SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Framing with dimension lumber.
2. Wood blocking, cants, and nailers.
3. Wood furring.
4. Wood sleepers.
5. Plywood backing panels.

1.2 DEFINITIONS

A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.

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

C. Exposed Framing: Framing not concealed by other construction.

1.3 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. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.5 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.

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that 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.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.

2.3 FIRE-RETARDANT-TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.

1. Treatment shall not promote corrosion of metal fasteners.
2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

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. Cants.
4. Furring.
5. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of the following species:

1. Hem-fir (north); NLGA.
2. Mixed southern pine or southern pine; SPIB.
3. Spruce-pine-fir; NLGA.

C. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:

1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, 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.

F. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
1. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.7 METAL FRAMING ANCHORS

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

1. Cleveland Steel Specialty Co.
2. KC Metals Products, Inc.
3. Simpson Strong-Tie Co., Inc.

B. Allowable design loads, as published by manufacturer, shall meet or exceed those of products of manufacturers listed. 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.

C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

1. Use for interior locations unless otherwise indicated.

D. 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 coating designation; and not less than 0.036 inch thick.

1. Use for wood-preservative-treated lumber and where indicated.

E. Stainless-Steel Sheet: ASTM A 666, Type 304.

1. Use for exterior locations and where indicated.

F. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.

1. Thickness: 0.050 inch.

G. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.

2.8 MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

E. 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. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

H. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

I. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).

2. ICC-ES evaluation report for fastener.

J. 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.

K. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with indicated fastener patterns where applicable.
2. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 WOOD 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.

3.3 WOOD FURRING INSTALLATION

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

B. Furring to Receive Gypsum Board: Install 1-by-2-inch nominal-size furring vertically at 16 inches o.c.

3.4 FLOOR JOIST FRAMING INSTALLATION

A. General: Install floor joists with crown edge up and support ends of each member with not less than 1-1/2 inches of bearing on wood or metal, or 3 inches on masonry. Attach floor joists as follows:

1. Where supported on wood members, by using metal framing anchors.
2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.

B. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than 2 inches from top or bottom.

C. Provide solid blocking of 2-inch nominal thickness by depth of joist at ends of joists unless nailed to header or band.

D. Provide bridging of type indicated below, at intervals of 96 inches o.c., between joists.
   1. Steel bridging installed to comply with bridging manufacturer's written instructions.

END OF SECTION 061000

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

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

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

1.2 SUBMITTALS

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

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

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

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

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

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.5 PROJECT CONDITIONS

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

1.6 COORDINATION

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

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. CECO Door Products.
2. Curries Company.
3. Steelcraft.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.8 or better.
3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:

1. Curries Company Polystyrene Core: 707 Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Weatherstripped Frames: Subject to the same compliance standards and requirements as standard hollow metal frames, provide where indicated weatherstripped profiles with 1/8" integral kerf formed into the frame soffit able to receive manufacturer's listed gasket material. Available for use in both masonry and drywall construction, with fire rating up to 3 hours complying with NFPA 105, UL 1784, and ASTM E-283 Test criteria.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Manufacturers Basis of Design:

a. CECO Door Products – SU Series.
b. Curries Company – M Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Manufacturers Basis of Design:

a. CECO Door Products SU Series.
b. Curries Company M Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

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

2.5

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.7 HOLLOW METAL PANELS

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

2.8 ACCESSORIES

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

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.9 FABRICATION

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

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

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

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.

a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge plot reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Two anchors per jamb up to 60 inches high.
        2) Three anchors per jamb from 60 to 90 inches high.
        3) Four anchors per jamb from 90 to 120 inches high.
        4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

    b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

        1) Three anchors per jamb up to 60 inches high.
        2) Four anchors per jamb from 60 to 90 inches high.
        3) Five anchors per jamb from 90 to 96 inches high.
        4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
        5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.
10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.10 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

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

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

END OF SECTION 081113

SECTION 081423 - CLAD WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Flush solid core low pressure clad or decorative laminate doors.
   2. Factory fitting clad wood doors to frames and factory machining for hardware.
   3. Light frames and glazing installed in clad wood doors.

B. Standards and References: Comply with the version year adopted by the Authority Having Jurisdiction.
   1. ANSI A208.1 - Particleboard.
   2. Intertek Testing Service (ITS Warnock Hersey) - Certification Listings for Fire Doors.
   3. NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
   4. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
   5. UL 10C - Positive Pressure Fire Tests of Door Assemblies; UL 1784 - Standard for Air Leakage Tests of Door Assemblies.
   6. Window and Door Manufacturers Association - WDMA I.S.1-A Architectural Wood Flush Doors.

1.3 SUBMITTALS

A. Product Data: For each type of door indicated. Include details of core and edge construction, louvers, trim for openings, and WDMA I.S.1-A classifications.

B. Shop Drawings shall include:
   1. Indicate location, size, and hand of each door.
   2. Indicate dimensions and locations of mortises and holes for hardware.
   3. Indicate dimensions and locations of cutouts.
   4. Indicate requirements for veneer matching.
   5. Indicate location and extent of hardware blocking.
   6. Indicate construction details not covered in Product Data.
   7. Indicate doors to be factory finished and finish requirements.
   8. Indicate fire protection ratings for fire rated doors.

C. Samples for Initial Selection: For decorative laminate door faces.

1. Decorative laminate, 8 by 10 inches, for each color and pattern selected.
2. Corner sections of doors, 12 x 12 inches, with door faces and edges representing actual materials to be used.
3. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Warranty: Sample of manufacturer's warranty.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain clad wood doors through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, latest edition, "Industry Standard for Architectural Wood Flush Doors." and the following minimum values (for particle core doors):
1. NWWDA TM-7 Cycle Slam Test: 1,000,000 cycles.
2. NWWDA TM-8 Hinge Loading Test 1,000 lbs.
3. NWWDA TM-10 Edge Screw Holding Test 850 lbs.
4. NWWDA TM-10 Face Screw Holding Test 650 lbs.

C. Fire Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.
1. Oversize Fire Rated Door Assemblies: For units exceeding sizes of tested assemblies provide manufacturer's construction label, indicating compliance to independent 3rd party certification agency's procedure, except for size.
2. Temperature Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire test exposure.
3. Smoke Control Door Assemblies: Comply with NFPA 105.
    1) Smoke "S" Label: Doors to bear "S" label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Security Rating for Particle Core Doors: ASTM F 476, Grade 40.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for receiving, handling, and installing clad wood doors.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package clad wood doors individually in plastic bags and wrap bundles of doors in plastic sheeting.

C. Mark each door on top rail with opening number used on Shop Drawings.

1.6 PROJECT CONDITIONS

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

1.7 WARRANTY

A. Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within the 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 wood face veneers exceeding 0.01 inch in a 3-inch span.
   2. Warranty includes installation that may be required due to repair or replacement of defective doors.
   3. Warranty Period for Solid Core Interior Doors: Life of installation according to manufacturer's written warranty.

PART 2 - PRODUCTS

2.1 DOOR CONSTRUCTION, GENERAL

A. WDMA I.S.1-A Performance Grade: Extra Heavy Duty; Aesthetic Grade: Premium.

B. Particleboard Core Doors:
   1. Particleboard: ANSI A208.1, Grade M-2.
   2. Wood Stiles and Rails: As required to meet Extra Heavy Duty Performance level.
   3. Blocking: As required to meet Extra Heavy Duty Performance level.

C. Mineral Core Doors:
   1. Core: Non-combustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire protection rating indicated.
   2. Edge Construction: At hinge stiles, provide laminated edge construction with improved screw holding capability and split resistance with outer stile matching polymer edging.

D. Fire Rated Doors: Provide construction and core specified above as needed to provide fire ratings indicated.

1. Category A Edge Construction: Provide fire rated door edge construction with intumescent seals concealed by outer stile (Category A) at 45, 60, and 90 minute rated doors. Comply with specified requirements for exposed edges.
2. Category B Edge Construction: Provide 20 minute fire rated doors as Category B, with smoke and fire seals (supplied by seal manufacturer) applied to frame.
3. Pairs: Provide fire retardant stiles that are listed and labeled for applications indicated without formed steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.
    a. Where required or specified, provide formed steel edges and astragals with intumescent seals. Finish steel edges and astragals with baked enamel.

2.2 LOW PRESSURE DECORATIVE LAMINATE (LPDL) FACED DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    1. Eggers Industries – eiDoor.
    2. The Maiman Company – Thermal Fused.
    3. Architect approved equal.

B. Low Pressure Decorative Laminate (LPDL) Thermal Fused Faces:
    1. Low pressure decorative laminates faces thermally fused to cores under heat and pressure, complying with Laminating Materials Association's Product Standard and Typical Physical Properties of Decorative Overlays. LMA.2003.
    2. Color or Wood Grain Pattern:
        a. See finish schedule in construction documents.

C. Exposed Edges: Impact resistant polymer edging, minimum .040" thick, applied to all four edges after faces.

D. Polymer Edging Color or Wood Grain Pattern: Manufacturer's standard color that most closely matches faces.

E. Provide doors with pilot holes factory drilled for vertical edge hinges and lock sets.

F. Where continuous hinges are specified, provide coarse thread particle board screws designed for use in dense wood.

2.3 BLOCKING

A. Fire Rated Doors:
    1. Provide blocking as indicated below:
        a. HB1: 5 inch in doors indicated to have closers and overhead stops.

2.4 LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.
    1. Blade Type: Vision proof inverted V or inverted Y.

2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish.

2.5 LIGHT FRAMES AND GLAZING

A. Wood Beads for Light Openings in Wood Doors up to and including 20-minute rating:
   1. Wood Species: Same species as door faces.
   2. Profile:
      a. M1 Flush Bead.
      b. At wood core doors with 20-minute fire protection ratings, provide wood beads and metal glazing clips approved for such use.

B. Metal Frames for Light Openings in Fire Rated Doors over 20-minute Rating: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for use in doors of fire protection rating indicated.
   1. Manufacturers:
      a. Air Louver.
      b. All Metal Stamping.
      c. Anemostat.
      d. Pemko.

C. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with the flush wood door manufacturer's written instructions.

2.6 FABRICATION

A. Factory fit doors to suit frame opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
   1. Comply with requirements in NFPA 80 for fire rated doors.

