through intelligent Analog standalone operation. The device shall automatically change to standalone conventional device operation in the event of a loop controller polling communications failure. In the Analog standalone detector mode, the Analog detector shall continue to operate using sensitivity and environmental compensation information stored in its microprocessor at the time of communications failure. The Analog loop controller shall monitor the loop and activate a loop alarm if any detector reaches its alarm sensitivity threshold.
- F. Each Signature Series device shall be capable of automatic electronic addressing and/or custom addressing without the use of DIP or rotary switches.

- G. The intelligent Analog detectors shall be suitable for mounting on any Signature Series detector-mounting base.
1. Fixed Temperature Heat Detector, SIGA-HFS: Provide intelligent fixed temperature heat detectors (SIGA-HFS). The heat detector shall have a Low Mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The heat detector shall have a nominal alarm point rating of 135°F (57°C). The heat detector shall be rated for ceiling installation at a minimum of 70 ft (21.3m) centers and be suitable for wall mount applications.
 2. 4D Multisensor Detector, SIGA-IPHS: Provide intelligent 4D multisensor smoke detectors (SIGA-IPHS). The multisensor analog detector shall use a light scattering type photoelectric smoke sensor, a unipolar ionization smoke sensor and an ambient temperature sensor to sense changes in air samples from its surroundings. The integral microprocessor shall employ time-based algorithms to dynamically examine values from the three sensors simultaneously and initiate an alarm based on that data. The 4D Multisensor shall be capable of adapting to ambient environmental conditions. The temperature sensor shall self-adjust to the ambient temperature of the surrounding air and input an alarm when there is a change of 65°F (35°C) in ambient temperature. Systems using central intelligence for alarm decisions shall not be acceptable. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, age and humidity. The information shall be stored in the integral processor and transferred to the analog loop controller for retrieval using a laptop PC or the SIGA-PRO Signature Program/Service Tool. Separately mounted photoelectric detectors, ionization detectors and heat detectors in the same location are not acceptable alternatives. The 4D Multisensor smoke detector shall be rated for ceiling installation at a minimum of 30-ft (9.1m) centers and suitable for wall mount applications. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The integral heat sensor shall cause an alarm when it senses a change in ambient temperature of 65°F (35°C) or reaches it fixed temperature alarm set point of 135°F (57°C) nominal. The 4D Multisensor detector shall be suitable for operation in the following environment:
 - a. Temperature: 32°F to 100°F (0°C to 38°C).
 - b. Humidity: 0-93% RH, non condensing.
 - c. Elevation : Up to 6,000 ft (1828 m).
 3. Standard Detector Mounting Bases, SIGA-SB / SIGA-SB4: Provide standard detector mounting bases (SIGA-SB or SIGA-SB4 as required). The base shall, contain no

electronics, support all Signature Series detector types and have the following minimum requirements:

- a. Removal of the respective detector shall not affect communications with other detectors.
 - b. Terminal connections shall be made on the room side of the base. Bases that must be removed to gain access to the terminals shall not be acceptable.
 - c. The base shall be capable of supporting one (1) Signature Series (SIGA-LED) Remote Alarm LED Indicator. Provide remote LED alarm indicators where shown on the plans.
4. Relay Detector Mounting Bases, SIGA-RB / SIGA-RB4: Provide relay detector mounting bases (SIGA-RB or SIGA-RB4 as required). The relay base shall support all Signature Series detector types and have the following minimum requirements:
- a. The relay shall be a bi-stable type and selectable for normally open or normally closed operation.
 - b. The position of the contact shall be supervised.
 - c. The detector processor upon power up shall exercise the relay operation.
 - d. The relay shall automatically de-energize when a detector is removed.
 - e. Its respective detector processor shall control the operation of the relay base. Detectors operating standalone mode shall operate the relay upon changing to alarm state. Relay bases not controlled by the detector microprocessor shall not be acceptable.
 - f. Form "C" Relay contacts shall have a minimum rating of 1 amp @ 30 Vdc and be listed for "pilot duty".
 - g. Removal of the respective detector shall not affect communications with other detectors.
 - h. Terminal connections shall be made on the room side of the base. Bases that must be removed to gain access to the terminals shall not be acceptable.