B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
   1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
   2. Metal Astragals: Factory machine astragals and formed steel edges for hardware for pairs of fire rated doors.

C. Openings: Cut and trim openings through doors in factory.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Comply with applicable requirements in Division 08 Section "Glazing."
   3. Louvers: Factory install louvers in prepared openings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 8 Section "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
   1. Install fire rated doors in corresponding fire rated frames according to NFPA 80.

C. Factory Fitted Doors: Align in frames for uniform clearance at each edge.

D. Field modifications to doors shall not be permitted, except those specifically allowed by manufacturer or fire rating requirements.

3.3 ADJUSTING

A. Operation: Re-hang or replace doors that do not swing or operate freely.

B. Replace doors that do not comply with requirements. Doors may be repaired if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081423

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.

2. Fire rated swinging doors.
3. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware, power supplies, back-ups and surge protection.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Clad Wood Doors”.
3. Division 08 Section “Access Control Hardware”.

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

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 80 - Fire Doors and Windows.
4. NFPA 101 - Life Safety Code.
5. State Building Codes, Local Amendments.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.2 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.

b. Complete (risers, point-to-point) access control system block wiring diagrams.

2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.3 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:

a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
b. Door Closers: Comply with the following maximum opening-force requirements indicated:

1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

3. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

b. Thresholds: Not more than 1/2 inch high.

4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.

a. Test Pressure: Positive pressure labeling.

F. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.4 DELIVERY, STORAGE, AND HANDLING

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

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight

package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.5 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closers.
4. Two years for electromechanical door hardware.

1.7 MAINTENANCE SERVICE

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

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

    a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
    b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

    a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
    b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:

    a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:

        1) Out-swinging exterior doors.
        2) Out-swinging access controlled doors.
        3) Out-swinging lockable doors.

5. Acceptable Manufacturers:

    a. Hager Companies (HA).
    b. McKinney Products (MK).
    c. Architect approved equal.

B. Pivots: ANSI/BHMA A156.4, Grade 1, certified pivots provided either center hung or 3/4" offset type complete with top, bottom, and intermediate pivots (offset pivots only) in quantity according to manufacturer's recommendations. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door. Pivots to be UL listed for windstorm where applicable.

1. Acceptable Manufacturers:

    a. ABH Manufacturing (AB).
    b. Dorma Products (DO).
    c. Rixson Door Controls (RF).

2.3 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

a. Hager Companies (HA) - ETW-QC (# wires) Option.
b. McKinney Products (MK) - QC (# wires) Option.
c. Architect approved equal.

B. Electrified Quick Connect Intermediate Transfer Pivots: Provide electrified offset intermediate transfer pivot hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Acceptable Manufacturers:

a. Rixson Door Controls (RF) - E-M19-QC (# wires).
b. Architect approved equal.

2.4 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:

a. Door Controls International (DC).
b. Rockwood Manufacturing (RO).
c. Trimco (TC).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.

2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

    a. Acceptable Manufacturers:

        1) Hiawatha, Inc. (HI).
        2) Rockwood Manufacturing (RO).
        3) Trimco (TC).

2.5 CYLINDERS AND KEYING

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

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Manufacturer’s Standard.

D. Patented Cylinders: ANSI/BHMA A156.5, Grade 1, certified cylinders employing a utility patented and restricted keyway requiring the use of patented controlled keys. Provide bump resistant, fixed core cylinders as standard with solid recessed cylinder collars. Cylinders are to be factory keyed where permanent keying records will be established and maintained.

1. Provide a 6 pin multi-level master key system comprised of patented controlled keys and security and high security cylinders operated by one (1) key of the highest level. Geographical exclusivity to be provided for all security and high security cylinders and UL437 certification where specified.

    a. Level 1 Cylinders: Provide utility patented controlled keyway cylinders that are furnished with patented keys available only from authorized distribution.

b. Level 2 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders constructed to provide protection against bumping and picking.
c. Level 3 Cylinders: Provide utility patented controlled keyway and side bar locking incorporating unique angled bottom pins for geographical exclusivity. Cylinders to be UL437 certified and constructed to provide protection against bumping, picking, and drilling.
d. Refer to hardware sets for specified levels.

2. Acceptable Manufacturer:

a. Sargent Manufacturing (SA) - Degree Series.
b. Corbin Russwin (RU) – Access 3 Series.
c. Architect approved equal.

E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Master Key System: Cylinders are operated by a change key and a master key.

F. Key Quantity: Provide the following minimum number of keys:

1. Grand Master Keys: Coordinate the requirements of the Owner through the Owner’s representative. Two (2)
2. Construction Keys (where required): Ten (10)

G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

H. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.

I. Key Control Software: Provide one network version of "Key Wizard" branded key management software package that includes one year of technical support and upgrades to software at no charge. Provide factory key system formatted for importing into “Key Wizard” software.

2.6 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped

12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.

1. Acceptable Manufacturers:

    a. Corbin Russwin Hardware (RU) – ML2000 Series.
    b. Sargent Manufacturing (SA) – 8200 Series.
    c. Architect approved equal.

B. Lock Trim Design: As specified in Hardware Sets.

2.7 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL LOCKING DEVICES

A. Integrated Wiegand Output Mortise Locks: Wiegand output ANSI A156.13, Grade 1, mortise lockset with integrated proximity card reader, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.
2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
3. 12VDC external power supply required for reader and lock, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). Fail safe or fail secure options.
1. Energy Efficient Design: Provide lock bodies which have a holding current draw of 15mA maximum, and can operate on either 12 or 24 volts. Locks are to be field configurable for fail safe or fail secure operation.
2. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.
3. Installation to include manufacturer's access control panel interface board or module where required for Wiegand output protocol.
    a. Acceptable Manufacturers:

        1) Corbin Russwin Hardware (RU) - Access 600 - ML20600 RNE1 Series.
        2) Sargent Manufacturing (SA) - Harmony - H1/H2 8200 Series.

2.8 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
4. Dustproof Strikes: BHMA A156.16.

2.9 CONVENTIONAL EXIT DEVICES

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

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.

   a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is not acceptable except in any case where the door light extends behind the device as in a full glass configuration.

5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.

6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
    b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.

8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

10. Rail Sizing: Provide exit device rails factory sized for proper door width application.

11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:

    a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
    b. Sargent Manufacturing (SA) - 80 Series.
    c. Architect approved equal.

2.10 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL EXIT DEVICES

A. Wiegand Output Integrated Card Reader Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated proximity card reader, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit

hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
3. 12VDC external power supply required for reader, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). 24VDC required for solenoid operated exit trim (12VDC if applicable). Fail safe or fail secure options.
4. Installation requires only one cable run from the exit hardware to the access control panel without requirements for additional proprietary lock panel interface boards or modules.

5. Acceptable Manufacturers:

    a. Corbin Russwin Hardware (RU) - Access 600 - ED5000 RNE1 Series.
    b. Sargent Manufacturing (SA) - Harmony - H1/H2 80 Series.
    c. Architect approved equal.

2.11 DOOR CLOSERS

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

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

    a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.

b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.

6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

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

1. Acceptable Manufacturers:

a. Corbin Russwin Hardware (RU) - DC8000 Series.
b. Sargent Manufacturing (SA) - 351 Series.
c. Norton Door Controls (NO) - 7500 Series.

2.12 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1” LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:

a. Stainless Steel: 300 series, 050-inch thick, with countersunk screw holes (CSK).

4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.

5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.

6. Acceptable Manufacturers:

   a. Rockwood Manufacturing (RO).
   b. Trimco (TC).
   c. Architect approved equal

2.13 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

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

   1. Acceptable Manufacturers:

      a. Hiawatha, Inc. (HI).
      b. Rockwood Manufacturing (RO).
      c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

   1. Acceptable Manufacturers:

      a. ABH Manufacturing (AB).
      b. Rixson Door Controls (RF).
      c. Rockwood Manufacturing (RO).

2.14 ARCHITECTURAL SEALS

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

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

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

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

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

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

F. Acceptable Manufacturers:

1. Pemko Manufacturing (PE).
2. Reese Enterprises, Inc. (RS).
3. Zero International (ZE).

G. Switching Power Supplies: Provide UL listed or recognized filtered and regulated power supplies. Provide single, dual, or multi-voltage units as shown in the hardware sets. Units must be expandable up to eight Class 2 power limited outputs. Units must include the capability to incorporate a battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:

a. Securitron (SU) - AQ Series.
b. Architect approved equal.

2.15 FABRICATION

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

2.16 FINISHES

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

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

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."

2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

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

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

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

3.7 DEMONSTRATION

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

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Refer to Section 080671, Door Hardware Schedule, for hardware sets.

END OF SECTION 087100

SECTION 092116.23 - GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

1.3 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 support them on risers on a flat platform to prevent sagging.

1.4 FIELD CONDITIONS

A. Environmental Limitations: Comply with gypsum-shaftliner-board manufacturer's written instructions.

B. Do not install finish panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated

B. STC Rating: 51, minimum.

C. Gypsum Shaftliner Board:

1. Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces, 1 inch thick, with double beveled long edges.

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

      1) Georgia-Pacific Building Products.
      2) National Gypsum Company.
      3) United States Gypsum Company

2. Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with ASTM D 3273 mold-resistance score of 10 as rated according to ASTM D 3274, 1 inch thick, and with double beveled long edges.

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

      1) Georgia-Pacific Building Products.
      2) National Gypsum Company.
      3) United States Gypsum Company

D. Non-Load-Bearing Steel Framing, General: Complying with ASTM C 645 requirements for metal unless otherwise indicated and complying with requirements for fire-resistance-rated assembly indicated.

1. Protective Coating: Coating with equivalent corrosion resistance of ASTM A 653/A 653M, G40 unless otherwise indicated.

E. Studs: Manufacturer's standard profile for repetitive, corner, and end members as follows:

1. Depth: As indicated.
2. Minimum Base-Metal Thickness: 0.018 inch

F. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.

1. Minimum Base-Metal Thickness: Matching steel studs

G. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. ClarkDietrich
   b. SCAFCO Steel Stud Company

2.3 Finish Panels: Gypsum board as specified in Section 092900 "Gypsum Board”.

A. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with shaft wall manufacturer's written instructions.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written instructions for application indicated.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.

1. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488/E 488M conducted by a qualified testing agency.
2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

E. Reinforcing: Galvanized-steel reinforcing strips with 0.033-inch minimum thickness of base metal (uncoated).

F. Acoustical Sealant: Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated and manufacturer's written installation instructions.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
   1. Reinforcing: Provide where items attach directly to shaft wall assembly as indicated on Drawings; accurately position and secure behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons and floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and 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 092116.23

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Studs and Runners: Provide documentation that framing members' certification is according to SIFA's "Code Compliance Certification Program for Cold-Formed Steel Structural and Non-Structural Framing Members."

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For embossed steel studs and runners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

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

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

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.

B. Studs and Runners: ASTM C 645. Use either steel studs and runners or embossed steel studs and runners.

1. Embossed Steel Studs and Runners:

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

1) ClarkDietrich Building Systems.
2) MarinoWARE.
3) Phillips Manufacturing Co.

b. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements.

c. Depth: As indicated on Drawings.

C. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ClarkDietrich Building Systems.
b. MarinoWARE.
c. SCAFCO Steel Stud Company.

2. Minimum Base-Metal Thickness: As required by horizontal deflection performance requirements.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

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

a. ClarkDietrich Building Systems.
b. MarinoWARE.
c. Architect approved equal.

2. Minimum Base-Metal Thickness: 0.0296 inch.

3. Depth: As indicated on Drawings.

E. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings.
2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of 0.0329 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

F. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

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

a. ClarkDietrich Building Systems.
b. MarinoWARE.
c. Architect approved equal.

2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

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, grab bars, toilet accessories, furnishings, or similar construction.

D. Install bracing at terminations in assemblies.

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. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) 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. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

2. 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.
3. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

   a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
5. Curved Partitions:

   a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.

b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:
1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced 16 inches o.c.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

C. Samples for Verification: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.3 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.

1.4 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 splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

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

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

2.2 GYPSUM BOARD, GENERAL

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

2.3 INTERIOR GYPSUM BOARD

A. Gypsum board: ASTM C 1396/C 1396M.

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

a. Georgia-Pacific Building Products.
b. National Gypsum Company.
c. United States Gypsum Company.

2. Thickness: 5/8 inch.
3. Long Edges: Tapered.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

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

a. Georgia-Pacific Building Products.
b. National Gypsum Company.
c. United States Gypsum Company.

2. Thickness: 5/8 inch.

3. Long Edges: Tapered.

2.4 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.

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

a. CertainTeed Corporation.
b. Georgia-Pacific Building Products.
c. National Gypsum Company.

2. Core: 5/8 inch, Type X.

3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. L-Bead: L-shaped; exposed long flange receives joint compound.
c. U-Bead: J-shaped; exposed short flange does not receive joint compound.

2.6 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 setting-type taping 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.

D. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.

B. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

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

a. Hilti, Inc.
b. Pecora Corporation.
c. United States Gypsum Company.

E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

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 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. 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.

C. 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.

D. 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.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. 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.

G. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

H. STC-Rated Assemblies: Seal construction 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.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:

1. Wallboard Type: As indicated on Drawings.
2. Type X: As indicated on Drawings.
3. Glass-Mat Interior Type: As indicated on Drawings.

B. Single-Layer Application:

1. On ceilings, apply gypsum board before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum board horizontally (perpendicular 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.
    b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.

3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 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. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.
2. L-Bead: Use where indicated.
3. U-Bead: Use where indicated.

C. Exterior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners.

3.6 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. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 4.

a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions.

3.7 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 092900

SECTION 093013 - PORCELAIN TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Porcelain tile.
   2. Metal edge strips.

1.2 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 Porcelain Tile."

C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.3 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 of trim and accessory for each color and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

C. Product Certificates: For each type of product.

D. Product Test Reports: For tile-setting and -grouting products and certified porcelain tile.

1.5 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. Retain option in "Tile and Trim Units" Subparagraph above and delete first subparagraph below, or delete option above and retain below.

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Porcelain Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

1.7 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.

D. Store liquid materials in unopened containers and protected from freezing.

1.8 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 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 Porcelain 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.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.

2.3 TILE PRODUCTS

A. Porcelain Tile Type as indicated on drawings: Refer to finish schedule in construction documents, sheet A770.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Architect approved equal.
   b. Crossville, Inc.
   c. Laticrete.

2. Face Size: 12 x 24.

3. Thickness: 3/8 inch.
4. Wearing Surface: Nonabrasive, smooth wall tile, abrasive aggregate embedded in surface of floor tile.
5. Dynamic Coefficient of Friction: Not less than 0.42.
6. Finish: As selected by Architect from manufacturer's full range.
7. Tile Color and Pattern: To Be Determined
8. Grout Color: As selected by Architect from manufacturer's full range.

B. Porcelain Tile Type as indicated on drawings: porcelain tile.

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

   a. Crossville, Inc.

   b. Architect approved equal.

C. Porcelain Tile Type: Glazed wall tile.

1. Manufacturers: Subject to compliance with requirements, provide products by the following
   a. Crossville, Inc.

   b. Architect approved equal.

2. Module Size: 6 x 6 inches.

1. Finish: As selected by Architect from manufacturer's full range.
2. Tile Color and Pattern: To Be Determined
3. Grout Color: As selected by Architect from manufacturer's full range.
4. Mounting: Factory, back mounted.

2.4 CRACK ISOLATION MEMBRANE

A. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Fast Floors.
      b. Laticrete.
      c. Schluter Systems L.P.

2.5 TILE BACKING PANELS

A. See section 092900.

2.6 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

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

      a. ARDEX GmbH.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
   2. Provide prepackaged, dry-mortar mix combined with acrylic resin liquid-latex additive 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.

2.7 GROUT MATERIALS

A. Non-Sanded Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. Standard Cement Grout: ANSI A118.6.

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

      a. Laticrete International, Inc.
      b. MAPEI Corporation.
      c. Summitville Tiles, Inc.
   2. Polymer Type: Acrylic resin in liquid-latex form for addition to prepackaged dry-grout mix.

2.8 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: As indicated in construction documents, sheet A770.

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

a. Blanke Corporation.
b. Ceramic Tool Company, Inc.
c. Schluter Systems L.P.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

C. Floor Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

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

a. Bonsal American, an Oldcastle company.
b. Custom Building Products.
c. Jamo Inc.

2.9 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.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. 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 PORCELAIN TILE INSTALLATION

A. Comply with TCNA's "Handbook for Porcelain, 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 Porcelain 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. Wall tiles as indicated in construction documents, sheet A770..

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. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

E. Jointing Pattern: 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. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   2. 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

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Wall Tile:1/8 inch.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. 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 TILE BACKING PANEL INSTALLATION

A. See section 092900.

3.5 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 Porcelain 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.

3.6 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.

3.7 INTERIOR PORCELAIN TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Porcelain Tile Installation: TCNA W245 or TCNA W248; thinset mortar on glass-mat, water-resistant gypsum backer board.

    a. Porcelain Tile Type: As indicated on the construction documents.
    b. Thinset Mortar: Latex- portland cement mortar.
    c. Grout: Standard unsanded cement grout.

END OF SECTION 093013

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

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

B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 6 inches in size.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch Samples of each type, color, pattern, and texture.
2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch long Samples of each type, finish, and color.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component 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 in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS

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

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling 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: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

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

C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

D. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

E. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 ACOUSTICAL PANELS – Type 1 (Archive)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation

B. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 2, water felted; with vinyl overlay.
2. Pattern: E lightly textured

C. Color: White.

D. LR: Not less than 0.80

E. NRC: Not less than 0.55.

F. CAC: Not less than 35.

G. AC: Not less than 170.

H. Edge/Joint Detail: Square.

I. Thickness: 1-1/2 inches.

J. Modular Size: 24 by 48 inches.

2.4 ACOUSTICAL PANELS – Type 2 (Typical)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corporation.
   3. USG Corporation

B. Classification: Provide fire-resistance-rated panels complying with ASTM E 1264 for type, form, and pattern as follows:
   1. Type and Form: Type III, mineral base with painted finish; Form 1.
   2. Pattern: Smooth

C. Color: White.

D. LR: Not less than 0.90

E. NRC: Not less than 0.95.

F. CAC: NA

G. AC: Not less than 190.

H. Edge/Joint Detail: Tegular.

I. Thickness: 1 inch.

J. Modular Size: 24 by 24 inches.

2.5 METAL SUSPENSION SYSTEMS, GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corporation.
   3. USG Corporation

B. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

C. 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.

1. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.

E. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

F. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

G. Clean-Room Gasket System: Where indicated, provide manufacturer's standard system, including manufacturer's standard gasket and related adhesives, tapes, seals, and retention clips, designed to seal out foreign material from and maintain positive pressure in clean room.

2.6 METAL SUSPENSION SYSTEM - Type 1 (Archive Area)

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation

B. Extra-Wide-Face, Double-Web, Metal Suspension System: Main and cross runners formed from extruded aluminum to produce structural members with 1-1/2-inch- wide flanges.

1. Structural Classification: Intermediate-duty system.
2. Face Design: Flat, flush.
3. Face Finish: Satin anodized according to AAMA 611.
4. Gasket System: Clean-room type.

2.7 METAL SUSPENSION SYSTEM Type 2 (Typical)

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

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. USG Corporation

B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 15/16-inch wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.

2.8 METAL EDGE MOLDINGS AND TRIM

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

1. Armstrong World Industries, Inc.
2. CertainTeed Corporation.
3. United States Gypsum Company.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical tile edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips and complying with seismic design requirements and the following:

1. Aluminum Alloy: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability properties of aluminum extrusions complying with ASTM B 221 for Alloy and Temper 6063-T5.
2. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, 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. Do not attach hangers to steel roof deck. Attach hangers to structural members.
5. 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.
6. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Do not use exposed fasteners, including pop rivets, on moldings and trim.

D. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

E. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:
   a. Install panels with pattern running in one direction parallel to long axis of space.

F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension-system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.