2.6 INTELLIGENT MODULES

- A. It shall be possible to address each Intelligent Signature Series module without the use of DIP or rotary switches. The personality of multifunction modules shall be programmable at site to suit conditions and may be changed at any time using a personality code downloaded from the Analog Loop Controller. Modules requiring EPROM, PROM, ROM changes or DIP switch and/or jumper changes shall not be acceptable. The modules shall have a minimum of 2 diagnostic LEDs mounted behind a finished cover plate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable

of storing up to 24 diagnostic codes that can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:

1. Temperature: 32°F to 120°F (0°C to 49°C).
2. Humidity: 0-93% RH, non-condensing.

B. Single Input Module, SIGA-CT1:

1. Provide intelligent single input modules (SIGA-CT1). The Single Input Module shall provide one (1) supervised Class B input circuit capable of a minimum of 4 personalities, each with a distinct operation. The single input module shall support the following circuit types:
 - a. Normally-Open Alarm Latching (Manual Fire Alarm Boxes, Heat Detectors, etc.).
 - b. Normally-Open Alarm Delayed Latching (Waterflow Switches).
 - c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.).
 - d. Normally-Open Active Latching (Supervisory, Tamper Switches).

C. Dual Input Module, SIGA-CT2:

1. Provide intelligent dual input modules (SIGA-CT2). The Dual Input Module shall provide two (2) supervised Class B input circuits each capable of a minimum of 4 personalities, each with a distinct operation. The dual input module shall support the following circuit types:
 - a. Normally-Open Alarm Latching (Manual Fire Alarm Boxes, Heat Detectors, etc.).
 - b. Normally-Open Alarm Delayed Latching (Waterflow Switches).
 - c. Normally-Open Active Non-Latching (Monitor, Fans, Dampers, Doors, etc.).
 - d. Normally-Open Active Latching (Supervisory, Tamper Switches).

D. Monitor Module, SIGA-MM1:

1. Provide intelligent monitor modules (SIGA-MM1). The Monitor Module shall be factory set to support one (1) supervised Class B Normally-Open Active Non-Latching Monitor circuit.

E. Waterflow/Tamper Module, SIGA-WTM or SIGA-CT2:

1. Provide intelligent waterflow/tamper modules (SIGA-WTM, CT2). The Waterflow/Tamper Module shall be factory set to support two (2) supervised Class B input circuits. Channel A shall support a Normally-Open Alarm Delayed Latching Waterflow Switch circuit. Channel B shall support a Normally-Open Active Latching Tamper Switch.

F. Single Input Signal Module, SIGA-CC1:

1. Provide intelligent single input signal modules (SIGA-CC1). The Single Input (Single Riser Select) Signal Module shall provide one (1) supervised Class B output circuit capable of a minimum of 2 personalities, each with a distinct operation. When selected as a telephone power selector, the module shall be capable of generating its own "ring tone". The single input signal module shall support the following operations:
 - a. Audible/Visible Signal Power Selector (Polarized 24 VDC @ 2A, 25Vrms @50w or 70 Vrms @ 35 Watts of Audio).
 - b. Telephone Power Selector with Ring Tone (Fire Fighters Telephone).

G. Dual Input Signal Module, SIGA-CC2:

1. Provide intelligent dual input signal modules (SIGA-CC2). The Dual Input (Dual Riser Select) Signal Module shall provide a means to selectively connect one of two (2) signaling circuit power risers to one (1) supervised output circuit. The dual input signal module shall support the following operation:
 - a. Audible/Visible Signal Power Selector (Polarized 24 VDC @ 2A, 25 Vrms @ 50w or 70 Vrms @ 35w of Audio).

H. Control Relay Module, SIGA-CR:

1. Provide intelligent control relay modules (SIGA-CR). The Control Relay Module shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC to control external appliances or equipment shutdown. The control relay shall be rated for pilot duty and releasing systems. The position of the relay contact shall be confirmed by the system firmware.