1. Fit adjoining tile to form flush, tight joints. Scribe and cut tile for accurate fit at borders and around penetrations through tile.
2. Hold tile field in compression by inserting leaf-type, spring-steel spacers between tile and moldings, spaced 12 inches o.c.
3. Not cut tile shall be less than 6”. If this would be the case the installer must cut the required size from a 24 x 48 inch tile.
4. Installer must cut tiles with tool specifically meant for this purpose. Do not use a utility knife or other similar cutter.
5. Installer must touch-up paint at all cut edges. Match tile face color.

3.4 CLEANING

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

END OF SECTION 095113

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Resilient base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

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

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. 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.

1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 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 time 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.

PART 2 - PRODUCTS

2.1 VINYL BASE

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

1. Armstrong World Industries, Inc.
2. Johnsonite; A Tarkett Company.
3. Roppe Corporation, USA.

B. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous).
2. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient flooring.

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

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

2.2 VINYL MOLDING ACCESSORY

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

1. Armstrong World Industries, Inc.
2. Johnsonite; A Tarkett Company.
3. Roppe Corporation, USA.

B. Description: Vinyl reducer strip for resilient flooring.

C. Profile and Dimensions: As shown on drawings.

D. Locations: As shown on drawings.

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

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

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. Concrete Substrates for Resilient Accessories: Prepare horizontal surfaces according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH

scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.

4. Moisture Testing: Proceed with installation only after substrates pass testing according to manufacturer's written recommendations, but not less stringent than the following:

   a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are the same temperature as the 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.

E. 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. 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.

   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

a. 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 exposed 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 096513

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid vinyl floor tile.
2. Vinyl composition floor tile.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

E. Product Schedule: For floor tile. Use same designations indicated on Drawings.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.

1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.8 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 floor tile during the following time 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. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 SOLID VINYL FLOOR TILE

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

1. Armstrong World Industries, Inc.
2. Forbo Flooring Systems.
3. Shaw Contract Group; a Berkshire Hathaway company.

B. Tile Standard: ASTM F 1700.

1. Class: Class III, printed film vinyl tile.
2. Type: A, smooth surface, B, embossed surface.

C. Thickness: 0.125 inch.

D. Size: 18 by 18 inches.

2.3 VINYL COMPOSITION FLOOR TILE

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

1. Armstrong World Industries, Inc.
2. Congoleum Corporation.
3. Mannington Mills, Inc.

B. Tile Standard: ASTM F 1066, Class 2, through-pattern tile.

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch.

E. Size: 12 by 12 inches.

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

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

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 floor tile.

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

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 10 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Access Flooring Panels: Remove protective film of oil or other coating using method recommended by access flooring manufacturer.

D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

E. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

F. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
2. Chemically Bonded Seams: Bond seams with chemical-bonding compound to permanently fuse sections into a seamless flooring. Prepare seams and apply compound to produce tightly fitted seams without gaps, overlays, or excess bonding compound on flooring surfaces.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Joint Sealant: Apply sealant to resilient terrazzo floor tile perimeter and around columns, at door frames, and at other joints and penetrations.

E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.

1. Sealer: Apply two base coats of liquid sealer.
2. Finish: Apply two coats of clear acrylic.

F. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096723 - RESINOUS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes resinous flooring systems.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project Site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.

B. Samples for Initial Selection: For each type of exposed finish required.

C. Samples for Verification: For each resinous flooring system required, 6 inches square, applied to a rigid backing by Installer for this Project.

1.4 INFORMATIONAL SUBMITTALS

A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.

B. Material Certificates: For each resinous flooring component, from manufacturer.

C. Material Test Reports: For each resinous flooring system, by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For resinous flooring to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.

B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.

C. Close spaces to traffic during resinous flooring application and for 24 hours after application unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 PERORMANCE REQUIREMENTS

A. Flammability: Self-extinguishing according to ASTM D 635.

2.2 MANUFACTURERS

A. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, from single source from single manufacturer. Obtain secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from manufacturer recommended in writing by manufacturer of primary materials.

2.3 RESINOUS FLOORING

A. Resinous Flooring System: Abrasion-, impact-, and chemical-resistant, aggregate-filled, and resin-based monolithic floor surfacing designed to produce a seamless floor and integral cove base.

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

1) DuraFlex.
2) Stonhard.
3) Sika

B. System Characteristics:

1. Color and Pattern: As selected by Architect from manufacturer's full range.
2. Wearing Surface: Orange-peel texture.
3. Overall System Thickness: 1/8 inch.

C. Primer: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated.

D. Waterproofing Membrane: Type recommended by resinous flooring manufacturer for substrate and resinous flooring system provided.

E. Reinforcing Membrane: Flexible resin formulation that is recommended by resinous flooring manufacturer for substrate and resinous flooring system indicated and that inhibits substrate cracks from reflecting through resinous flooring.
1. Provide material as needed for existing conditions

F. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.

G. Body Coats:
1. Resin: Epoxy.
2. Formulation Description: Water based .
3. Type: Pigmented.
4. Application Method: Self-leveling slurry.
5. Number of Coats: Two.
6. Thickness of Coats: 1/16 inch
7. Aggregates: Manufacturer's standard.

H. Topcoats: Sealing or finish coats.
1. Resin: Epoxy
2. Formulation Description: manufacturers standard for low VOC system.
3. Type: Pigmented.
4. Number of Coats: One.
5. Thickness of Coats: 8 mils
6. Finish: Matte.

I. System Physical Properties: Provide resinous flooring system with the following minimum physical property requirements when tested according to test methods indicated:

1. Compressive Strength: 16,000 psi minimum according to ASTM C 579.
2. Tensile Strength: 3,500 psi minimum according to ASTM C 307.
3. Flexural Modulus of Elasticity: <**Insert value**> minimum according to ASTM C 580.
4. Water Absorption: 0.04 percent maximum according to ASTM C 413.
5. Shrinkage: <**Insert number**> percent maximum according to ASTM C 531.
6. Indentation: <**Insert number**> percent maximum according to MIL-D-3134J.
7. Impact Resistance: No chipping, cracking, or delamination and not more than 1/16-inch permanent indentation according to MIL-D-3134J.
8. Resistance to Elevated Temperature: No slip or flow of more than 1/16 inch according to MIL-D-3134J.

9. Abrasion Resistance: <**Insert value**> maximum weight loss according to ASTM D 4060.
10. Hardness: 75-80, Shore D according to ASTM D 2240.
11. Critical Radiant Flux: **0.45 W/sq. cm** or greater according to NFPA 253.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry substrate for resinous flooring application.

B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.

1. Roughen concrete substrates as follows:
   a. Comply with ASTM C 811 requirements unless manufacturer's written instructions are more stringent.

2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written instructions.
3. Verify that concrete substrates are dry and moisture-vapor emissions are within acceptable levels according to manufacturer's written instructions.

   a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with application of resinous flooring only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. of slab area in 24 hours.
   b. Plastic Sheet Test: ASTM D 4263. Proceed with application only after testing indicates absence of moisture in substrates.
   c. Relative Humidity Test: Use in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

4. Alkalinity and Adhesion Testing: Verify that concrete substrates have pH within acceptable range. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.

C. Patching and Filling: Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.

1. Control Joint Treatment: Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written instructions.

D. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.

3.2 APPLICATION

A. Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.

1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
3. Expansion and Isolation Joint Treatment: At substrate expansion and isolation joints, comply with resinous flooring manufacturer's written instructions.

B. Primer: Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Waterproofing Membrane: Apply waterproofing membrane if required by manufacturer to address conditions in field, in manufacturer's recommended thickness.

D. Reinforcing Membrane: Apply reinforcing membrane to **substrate cracks**.

E. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details, including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.

1. Integral Cove Base: 4 inches high.

F. Self-Leveling Body Coats: Apply self-leveling slurry body coats in thickness indicated for flooring system.

1. Aggregates: Broadcast aggregates at rate recommended by manufacturer and, after resin is cured, remove excess aggregates to provide surface texture indicated.

G. Troweled or Screeded Body Coats: Apply troweled or screeded body coats in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When body coats are cured, remove trowel marks and roughness using method recommended by manufacturer.

H. Grout Coat: Apply grout coat, of type recommended by resinous flooring manufacturer, to fill voids in surface of final body coat.

I. Topcoats: Apply topcoats in number indicated for flooring system and at spreading rates recommended in writing by manufacturer and to produce wearing surface indicated.

3.3 FIELD QUALITY CONTROL

A. Material Sampling: Owner may, at any time and any number of times during resinous flooring application, require material samples for testing for compliance with requirements.

1. Owner will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

B. Core Sampling: At the direction of Owner and at locations designated by Owner, take one core sample per 1000 sq. ft. but at not less than 10 location of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring. Correct deficiencies in installed flooring as indicated by testing.

3.4 PROTECTION

A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 096813 - 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.

1.3 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. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

D. Samples for Initial Selection: For each type of carpet tile.

1. Include Samples of exposed edge, transition, and other accessory stripping involving color or finish selection.

E. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

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

G. Sustainable Product Certification: Provide ANSI/NSF 140 certification for carpet products.

1.4 IINFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

C. Sample Warranty: For special warranty.

1.5 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.

1.6 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.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

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.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

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 CARPET TILE

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

1. Forbo.
2. Interface, LLC.
3. Shaw Contract Group; a Berkshire Hathaway company.

B. Color: Refer to finish schedule in Drawings.

C. Pattern: Refer to finish schedule in Drawings.

D. Pile Characteristic: Cut pile.

E. Density: 26 oz.

F. Size: 20 by 20 inches.

G. Applied Treatments:

1. Soil-Resistance Treatment: Manufacturer's standard treatment.
2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:

a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

2.2 INSTALLATION ACCESSORIES

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

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

C. Transition Strips: Refer to finish schedule on Drawings.

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 033000 "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. Metal Substrates: Clean grease, oil, soil and rust, and prime if recommended in writing by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: As recommended in writing by carpet tile manufacturer.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

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 096813

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
2. Indicate VOC content.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Apply coats on Samples in steps 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: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

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. Paint: percent, but not less than 2 gal. of each material and color applied.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

   a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
   b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

   a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. 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.

1.7 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 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, provide products by one of the following:

1. Benjamin Moore & Co.
2. PPG Architectural Finishes, Inc.
3. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, provide product listed in the Interior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As indicated in the finish schedule in the construction documents.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove

rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

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. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
4. Wood: 15 percent.
5. Gypsum Board: 12 percent.
6. Plaster: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Plaster Substrates: Verify that plaster is fully cured.

E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.

F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

G. Proceed with coating application only after unsatisfactory conditions have been corrected.

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

3.2 PREPARATION

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

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. 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.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Wood Substrates:

1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. 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.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

a. Equipment, including panelboards.
b. Uninsulated metal piping.
c. Uninsulated plastic piping.
d. Pipe hangers and supports.
e. Metal conduit.
f. Plastic conduit.
g. Tanks that do not have factory-applied final finishes.
h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 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.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI INT 3.1A:

   a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

      1) Sherwin-Williams Company (The).

   b. Prime Coat: Latex, interior, matching topcoat.
   c. Intermediate Coat: Latex, interior, matching topcoat.
   d. Topcoat: Latex, interior, (MPI Gloss Level 3), MPI #52.

      1) Sherwin-Williams Company (The).

2. Latex over Latex Aggregate System MPI INT 3.1B:

   a. Prime Coat: Textured coating, latex, flat, MPI #42.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, matching topcoat.

   c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

      1) Sherwin-Williams Company (The).

3. Latex Aggregate System MPI INT 3.1N:

   a. Prime Coat: As recommended in writing by topcoat manufacturer.
   b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
   c. Topcoat: Textured coating, latex, nonflat, MPI #41.

      1) Sherwin-Williams Company (The).

4. Institutional Low-Odor/VOC Latex System MPI INT 3.1M:

   a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

   c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

      1) Sherwin-Williams Company (The).

5. High-Performance Architectural Latex System MPI INT 3.1C:

   a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

      1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

6. Water-Based Light Industrial Coating System MPI INT 3.1L:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

7. Alkyd System MPI INT 3.1D:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

8. Concrete Stain System MPI INT 3.1K:

a. First Coat: Stain, interior, matching topcoat.
b. Topcoat: Stain, interior, MPI #58.

1) Sherwin-Williams Company (The).

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Enamel System MPI INT 3.2A:

a. Prime Coat: Floor paint, latex, matching topcoat.
b. Intermediate Coat: Floor paint, latex, matching topcoat.
c. Topcoat: Floor paint, latex, low gloss (maximum MPI Gloss Level 3), MPI #60.

1) Sherwin-Williams Company (The).

2. Alkyd Floor Enamel System MPI INT 3.2B:

   a. Prime Coat: Floor enamel, alkyd, matching topcoat.
   b. Intermediate Coat: Floor enamel, alkyd, matching topcoat.
   c. Topcoat: Floor enamel, alkyd, gloss (MPI Gloss Level 6), MPI #27.

      1) Sherwin-Williams Company (The).

3. Concrete Stain System MPI INT 3.2E:

   a. First Coat: Stain, interior, for concrete floors, matching topcoat.
   b. Topcoat: Stain, interior, for concrete floors, MPI #58.

      1) Sherwin-Williams Company (The).

4. Water-Based Concrete Floor Sealer System MPI INT 3.2G:

   a. First Coat: Sealer, water based, for concrete floors, matching topcoat.
   b. Topcoat: Sealer, water based, for concrete floors, MPI #99.

5. Solvent-Based Concrete Floor Sealer System MPI INT 3.2F:

   a. First Coat: Sealer, solvent based, for concrete floors, matching topcoat.
   b. Topcoat: Sealer, solvent based, for concrete floors, MPI #104.

      1) Sherwin-Williams Company (The).

C. Cement Board Substrates:

1. Latex System MPI INT 3.3A:

   a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, matching topcoat.

   c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

      1) Sherwin-Williams Company (The).

2. Institutional Low-Odor/VOC Latex System MPI INT 3.3G:

   a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

3. High-Performance Architectural Latex System MPI INT 3.3B:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

4. Water-Based Light Industrial Coating System MPI INT 3.3H:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

5. Alkyd System MPI INT 3.3C:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

D. Clay Masonry Substrates:

1. Latex System MPI INT 4.1A:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Latex Aggregate System MPI INT 4.1B:

a. Prime Coat: Primer for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
b. Intermediate Coat: Intermediate coat for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 4.1M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 4.1L:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

5. Water-Based Light Industrial Coating System MPI INT 4.1C:

a. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

d. Intermediate Coat: Alkyd, interior, matching topcoat.

e. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

6. Clear (2-Component) Polyurethane System MPI INT 4.1K:

a. Prime Coat: Two-component polyurethane matching topcoat.
b. Intermediate Coat: Two-component polyurethane matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two-component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

1) Sherwin-Williams Company (The).

E. CMU Substrates:

1. Latex System MPI INT 4.2A:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Latex Aggregate System MPI INT 4.2B:

a. Prime Coat: Primer for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
b. Intermediate Coat: Intermediate coat for textured coating, latex, flat, as recommended in writing by topcoat manufacturer.
c. Topcoat: Textured coating, latex, nonflat, MPI #41.

1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 4.2D:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) Sherwin-Williams Company (The).

b. Prime Coat: Primer, alkali resistant, water based, MPI #3.

1) Sherwin-Williams Company (The).

c. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

d. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

5. Water-Based Light Industrial Coating System MPI INT 4.2K:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

6. Alkyd System MPI INT 4.2C:

a. Block Filler: Block filler, latex, interior/exterior, MPI #4.

1) Sherwin-Williams Company (The).

b. Sealer Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams Company (The).

c. Intermediate Coat: Alkyd, interior, matching topcoat.

d. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

7. Clear (2-Component) Polyurethane System MPI INT 4.2Q:

a. Prime Coat: Two-component polyurethane, matching topcoat.
b. Intermediate Coat: Two-component polyurethane, matching topcoat.
c. Topcoat: Varnish, aliphatic polyurethane, two component (MPI Gloss Level 6 or MPI Gloss Level 7), MPI #78.

1) Sherwin-Williams Company (The).

F. Steel Substrates:

1. Latex System, Alkyd Primer MPI INT 5.1Q:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).

b. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.

1) Sherwin-Williams Company (The).

c. Prime Coat: Shop primer specified in Section where substrate is specified.
d. Intermediate Coat: Latex, interior, matching topcoat.

e. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Latex over Shop-Applied Quick-Drying Shop Primer System MPI INT 5.1X:

a. Prime Coat: Primer, quick dry, for shop application, MPI #275.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 5.1S:

a. Prime Coat: Primer, rust inhibitive, water based MPI #107.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 5.1R:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

5. Water-Based Light Industrial Coating System MPI INT 5.1B:

a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

6. Water-Based Light Industrial Coating System over Epoxy Primer System MPI INT 5.1N:

a. Prime Coat: Primer, epoxy, anti-corrosive MPI #101.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

7. Water-Based Dry-Fall System MPI INT 5.1C:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).

b. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.

1) Sherwin-Williams Company (The).

8. Water-Based Dry-Fall over Shop-Applied Quick-Drying Shop Primer System MPI INT 5.1CC:

a. Prime Coat: Primer, quick dry, for shop application, MPI #275.

1) Sherwin-Williams Company (The).

b. Topcoat: Dry fall, latex (MPI Gloss Level 3), MPI #155.

1) Sherwin-Williams Company (The).

9. Alkyd System MPI INT 5.1E:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

10. Alkyd over Surface-Tolerant Primer System MPI INT 5.1T:

a. Prime Coat: Primer, metal, surface tolerant MPI #23.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

d. Intermediate Coat: Alkyd, interior, matching topcoat.

e. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

11. Quick-Dry Enamel System MPI INT 5.1A:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, quick dry, matching topcoat.
c. Topcoat: Alkyd, quick dry, semi-gloss (MPI Gloss Level 5), MPI #81.

1) Sherwin-Williams Company (The).

12. Alkyd Dry-Fall System MPI INT 5.1D:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).

b. Topcoat: Dry fall, alkyd (MPI Gloss Level 3), MPI #89.

1) Sherwin-Williams Company (The).

13. Alkyd Dry-Fall over Quick-Drying Primer System MPI INT 5.1DD:

a. Prime Coat: Primer, quick dry, for shop application, MPI #275.

1) Sherwin-Williams Company (The).

b. Topcoat: Dry fall, alkyd (MPI Gloss Level 3), MPI #89.

1) Sherwin-Williams Company (The).

14. Aluminum Paint System MPI INT 5.1M:

a. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.

1) Sherwin-Williams Company (The).
b. Intermediate Coat: Aluminum paint, matching topcoat.
c. Topcoat: Aluminum paint, MPI #1.

1) Sherwin-Williams Company (The).

G. Galvanized-Metal Substrates:

1. Latex System MPI INT 5.3A:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Institutional Low-Odor/VOC Latex System MPI INT 5.3N:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

3. High-Performance Architectural Latex System MPI INT 5.3M:

a. Prime Coat: Primer, galvanized, water based, MPI #134.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

4. Water-Based Light Industrial Coating System MPI INT 5.3B:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

5. Water-Based Dry-Fall System MPI INT 5.3H:

a. Prime Coat: Dry fall, water based, for galvanized steel, matching topcoat.

b. Topcoat: Dry fall, water based, for galvanized steel, flat (MPI Gloss Level 1), MPI #133.

1) Sherwin-Williams Company (The).

6. Alkyd over Cementitious Primer System MPI INT 5.3C:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

7. Alkyd Dry-Fall System (Cementitious Primer) MPI INT 5.3F:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) Sherwin-Williams Company (The).

b. Topcoat: Dry fall, alkyd (MPI Gloss Level 3), MPI #89.

1) Sherwin-Williams Company (The).

8. Aluminum Paint System (Cementitious Primer) MPI INT 5.3G:

a. Prime Coat: Primer, galvanized, cementitious, MPI #26.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Aluminum paint, matching topcoat.
c. Topcoat: Aluminum paint, MPI #1.

1) Sherwin-Williams Company (The).

H. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System MPI INT 5.4H:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Institutional Low-Odor/VOC Latex System MPI INT 5.4G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

3. High-Performance Architectural Latex System MPI INT 5.4F:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

4. Water-Based Light Industrial Coating System MPI INT 5.4E:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

5. Alkyd System MPI INT 5.4A:

a. Prime Coat: Primer, vinyl wash, MPI #80.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

I. Copper Substrates:

1. Latex System MPI INT 5.5H:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Institutional Low-Odor/VOC Latex System MPI INT 5.5G:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

3. High-Performance Architectural Latex System MPI INT 5.5F:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

4. Water-Based Light Industrial Coating System MPI INT 5.5E:

a. Prime Coat: Primer, quick dry, for aluminum, MPI #95.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

5. Alkyd System MPI INT 5.5A:

a. Prime Coat: Primer, vinyl wash, MPI #80.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

J. Stainless-Steel Substrates:

1. Latex System MPI INT 5.6H:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. High-Performance Architectural Latex System MPI INT 5.6G:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

3. Water-Based Light Industrial Coating System MPI INT 5.6A:

a. Prime Coat: Primer, bonding, solvent based, MPI #69.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

4. Alkyd System MPI INT 5.6B:

a. Prime Coat: Primer, vinyl wash, MPI #80.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

K. Wood Substrates: Glued-laminated construction.

1. Latex over Latex Primer System MPI INT 6.1M:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Latex over Alkyd Primer System MPI INT 6.1A:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 6.1Q:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 6.1N:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

5. Alkyd System MPI INT 6.1B:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

L. Wood Substrates: Exposed framing.

1. Latex over Latex Primer System MPI INT 6.2D:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Latex over Alkyd Primer System MPI INT 6.2A:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 6.2L:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 6.2B:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

5. Alkyd System MPI INT 6.2C:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

M. Wood Substrates: Wood trim, Architectural woodwork, Doors and Windows.

1. Latex over Latex Primer System MPI INT 6.3T:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 5), MPI #54.

1) Sherwin-Williams Company (The).

2. Latex over Alkyd Primer System MPI INT 6.3U:

   a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, matching topcoat.

   c. Topcoat: Latex, interior (MPI Gloss Level 5), MPI #524.

      1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 6.3V:

   a. Prime Coat: Primer, latex, for interior wood, MPI #39.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

   c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

      1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 6.3A:

   a. Prime Coat: Primer, latex, for interior wood, MPI #39.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

   c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

      1) Sherwin-Williams Company (The).

5. Water-Based Light Industrial Coating System MPI INT 6.3P:

   a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

      1) Sherwin-Williams Company (The).

   b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

   c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

6. Water-Based Alkyd System MPI INT 6.3BB:

a. Prime Coat: Primer, latex, for interior wood, MPI #39.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, water based, matching topcoat.
c. Topcoat: Alkyd, water based, gloss (MPI Gloss Level 6-7), MPI #157.

1) Sherwin-Williams Company (The).

7. Alkyd System MPI INT 6.3B:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

1) Sherwin-Williams Company (The).

N. Gypsum Board Substrates:

1. Latex over Latex Sealer System MPI INT 9.2A:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams Company (The).
b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

2. Latex over Alkyd Primer System (for Plaster Only) MPI INT 9.2K:

a. Prime Coat: Primer sealer, alkyd, interior, MPI #45.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, matching topcoat.

c. Topcoat: Latex, interior (MPI Gloss Level 3), MPI #52.

1) Sherwin-Williams Company (The).

3. Institutional Low-Odor/VOC Latex System MPI INT 9.2M:

a. Prime Coat: Primer sealer, interior, institutional low odor/VOC, MPI #149.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, institutional low odor/VOC, matching topcoat.

c. Topcoat: Latex, interior, institutional low odor/VOC (MPI Gloss Level 3), MPI #145.

1) Sherwin-Williams Company (The).

4. High-Performance Architectural Latex System MPI INT 9.2B:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.

c. Topcoat: Latex, interior, high performance architectural (MPI Gloss Level 3), MPI #139.

1) Sherwin-Williams Company (The).

5. Water-Based Light Industrial Coating System MPI INT 9.2L:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.

c. Topcoat: Light industrial coating, interior, water based (MPI Gloss Level 3), MPI #151.

1) Sherwin-Williams Company (The).

6. Alkyd over Latex Sealer System MPI INT 9.2C:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.

1) Sherwin-Williams Company (The).

b. Intermediate Coat: Alkyd, interior, matching topcoat.

c. Topcoat: Alkyd, interior (MPI Gloss Level 3), MPI #51.

1) Sherwin-Williams Company (The).

END OF SECTION 099123

SECTION 220000 – PLUMBING

PART I -- GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.2 SUMMARY

A. This section addresses materials and methods common to more than one Subcontractor. Refer to the drawings to determine the extent of work required of each individual trade.

1.4 DESCRIPTION OF WORK

A. The work described herein shall be interpreted as work to be done by the Plumbing Subcontractor. Work to be performed by other trades will be specifically referenced to a particular Contractor or Subcontractor.

B. The work under this section shall consist of furnishing all labor, materials, equipment, supervision, transportation, construction, facilities, devices and incidentals necessary to provide complete plumbing systems as hereinafter described and as indicated on the drawings, including, but not limited to the following:

1. Sanitary, waste and vent piping system
2. Roof Drains and Roof Drainage System (Primary and Overflow)
3. Domestic hot and cold water piping system
4. Natural Gas Piping System.
5. Plumbing fixtures and trim
6. Sleeves, escutcheons, hangers and supports
7. Fire safing of pipe penetrations
8. Storage Water Heater System
9. Medical Gas Systems
10. Floor drains
11. Hose bibbs
12. Insulation
13. Valves
14. Water Hammer arrestors
15. Vacuum Breakers
16. Fittings, unions and couplings
17. Cleaning, flushing, testing and disinfection
18. All supplementary steel for piping and equipment support
19. Guarantees
20. Drilling for inserts

21. Vibration isolation and flexible connections
22. Core drilling
23. Coordination drawings
24. Access panels

1.5 CODES, ORDINANCES AND PERMITS

A. All material and work provided shall be in accordance with the following codes and standards:
   1. State Plumbing and Fuel Gas Code
   2. State Department of Public Safety
   3. Standards of the Underwriters' Laboratories (UL)
   4. State and local Building Codes
   5. NFPA 99
   6. Occupational Safety and Health Act
   7. Local Codes and Board of Health requirements
   8. Requirements of the Rhode Island Department of Environmental Protection
   9. Requirements of the Town of East Providence R.I.

B. Where the contract documents indicate more stringent requirements than the above codes and ordinances, the contract documents shall take precedence.

C. File all documents, pay all fees and secure all permits, inspections and approvals necessary for the work of this section.

1.6 CONTRACT DRAWINGS & SPECIFICATIONS

A. The Contract Drawings are generally diagrammatic and convey the Scope of Work and General Arrangement of apparatus and equipment. The locations of all items shown on the drawings or called for in the specifications that are not definitely fixed by dimensions are approximate only. The exact locations necessary to secure the best conditions and results must be determined at the project and shall have the approval of the Architect and Engineer before being installed. The Subcontractor shall follow drawings in laying out work and shall check drawings of the other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. If directed by the General Contractor, Engineer and/or Architect, the Subcontractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or before proper execution of the work.

B. Specifications: The specifications are intended only to complement the drawings; however, work detailed and/or noted only on the drawings or work described only in the specifications shall all be considered as part of the scope of work.

1.7 SHOP DRAWINGS

A. Within thirty (30) days after the date of notice to proceed, and before purchasing any materials or equipment, submit for approval a complete list, in six (6) copies, of all

materials to be incorporated in the work.

B. After the list has been processed, submit six (6) complete sets of shop drawings of all equipment. These shop-drawing submittals shall be submitted within thirty (30) days after the processing date of the original submittal.

C. All submittals shall be complete and shall be in three-ring loose-leaf binders. No consideration will be given to partial submittals, except with prior approval.

D. The approval of the equipment does not relieve the Subcontractor of responsibility of shop drawing errors related to details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the Specifications, and/or job conditions as they exist.

E. Refer to General Requirements for the substitutions of equipment and submittal of shop drawings. If apparatus or materials are substituted for those specified, and such substitution necessitates changes in, or additional connections, piping, supports, or construction, same shall be provided. Plumbing Subcontractor to assume cost and entire responsibility thereof.

1.8 RECORD DRAWINGS

A. The General Contractor will provide two sets of black or blue line and white drawings to the Plumbing Contractor to maintain and submit record drawings. One set of which shall be maintained at the site, and which shall, at all times, be accurate, clear and complete. Showing the actual location of all equipment and piping. The record drawings shall be available to the Architect/Engineer and/or General Contractor field representative at all times.

B. Any addenda, sketches, and supplementary drawings issued during the course of construction shall be transferred to the "as-built" drawings.

C. At the completion of the contract, submit an accurate, checked set of "as-built" drawings.

D. All valves installed shall be indicated on these drawings, and shall be numbered with numbers corresponding to those on the valve charts.

E. All costs related to these requirements shall be paid for by this Subcontractor.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Operating Instructions: Provide operating instructions to the Owner's designated representative with respect to the operation functions and maintenance procedures for all equipment and systems installed. The cost of such instructions, up to one full day of the Contractor's time, shall be included in the contract price. The cost of providing a manufacturer's representative at the site for instructional purposes shall be included in the Contract Price.

B. Maintenance Manuals: At the completion of the project, turn over to the General Contractor four (4) complete manuals in 3-ring binders, indexed, containing the following:

1. Complete shop drawings of all material and equipment in Part 2 of this section.
2. Operation descriptions of all systems.
3. Names, addresses and telephone numbers of all suppliers of system components.

4. Preventative maintenance instructions for all systems.
5. Spare parts list of all system components.
6. Copies of all valve charts.

1.10 GUARANTEE

A. This Contractor shall obtain in the General Contractor's and Owner's name, the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities which the Contractor may have by law or other provisions of the Contract Documents. The guarantee shall be for a period of one (1) year minimum from the date of acceptance or final payment.

1.11 STORAGE OF MATERIALS

A. Store materials prior to their installation where designated by the General Contractor. This Contractor shall be responsible for all materials stored and protect all installed equipment from injury or defacement.

1.12 SITE VISITATION

A. This Contractor shall be required to visit the site and to have examined the existing conditions, which may affect the work under this contract. Failure to do so shall be this Subcontractor's responsibility and no claims for extra compensation or extension of time shall be allowed because of it.

1.13 INSPECTION AND TESTS

A. If inspection of materials installed shows defects, such defective work, materials, and/or equipment shall be replaced at no cost to the General Contractor or Owner, and the inspection and tests repeated.