I. Universal Class A/B Module, SIGA-UM:

1. Provide intelligent class A/B modules (SIGA-UM). The Universal Class A/B Module shall be capable of a minimum of fifteen (15) distinct operations. The universal class A/B module shall support the following circuit types:
 - a. Two (2) supervised Class B Normally-Open Alarm Latching.
 - b. Two (2) supervised Class B Normally-Open Alarm Delayed Latching.
 - c. Two (2) supervised Class B Normally-Open Active Non-Latching.
 - d. Two (2) supervised Class B Normally-Open Active Latching.
 - e. One (1) form "C" dry relay contact rated at 2 amps @ 24 VDC.
 - f. One (1) supervised Class A Normally-Open Alarm Latching.
 - g. One (1) supervised Class A Normally-Open Alarm Delayed Latching.

- h. One (1) supervised Class A Normally-Open Active Non-Latching.
- i. One (1) supervised Class A Normally-Open Active Latching.
- j. One (1) supervised Class A 2-wire Smoke Alarm Non-Verified.
- k. One (1) supervised Class B 2-wire Smoke Alarm Non-Verified.
- l. One (1) supervised Class A 2-wire Smoke Alarm Verified.
- m. One (1) supervised Class B 2-wire Smoke Alarm Verified.
- n. One (1) supervised Class A Signal Circuit, 24Vdc @ 2A.
- o. One (1) supervised Class B Signal Circuit, 24Vdc @ 2A.

2.7 INTELLIGENT MANUAL FIRE ALARM BOX

- A. It shall be possible to address each Signature Series fire alarm box without the use of DIP or rotary switches. The manual fire alarm box shall have a minimum of 2 diagnostic LEDs mounted on their integral, factory assembled single or two stage input module. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The manual fire alarm box shall be capable of storing up to 24 diagnostic codes that can be retrieved for troubleshooting assistance. Input circuit wiring shall be supervised for open and ground faults. The manual fire alarm box shall be suitable for operation in the following environment:
 - 1. Temperature: 32°F to 120°F (0°C to 49°C).
 - 2. Humidity: 0-93% RH, non-condensing.
- B. Double Action Manual Fire Alarm Box, SIGA-278:
 - 1. Provide intelligent double action, single stage manual fire alarm box (SIGA-278). The manual fire alarm box shall be of Lexan construction with an internal toggle switch. Provide a key locked test feature. Finish the manual fire alarm box in red with white "PULL IN CASE OF FIRE" lettering.
- C. Manual Fire Alarm Box Covers:
 - 1. Provide manual fire alarm box cover, Safety Technology International STI "Stopper II", over each manual fire alarm box. Unless otherwise noted covers shall be installed over manual stations in areas accessible by students or the public I.E; corridors, entries, classrooms, restrooms Etc. They shall consist of a tamper-proof; clear Lexan polycarbonate shield and frame suitable for mounting over flush-mounted or surface-mounted manual fire alarm boxes. The cover shall contain an integral horn that will sound an 85 db warning tone when the cover is lifted. The power source shall be a 9-volt dc alkaline battery included with the unit.

2.8 NOTIFICATION APPLIANCES

A. General

1. Appliances shall be U.L. Listed for Fire Protective Service.
2. Strobe appliances or combination appliances with strobes shall be capable of providing the "Equivalent Facilitation" which is allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADA(AG)), and shall be UL 1971, and ULC S526 Listed.
3. Appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to ensure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances are done in accordance with the single manufacturers' instructions.
4. Appliances that do not meet the above requirements, and are submitted for use shall be provided with written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers which clearly states that their equipment (as submitted) are 100% compatible with each other for the purposes intended.
5. Initial settings for all devices with field selectable settings shall be set in accordance with the values indicated on the Drawings. Values shall be included on the Shop Drawing and As-built Drawing submittals.