B. Make all reasonable tests as required, and prove the integrity of all work and leave the entire installation in correct adjustment and ready to operate.

1.14 DEFINITION OF TERMS

A. "Contractor and/or Subcontractor" specifically means, the Plumbing Subcontractor working under this Section of the Specification.

B. "Furnish and Install" or "Provide" means to supply, erect, install and connect in complete readiness for operation, the particular work referred to, unless otherwise specified.

C. "Concealed" means hidden, in chases, furred spaces, walls, above ceilings or enclosed in construction.

D. "Exposed" means visible, in sight, or not installed "concealed" as defined above.

E. "Approved Equal" means any equipment or material, which is approved by the engineer, and equal in quality, durability, appearance, strength, design and performance to the equipment or material originally specified.

F. "Piping" means all piping including fittings, joints, hangers, supports and valves.

G. "Underground" means piping that is buried exterior to or within the building.

1.15 CONFLICT BETWEEN PLANS AND SPECIFICATIONS

A. In case of conflict between the contract drawings and specifications, the Engineer shall determine which takes precedence.

1.16 CONTRACT COST BREAKDOWN

A. Submit a breakdown of contract price to aid the General Contractor in determining the value of work installed, as the job progresses.

B. No requisitions will be paid to the Contractor until after the breakdown is delivered to the General Contractor.

1.17 ELECTRICAL CHARACTERISTICS

A. In general, and unless specifically indicated otherwise in the specifications or noted on the drawings, all building service equipment shall be of the following characteristics:

B. Motors up to and including 1/3 horsepower shall be suitable for 120 volt, single-phase operation.

C. Motors larger than 1/3 horsepower shall be suitable for 480 volts, three-phase operation.

1.18 COOPERATION WITH OTHER TRADES

A. Give full cooperation to other trades and furnish in writing to the Architect any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Coordination drawings, General: Prepare coordination drawings according to the requirements in individual sections and as noted below.

1. Content: Project specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

2. Using architect provided base building Autodesk REVIT model (V2016), each sub-contractor shall indicate functional and spatial relationships pertaining to components of architectural, structural, mechanical, electrical, plumbing and fire protection systems. Each trade shall create 3-dimensional representation of their respective systems and components to be integrated into the base building Autodesk REVIT model by general contractor. Each trade shall utilize a unique color for their portion of the coordination model such that systems of different trades are visually distinct from one another.

3. Indicate dimensions shown on the drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide Alternate sketches to architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the contract.

C. Coordination Model Organization: Organize coordination model as follows:

1. Floors and Ceilings: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire alarm and electrical work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid.

2. Plenum Space: Indicate sub-framing for support of ceiling and wall systems, mechanical and electrical equipment, and related work. Locate components within ceiling plenum to accommodate layout of light fixtures as indicated on drawings.

3. Mechanical Rooms: Provide coordination Models of mechanical rooms showing plans and elevations of mechanical, plumbing, fire protection, fire-alarm and electrical equipment.

4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.

5. Slab Edge and Embedded items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.

6. Review: Using Autodesk compatible software contractor shall perform clash detection review utilizing Autodesk REVIT model identified in item A.1.a above. Any and all conflicts shall be immediately brought to the attention of the architect. Architect will review coordination model to confirm that the work is being coordinated, but not for the details of the coordination, which are General Contractor's responsibility.

D. Furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

E. The cost of preparing and reproducing these Drawings will be included as part of this Contract.

F. Coordination Drawings shall not be construed as replacing any Shop Drawings.

G. The Plumbing Subcontractor shall be additionally responsible for preparing drawings indicating all the buried or underground plumbing systems. Include in these documents all other underground components such as, but not limited to, underslab drainage systems, foundation drainage systems, footings, foundation walls, pits, tie beams, electric and telephone duct banks.

PART 2 - PRODUCTS

2.1 ACCESS PANELS

A. Furnish access panels for access to all concealed parts of the plumbing system that require accessibility such as valves, shock absorbers and cleanouts. Access panels to be installed by others under the appropriate section of the specifications.

B. All access panels shall be located in a workmanlike manner, positioned so that the component can be easily reached and the size shall be sufficient for this purpose

(minimum size 12-in. square). Location of access panels will be submitted for approval prior to installation.

C. Access panels shall be prime painted with cam lock, as manufactured by Inland Steel Products Co. Milcor, Miami Carey or Walsh-Hannon-Gladwin, Inc., Wayloctor or an approved equal. Provide fire rated access panels where required by applicable code. They should be as follows:

1. Drywall Surfaces: Acudor DW-5040
2. Masonry Construction: Acudor UF-5000
3. Plastered Surfaces: Acudor PS-5030

D. Access panel shop drawings shall be submitted to the Architect for approval.

2.2 PIPING/FITTINGS/JOINTS

A. Pipe and fittings shall be of US manufacture, and shall conform to the latest ASA, ASTM and/or FS Standards.

B. Above Ground Water Piping 2 in and Smaller:

1. Pipe:
   a. Type L copper tubing, conforming to Federal Specification WW-T-799 hard temper, or ASTM B88 drawn copper.
   b. ASTM A312, 304/304L Stainless Steel, .049 wall, certified for use with Pressfit® products.
2. Fittings:
   a. Wrought copper and bronze solder joints.
   b. 304/304L Precision cold drawn austenitic stainless steel, Vic-Press 304™.
3. Joints:
   a. Soldered joints shall be lead free solder.
   b. Vic-Press 304™ fittings and couplings, complete with elastomer O-ring.

C. Above Ground Sanitary Waste and Vent and Roof Drainage:

1. Cast iron no-hub pipe, fittings, uncoated and joined with State Plumbing Code approved stainless steel coupling with neoprene gasket.
2. Schedule 40 PVC may be installed for sanitary waste and vent piping only not roof drainage.
3. Insulate all horizontal roof drainage including roof drain body with ½" wrapped fiberglass insulation.
4. Type L hard tempered copper tube with soldered cast bronze or wrought copper fittings of the recessed drainage pattern, for waste and vent piping 1-1/2 in. and smaller.

D. Below Ground Sanitary Waste and Vent and Roof Drainage:

1. Service weight cast iron soil pipe, asphalt or coal-tar pitch coated, caulked with lead and oakum or neoprene gaskets.
2. Schedule 40 PVC may be installed for sanitary waste and vent piping

E. Natural Gas Piping 2-1/2 in. and Larger: Schedule 40, seamless black steel pipe (ASTM

A120) with Schedule 40, black steel fittings. Pipe joints shall be welded or flanged.

F. Natural Gas Piping 2 in. and Smaller: Schedule 40, seamless black steel pipe (ASTM B16.3) with 125-psi malleable iron, screwed fittings.

G. Medical Gas Piping shall be type “L” or “K” medical grade copper piping with brazed fittings. Piping and fittings shall be in accordance with NFPA 99 latest edition. Medical Gas piping shall include: Oxygen, Medical Air Supply and Intake, Medical Vacuum Supply and Exhaust,WAGD piping and Nitrous Oxide piping. All systems shall comply with NFPA 99 criteria.

H. Medical Gas System Equipment

Medical Gas Equipment shall be as follows:

1. AMICO Rotary Vane – Lubricated Duplex Vertical “Space Saver” Vacuum System. AMICO Model #V-RVL-D-080P-TS-N-050-M. 5 hp, 460 Volts, 60 HZ., 3 Phase. AMICO #VV-ISO-G2L-20 Locking Isolation Valve with dual gauge ports. AMICO #M-PRSW-GA-VAC Vacuum gauge and pressure switch.

2. AMICO Scroll Medical Air Plant with Desiccant Air Treatment System. AMICO Model #A-SCD-D-080P-TS-N-050-46063-T. 5 hp, 460 volts, 60 HZ., 3 phase. AMICO #VV-ISO-G2L-O7 Locking Isolation valve with dual gauge ports. AMICO #M-PRSW-GA-AIR Pressure switch and gauge assembly – Medical Air.

3. AMICO Oxygen Manifold System – Alert 3 series Automatic Dome Loaded Manifold with Analog Gauges and AMICO header bar for 10 Primary cylinders and 10 reserve cylinders with automatic swith over.

4. AMICO Nitrous Oxide Manifold System – Alert 3 series Automatic Dome Loaded Manifold with Analog Gauges and AMICO header bar for 4 Primary cylinders and 4 reserve cylinders with automatic swith over.

5. AMICO Alert 4 series Master Alarm Panels - #A4M-E-20 – 20 Points. Two Master Alarm Panels.

6. AMICO Alert 3 series LCD Area Alarm Panel with sensors – 8 gas #A3AR-U-OVOVOAV2 to monitor (1) Pre-Op Oxygen, Vacuum on the controlled side, (2) Recovery Oxygen, Vacuum on the controlled side and (3) Ors Oxygen, Medical Air, Vacuum, N20 on main lines.

7. AMICO Zone Valve Box Assemblies with gauges – (2) 2-gas Vacuum and Oxygen #VBU-M0510 (6) 4-gas Oxygen, Vacuum, Medical Air and Nitrous Oxide #VBU-M05050507

8. AMICO Ceiling Outlet/Inlet Stations – AMICO #O-DISCEI-U-OXY Ceiling Outlet Station –DISS – Oxygen, AMICO #O-DISCEI-U-AIR Ceiling Outlet Station –DISS – Med. Air, AMICO #O-DISCEI-U-N2O Ceiling Outlet Station –DISS – Ntrous Oxide, AMICO #O-DISCEI-U-WAG Ceiling Outlet Station –DISS – WAGD, AMICO #O-DISCEI-U-VAC Ceiling Outlet Station –DISS – Vacuum

9. AMICO Wall Outlet/Inlet Stations – AMICO #O-DISWAL-U-OXY Wall Outlet Station – Oxygen, AMICO #O-DISWAL-U-VAC Wall Inlet Station – Vacuum, AMICO #O-WALSLIDE Wall Slide Assembly – Recessed

2.3 HANGERS

A. All piping shall be supported from the building structure by means of approved standard weight UL/FM hangers and supports. Piping shall be supported to maintain required grading and pitching of lines to prevent vibration and to secure piping in place and shall be so arranged as to provide for expansion and contraction. Piping shall not be hung from the hangers of other trades.