B. Synchronized Strobes

1. Strobes shall flash at a rate of one flash per second and shall be synchronized indefinitely within 10 milliseconds of other strobes per UL 1971 Standard.
2. Indoor Wall Mounted Strobes, Genesis Series – Type GE: Provide strobes manufactured by EST. In - Out screw terminals shall be provided for wiring. The strobes shall have a white face plate. They shall provide field configurable 15 cd, 30 cd, 75 cd or 110 cd synchronized flash outputs as required by the application. The strobe shall have lens markings oriented for wall mounting.
3. Indoor Ceiling Mounted Strobes, Genesis Series – Type GE: Provide strobes manufactured by EST. In - Out screw terminals shall be provided for wiring. The strobes shall have a white face plate. They shall provide field configurable 15 cd, 30 cd, 75 cd or 95 cd synchronized flash outputs as required by the application. High output strobes shall provide field configurable 95 cd, 115 cd, 150 cd or 177 cd synchronized flash outputs as required by the application

C. Speaker/Strobes:

1. Wall Mount: Provide speaker/strobes as manufactured by EST, Genesis Series – Type GE.
 - a. Provide speaker with Mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker/strobe housings shall be white. Speakers shall be provided for use with 25V/70V systems. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w selectable

- via switch mounted on unit. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
- b. Provide strobe with provide field configurable 15 cd, 30 cd, 75 cd or 95 cd synchronized flash outputs as required by the application. The strobe shall have lens markings oriented for wall mounting.
 - c. Where required provide high candela output strobe with provide field configurable 95 cd, 115 cd, 150 cd or 177 cd synchronized flash outputs as required by the application. The strobe shall have lens markings oriented for wall mounting.
2. Ceiling Mount: Provide speaker/strobes as manufactured by EST, Genesis Series – Type GE.
- a. Provide speaker with Mylar cone. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker shall be round, surface mount, slim profile with white finish. Speakers shall be provided for use with 25V/70V systems. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w selectable via switch mounted on unit. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
 - b. Provide strobe with provide field configurable 15 cd, 30 cd, 75 cd or 95 cd synchronized flash outputs as required by the application. The strobe shall have lens markings oriented for ceiling mounting.
 - c. Where required provide high candela output strobe with provide field configurable 95 cd, 115 cd, 150 cd or 177 cd synchronized flash outputs as required by the application. The strobe shall have lens markings oriented for wall mounting.
- D. Speakers:
1. Wall Mount: Provide speakers with a Mylar cone as manufactured by EST, Genesis Series – Type GE. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker housings shall be white. Speakers shall be provided for use with 25V/70V systems. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w selectable via switch mounted on unit. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
 2. Ceiling Mount: Provide speakers with a 4 inch Mylar cone as manufactured by EST, Genesis Series. Paper type cones are not acceptable. The rear of the speaker shall be completely sealed protecting the cone during and after installation. In - Out screw terminals shall be provided for wiring. Speaker shall be round, surface mount, slim profile with white finish. Speakers shall be provided for use with 25V/70V systems. Speakers shall provide power taps at 1/4w, 1/2w, 1w, and 2w selectable via switch mounted on unit. Speakers shall provide UL confirmed 90 dBA sound output at 2w.
- E. Sprinkler Bell:
1. Provide electrically operated, 10 inch diameter, red color alarm gong with “Call Fire Dept.” sign. Refer to drawings for locations. Coordinate exact mounting height and location with the Architect. EST 439D-10AW on weatherproof back box.

2.9 BOOSTER POWER SUPPLIES (BPS), EST BPS6A OR BPS10A:

- A. Provide, where required, GE Security, EST BPS6A booster power supplies as an extension of the Notification appliance circuits. The Booster Power Supplies, (BPS), units shall incorporate its own standby power supply capable of providing 24 hours of standby power followed by 5 minutes of alarm. The BPS shall be able to charge a 24 Amp Hour battery.
- B. The BPS shall incorporate four independently supervised notification appliance circuits, (NAC). It shall be possible to configure the NACs so that they will follow the main FACP signal circuit's output or be activated and synchronized across the entire building via use of an EST SIGA-CC1S addressable module. The BPS shall be configurable to operate independently at any one of the following rates: continuous, 3-3-3 temporal, or code follower.
- C. The BPS units shall have four configurable outputs that can be used for NAC control, or 24 volt DC power output for door holders, door locks or fan control power. Any of the circuits in the BPS shall be individually programmed to provide either 24 Volt DC NAC supervision and signal initiation or as a power riser for auxiliary control of Fire Alarm devices.

2.10 ANCILLARY DEVICES

- A. Remote Relays:
 - 1. Multi Voltage Control Relays, MR-100 Series: Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be SPDT and rated for 10 amperes at 115 VAC. A single relay may be energized from a voltage source of 24 VDC, 24 VAC, 115 VAC, or 230 VAC. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.
 - 2. Multi Voltage Control Relays, MR-200 Series: Provide remote control relays connected to supervised ancillary circuits for control of fans, dampers, door releases, etc. Relay contact ratings shall be DPDT and rated for 10 amperes at 115 Vac. A single relay may be energized from a voltage source of 24 VDC, 24 VAC, 115 VAC, or 230 VAC. A red LED shall indicate the relay is energized. A metal enclosure shall be provided.

2.11 SYSTEM MAP

- A. On wall beside Fire Alarm Control Panel or where requested by Owner; provide system map, framed under clear tempered glass. Map shall consist of a basic floor plan of the entire building.
- B. Layout and map to show North, South, East, and West as it applies to the specific building.
- C. Map shall show the location of every fire alarm initiating device in the building. Each device shall be assigned a unique address. This address shall be indicated on the map, along with the device type, and the number shall be marked on the device's base.
- D. Room names and numbers shall be identified on the plan, shall match UAA current/up to date ADA Plans/Records and shall match system programming.
- E. Coordinate exact location for the map - Submit map and fabrication for review.

2.12 FIREWORKS GRAPHIC WORKSTATION – FIRE ALARM MONITORING

- A. There is an existing Edwards/EST FireWorks graphical command & interface system in place for use by UAA. The following requirements shall apply for that existing system.
- B.
- C. Note: Whereas a Substitute product/brand is proposed (Reference Paragraph 2.1 - BASIS OF DESIGN AND PRODUCT SUBSTITUTIONS) a complete operational graphical command & interface system for the substitute product/brand shall be provided and also meet the following requirements.
- D. The UAA graphic workstation shall monitor the building included in the scope of the project.
- E. All events on a remote fire alarm control panel (EST3) shall display the address of the alarm or off normal point with type and description and time of the event in a prioritized color-coded event list on the FireWorks display. Multiple events may be displayed on the “Event List” area on the display. By highlighting one of the events in the Event List, the information about the location and any special information about the location, what is stored there etc., will be described in the “Event Action” window on the FireWorks monitor.
- F. The workstation shall have graphic displays added of the buildings in this project with point by point location icons for each fire alarm device in the buildings. This feature shall allow for any operator at the FireWorks console to view the map of the buildings that have been imported into the system and to be able to zoom down to follow any device in the “Event List” to a map that shows the floor layout in the immediate vicinity of the device and show what device or devices are active on the FireWorks monitor.
- G. Provide graphics and messaging as per by UAA. Coordinate requirements with UAA then submit graphics and messaging for review.
- H. Each device in the remote buildings being monitored shall have an individual message on the “Event Action” window of the system that is tailored to the device’s location and any direction that UAA wants the FireWorks operator to make. This “Event Action” description shall be customizable by UAA personnel so that any day to day changes to an area of any of the remote sites can be updated when the change happens by UAA personnel. Any directions that relate to the life safety emergency plans can be incorporated into the FireWorks system in this fashion.
- I. It shall be possible for the FireWorks operator to log into the system in real time and comment on who he called and what was said for future review.
- J. The FireWorks system shall log all events and operator actions to history for future review.
- K. Fire alarm control capabilities from the FireWorks station include:
 - 1. Generating status, maintenance and sensitivity reports for all fire alarm components.
 - 2. Receipt of a fire alarm shall activate an audio WAV file over the workstation speakers alerting the operator to a fire alarm, and providing audible instructions.
 - 3. Generating a report/list of all devices on the systems including the; addresses, status, history messages and sensitivities.

- L. UAA personnel shall be able to log-in to the FireWorks graphical command & interface system from another computer at another remote location.

2.13

2.14 FIREWORKS CONNECTION HARDWARE

- A. Provide EST Netcom-1 S device and red jacket Cat-6A cabling to the main Telecommunications room in the building.

2.15 CONDUCTORS

- A. In general, conductors shall be of the sizes and types recommended by the system manufacturer.
- B. Voltage drop on Notification Appliance Circuits shall not exceed 10% at the most distant device on each circuit.

2.16 SPARE CAPACITY

- A. Signaling Line Circuits and Notification Appliance Circuits shall be sized to provide 20% spare capacity to allow future addition of devices.
- B. Circuits shall be sized to accommodate 20% spare capacity.
- C. Voltage drop will not exceed 10% at the most distant device in a circuit.
- D. Audio amplifiers shall be sized for a minimum of 20% spare additional capacity.
- E. Initiating circuits shall be limited to half of manufacturer's recommended maximum capacitance and shall not exceed manufacturer's maximum resistance to the furthest point on the cable.
- F. SLC/Initiation Circuits shall be limited to 2/3 of the maximum number of devices permitted by the manufacturer per circuit.

2.17 SECONDARY SUPPLY CAPACITY AND SOURCES

- A. Standby battery capacity shall have sufficient capacity to operate the system under maximum quiescent load (system functioning in a non-alarm condition) for a minimum of 24 hours; and, at the end of that period, shall be capable of operating all alarm notification appliances used for evacuation or to direct aid to the location of an emergency for 10 minutes.
- B. The secondary supply shall consist of the following:
 - 1. A storage battery arranged in accordance with NFPA 72.
 - 2. Operation on secondary power shall not affect the performance of the fire alarm system.

PART 3 - EXECUTION

3.1 INSTALLATION (GENERAL)

- A. The entire system shall be installed in a workmanlike manner in accordance with approved manufacturer's manuals and wiring diagrams. Furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation. Wiring shall be of the type recommended by the NEC, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.
- B. Penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- C. Mount the Fire Alarm Control Panel enclosures in the locations shown on the Drawings. Field coordinate exact mounting locations.
- D. Field coordinate exact mounting locations.
 - 1. Where field conditions (such as conflicts with other features, obstructions that violate the placement rules of the applicable Fire Code, and the like) make necessary the relocation of detectors from the positions shown on the plans, such relocations shall be made in strict accordance with the applicable Fire Code, and shall be made at no additional cost to the Owner.
 - 2. As far as possible within the rules of the applicable Fire Code, the final placement of exposed detectors shall present a uniform appearance.
- E. Wall mounted devices in finished areas such as manual fire alarm boxes and notification appliances shall be recessed in flush mounted junction boxes. Surface mounted box extensions shall not be used.
- F. Adjust each detector in accordance with manufacturer's recommendations for the specific location and circumstance.
- G. Detectors shall be installed a minimum of 3 feet from any supply or return air diffuser.
- H. Control functions which include outputs activated by specific inputs, such as door releases, fan shutdown, damper operation, etc., shall have both inputs and associated outputs connected to the same control panel. Control functions shall be accomplished with addressable control modules. Control through relay bases is not acceptable.
- I. Relays shall be located within three feet of the device or circuit controlled or monitored in accordance with NFPA 72.
- J. Coordinate exact mounting locations with ceiling types & heights as indicated on the plans. Field coordinate exact mounting heights.

- K. Provide 3/4 inch C.O. with pull string between Fire Alarm Control Panel (FACP) and Telephone Terminal Board (TTB) for future use. This conduit shall be in addition to any conduits and Telecom required for this project.

3.2 EVAC SYSTEM ALARM NOTIFICATION/EVACUATION MESSAGING

- A. Coordinate exact alarm notification message verbiage and sequencing with the Owner. Include a pre-announcement tone for a fire alarm per NFPA 72 Chapter 24 Paragraph 24.4.1.2.1:
 - 1. The pre-announcement tone for a fire alarm shall meet the requirements of NFPA 72 Chapter 24 Paragraph 24.4.1.2.1: "Evacuation messages shall be preceded and followed by a minimum of two cycles of the emergency evacuation signal specified in 18.4.2." and Chapter 18 Paragraph 18.4.2: "18.4.2 - Distinctive Evacuation Signal 18.4.2.1 - To meet the requirements of Section 10.7, the alarm audible signal pattern used to notify building occupants of the need to evacuate (leave the building) shall be the standard alarm evacuation signal consisting of a three-pulse temporal pattern:
 - 2. (1) "On" phase lasting 0.5 second +10 percent
 - 3. (2) "Off" phase lasting 0.5 second $\pm$ 10 percent for three successive "on" periods
 - 4. (3) "Off" phase lasting 1.5 seconds $\pm$ 10 percent."

3.3 SYSTEM WIRING

- A. Wiring shall be in metal raceways shared by no other system. Raceways shall be installed in accordance with Section 26 05 33 - Conduit and Fittings. Fire alarm conduit shall be identified in accordance with Section 26 05 33 – Raceway and Boxes for Electrical Systems.
- B. Field devices shall be installed in accordance with Section 26 05 33 – Raceway and Boxes for Electrical Systems. Paint boxes and covers red.
- C. Install Conductors in accordance with Section 26 05 19 Low Voltage Electrical Power Conductors and Cables. Wires shall be landed on device terminals, or terminal strips or blocks, and shall be labeled and numbered at their terminations. Wiring shall be installed in a neat and workmanlike manner. Bundles of wiring shall be secured with self-locking nylon cable ties, not tape. If terminal strips or blocks are required to transition wire size down at devices, they shall not be located in the device junction box unless adequate space is available. Surface mounted box extensions shall not be used at recessed device locations to provide adequate room. If required, locate terminal strips or blocks in properly sized, separate junction boxes, located in accessible ceiling spaces. Clearly mark covers of junction boxes per Section 26 00 00 - Electrical General Requirements.

3.4 PROTECTION OF FIRE ALARM CONTROL UNITS

- A. Provide automatic smoke detection at the location of each fire alarm control unit(s) including fire alarm control panels, remote power supplies and remote booster power supplies.

3.5 DOOR UNLOCKING DEVICES

- A. Any device or system intended to effect the locking/unlocking of emergency exits shall be connected to the building fire alarm system. These exits shall unlock upon receipt of any fire alarm signal.
- B. Coordinate building lockdown/door controls with Owner. Ensure operation of fire alarm system meet Owner requirements – confirm verify and test in accordance with and during fire alarm certification/checkout.

3.6 INTERCONNECTIONS TO OTHER SYSTEMS

- A. Provide new input modules for monitoring of existing sprinkler flow, tamper, and low air pressure switches. Provide sufficient modules to give each switch an individual address. Connect supervised circuits from modules to switches and program system to provide specified functions for each switch.

3.7 PROGRAMMING

- A. Provide system programming as required for operation of system as specified. Submit device locations and numbering scheme for approval prior to programming device descriptions.
- B. Reprogram system after substantial completion to make any Owner requested changes and to optimize system performance. Provide additional reprogramming during warranty period as required for proper system operation.

3.8 TESTING AND REPORTS

- A. Upon completion of the system installation, an Approved representative of the system manufacturer shall conduct a thorough test of the system and all related devices and components of the system, and submit a written report of the findings to the Contracting Agency at least 72 hours prior to the substantial completion site observation. The testing shall include, at the least, verification of the following:
 - 1. The functional operation of each resettable initiating device (manual fire alarm boxes, detectors, etc.) and circuit.
 - 2. The functional operation of each and every alarm device and circuit.
 - 3. The functional operation of each monitored device circuit.
 - 4. The functional operation of each control and output circuit.
 - 5. The supervision function of each Initiating, Indicating, Monitoring, Control and Supply Circuit.
 - 6. Central Station automatic signaling.

7. Proper initiation and execution of mechanical systems control sequences.
8. Verify that wire size, power supply, number of devices on a circuit, etc. are suitable to support 100% of devices being in alarm or operated simultaneously. Test shall include the following as a minimum:
 - a. Place all detectors and monitor modules in alarm. Each shall display its address and alarm condition. At least the first ten devices on each circuit shall also have their alarm LEDs lighted, where applicable.
 - b. Operate all control modules for the alarm or operated condition. Each module shall display its address and condition.
 - c. Reset all alarmed and operated devices. The panel shall display the address of any off-normal devices.
9. Test a representative number of detectors for alarm verification by momentarily testing for alarm. The detectors shall not initiate an alarm. Then test by placing the detectors in alarm such that it remains in alarm for the selected verification time. The detector shall initiate an alarm.
10. Test a representative number of detector for trouble by removing the detector from its base. The address and trouble condition for each shall be displayed. Insert a different type of detector into the base. The address and trouble condition shall be displayed. The detector shall return to normal only when the proper detector type is reinserted into the base.
11. Print out the English-language descriptor, currently sensed value, pre-alarm threshold value, alarm threshold value and status of each sensor in the system. Also print out the English-language descriptor and status of each module in the system. The printout shall also include the date and time.

3.9 TRAINING

- A. After the system provided in this Section is completely installed and operational, and at a time chosen by the Owner, provide the Owner's system operators and maintenance personnel and representatives of the local Fire Department with a total of eight (4) hours of instruction on the operation, maintenance, and troubleshooting of all equipment provided under this Section.
- B. Training sessions shall be presented by a fully qualified, trained representative of the equipment manufacturer, who is thoroughly knowledgeable on the specific installation. Separate sessions shall be given for operation personnel (i.e.: facility staff and Fire Department) and maintenance personnel, with the length and content of the sessions tailored to the respective groups.
- C. Provide an additional two (2) hours of follow-up instruction for review and clarification at a later time mutually agreed on with the Owner, if the Owner deems it necessary.

3.10 SPARE COMPONENTS

- A. Furnish to Owner the following spare components:
 - 1. One (1) speaker only – wall/ceiling.
 - 2. One (1) speaker/strobes of each type – wall/ceiling.
 - 3. One (1) strobe only of each type – wall/ceiling.
 - 4. One (1) 4D Signature series intelligent addressable multi-sensor detector.
 - 5. One (1) Signature series intelligent addressable heat detector.
 - 6. One (1) addressable relay modules.
 - 7. One (1) addressable input modules.
- B. Spare components shall be available on-site for inventory at the time of substantial inspection.

3.11 ACCEPTABLE INSTALLERS

- A. The Fire Alarm EVAC System specified herein shall be installed by a Factory Trained and Authorized Engineered Systems Distributor.
- B. Field Connected Devices may be installed and wired by licensed contractors under the direct supervision of a Factory Trained and Authorized Engineered Systems Distributor. Installation shall be supervised and tested by trained representatives of the manufacturer of the system equipment who shall have a State fire alarm license.

3.12 EXAMINATION

- A. Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm EVAC System and associated components are to be installed shall be made.
- B. Any of these area(s) which are found to be outside the manufacturers' recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to Contracting Agency.
- C. Shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3.13 DEMONSTRATION

- A. Each of the intended operations of the installed Fire Alarm EVAC System shall be demonstrated to the Contracting Agency and the Local Authority Having Jurisdiction by the Installing Engineered System Distributor.

3.14 TELECOM CABLE INSTALLATION

- A. Cable installation shall be in accordance with Section 27 20 10 - Telecom Distribution System.

END OF SECTION 28 31 00