B. The spacing of hangers for horizontal piping shall be in accordance with The International Plumbing and Fuel Gas Code Code. In no case shall horizontal piping be supported at intervals greater than 10 ft. Vertical lines shall be adequately supported at their bases by a suitable hanger placed in the horizontal line near the riser and at every story height vertically.

C. Hangers shall be manufactured by Grinnell, Carpenter and Patterson, Fee and Mason, or equal. All hangers and support figure numbers referred to are Carpenter and Patterson.

1. Steel clevis hangers; Fig. 100; attached to steel rod with two nuts for piping 3 in. and larger.
2. For piping 2-1/2 in. and smaller, steel clevis hanger; Fig. 100, or steel band adjustable swivel ring hanger; Fig. 800.
3. Beam clamps shall be Fig. 196 with Fig. 22 retaining clip.
4. Riser clamps shall be Fig. 126 or Fig. 89; riser clamps shall be installed at all risers through floors at each floor.
5. In lieu of individual hangers, Fig. 342 gang hangers, clips and shields may be used.

D. On insulated piping, each hanger shall be oversized so that the hanger will allow the insulation to pass through undisturbed and uncut. Install a 14 gauge metal pipe shield between pipe insulation and at all pipe hangers or saddles. Hangers shall be around insulation so insulation will be between pipe and hanger or saddle.

E. Seismic Restraints: It is the intent of this seismic specification to keep all mechanical building system components in place during a seismic event.

1. All mechanical systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturer's or construction standards, the most stringent shall apply.
2. This contractor shall engage a professional structural engineer registered in the jurisdiction of this project to review the entire installation to determine all seismic restraint requirements and methods. Contractor shall submit a report outlining the structural engineer’s review as well as seismic restraint shop drawings and supporting calculations prepared by the professional structural engineer for review by the Architect.
3. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the applicable building code.

2.4 INSULATION

A. Pipe and equipment installed under this Contract shall be covered as follows:

1. All cold water piping: 1/2 in. glass fiber, 3-1/2 pound density, snap-on fiberglass insulation with vapor barrier jacket and self-sealing lap.
2. All Hot Water and Tempered Water Piping: 1 in. glass fiber, 3-1/2 pound density, snap-on fiberglass insulation with jacketed vapor barrier and self-sealing lap.

.

3. All valves and fittings shall have fiberglass insulation and covered with Manville's Zeston or Proto, PVC fitting covers with a 25/50 flame and smoke rating. The covers shall be Manville's Zeston or an approved equal. The covers shall be secured in place with a 1-inch wide white vinyl tape on all seams joints and throat. No tacks or staples will be allowed on this project.
4. All horizontal roof drain piping including roof drain body shall be insulated with ½" wrapped fiberglass insulation.
5. All piping on factory assembled equipment shall be insulated same as for field installed piping.

B. All pipe insulation shall be covered with a fire retardant vapor jacket in accordance with NFPA. Jacket shall be constructed of outer layers of white kraft paper and one mil aluminum foil with a glass fiber reinforcing between, laminated together with fire retardant adhesive. This jacket shall have a water vapor permeability of .02 perms.

C. Joints: The end joints of insulation shall be tightly butted and covered with factory furnished end joint sealing tapes. The jacket overlap shall be sealed with an approved sealer which shall not mar the jacket finish. End joints on cold water piping shall be sealed with vapor barrier mastic.

D. All sealer, solvents, tapes, adhesives and mastics used in conjunction with the installation of all insulation specified under this section of the specifications, shall pass the maximum possible fire safe qualities available and be of a type approved under NFPA or NFBU 91A and 90B Standards. The flame-spread rating shall not exceed 25. Smoke development rating shall not exceed 50.

E. No covering will be applied until the piping has passed all tests as required by the Engineer and approving authority.

F. All covering shall be Gustin Bacon, Johns-Manville, Owens Corning Fiberglass Co., or equal by recognized manufacturer, and shall be installed by reputable Sub-subcontractors regularly engaged in this work and employing particularly skilled therein.

2.5 VALVES

A. Furnish and install valves, required by code, where indicated on the drawings or specifications, so located that they may be operated, repaired or replaced with minimum effort and repacked under pressure. Provide access panels where valves are concealed behind non-removable ceilings or walls. Provide shut off valves for each battery of fixtures.

B. Gate valves 1/2 in. to 2-1/2 in. shall be all bronze, solder end, non-rising stem, 200-psi cold working pressure.

C. Ball valves 2 in. and smaller shall be two piece, all bronze with full port chrome plated

ball, teflon seats, solder or threaded ends, extended stems and 600 psi cold working pressure.

D. Stop and waste ball valves 3/4 in. and smaller shall be two piece, all bronze, with full port chrome plated ball, drain cap, teflon seats, solder or threaded ends, extended stems and 400-psi cold working pressure.

E. Swing checks 3 in. and smaller shall be horizontal, all bronze, regrinding bronze disc, solder end, 200-psi working pressure.

F. Pressure Reducing Valves (if required): PRV 2-1/2 in. and smaller shall be pressure regulating, all bronze construction with separate strainer, thread end, 250-psi inlet pressure, adjustment range 25-75 psi with built-in bypass feature. Equal to Zurn/Wilkins 500YSBR (1/2" to 2") or Watts 223SB.

2.6 HOSE BIBS

A. Hose bibs shall be Chicago No. 293, 1/2-in. brass "Y" pattern with lock shield, composition disk, loose tee handler and 3/4 in. hose end. Provide watts #8-A chrome plated backflow preventer on outlet. Mount the hose bib with the outlet 16-in. above finish floor. Install hose bib where existing water service enters basement.

2.7 TRAPS

A. Furnish and install traps with cleanouts on all fixtures and equipment requiring connections to the sanitary system of the same size and material as the pipe on which they occur.

B. Traps installed on threaded pipe shall be recessed drainage pattern.

2.8 DRAINS / TRAPS

A. Furnish and install all drains as shown on the drawings.

B. Floor Drains in Bathrooms and Shower Areas shall be Zurn mo. ZN-415, 2 inch, B Type with 6-inch diameter strainers, or approved equal.

2.9 PLUMBING FIXTURES

A. Plumbing fixtures shall be of the best quality as fabricated by a manufacturer of established reputation.

B. All fixtures shall have the manufacturer's guarantee label or trademark indicating first quality.

C. All materials specified to be chromium plated shall be thoroughly cleaned and polished before plating and plate shall be heavily, thoroughly and evenly plated, guaranteed not to strip or peel.

D. Where escutcheons are not furnished with plumbing fixtures, this Contractor shall supply them. Fixtures shall meet the requirements for the conservation of hot and cold water as noted in the State Plumbing Code.

E. Each fixture shall be separately trapped, using the type and size of trap required by the Plumbing Code or as specifically denoted otherwise. Unless otherwise specified, faucets and all exposed fittings and pipe shall be chrome plated. All replacement materials shall be verified in the field to assure a trouble free installation.

F. Dimensions locating plumbing fixtures shall be as shown on the architectural drawings.

2.10 FIXTURE SCHEDULE

A. Refer to Plumbing Fixture Schedule on drawings for specification of plumbing fixtures.

2.11 PIPING ACCESSORIES

A. Furnish and install pressure and temperature relief valves, ASME rated, temperature relief 210 degree F, double BTU rated, self-closing as manufactured by Watts Regulator Co. or approved equal.

B. Furnish and install vacuum reliefs, Watts Regulator Co., or approved equal.

2.12 SHOCK ABSORBERS

A. Furnish and install where shown on or as scheduled on the drawings and where required to prevent water hammer, Zurn Z-1700 Shoktrol arrestors stainless steel, gas filled, bellows type shock absorber. Installation of absorbers shall be as per manufacturer's recommendations. Access panels are required at shock absorbers..

2.13 DRAIN VALVES

A. It shall be possible to drain the water from all the cold and hot water piping risers located in the lower levels. This subcontractor shall furnish and install 1/2-in. bronze gate valves with 3/4-in. hose outlets to drain each section and branch.

2.14 FIRE SAFING

A. Where piping passes through fire rated walls, floors and ceilings, provide a fire safing system so as to maintain the integrity of the rated assemblies to the satisfaction of the Architect and the Building Inspector. The fire safing system shall be as manufactured by 3M, Dow, Bio-Fire Shield, or Nelson. Provide manufacturer's details or custom details when there are not manufacturer's details for each condition with a UL listing referenced. Where piping is insulated, pipe insulation shall run continuously through the rated opening. Details shall show the required depth and annular space width requirements and limitations and any packing requirements.

B. Refer to architectural drawings for rated walls and partitions. Where there are no architectural drawings or they do not indicate rated walls and partitions, the following guidelines shall be used. All floors, corridor walls, party walls, mechanical room walls, duct and pipe chase walls, stairwells, trash room and chute walls shall be considered minimum two hour fire rated walls.

C. Products for fire safing of PVC piping shall be Proset System "C" or approved equal.

2.16 WATER HEATERS

A. Refer to gas fired water heater schedules on plumbing drawings for specification of water heaters.

2.17 SYSTEMS IDENTIFICATION

A. All systems identification materials shall meet ANSI standard A13.1 - 1975, and be as manufactured by Seton Name Plate Corporation or approved equal.

B. Valve tags shall be circular 19 gauge brass, 1-1/2 in. diameter, with black filled text Seton No. 250-BL with No 530 brass hooks, No. 16 brass jack chain, or No.6 nickel-plated bead chain. Letter abbreviations shall be 4 in. high above 1/2-in. high numbers.

C. Pipe markers shall be setmark type "SNA" pre-molded acrylic plastic, snap on markers, either 8 in. or 12 in. long with overlap, for up to 6 in. diameter ER and type "STP" strap for 6 in. and larger. The background, field and legend colors and letter sizes shall be per ANSI standards.

2.18 ESCUTCHEONS

A. Install escutcheons around exposed pipe passing through finished floor, wall or ceiling. Escutcheons shall be one piece heavy cast brass, chromium plated, with set screw adjustable and shall be of sufficient outside diameter to cover sleeve opening and shall fit snugly around pipe.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. Prior to the work of this section, this Contractor must ascertain that preceding work has been accomplished in a manner to permit compliance with the level of quality required by this Section.

B. The entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner. It is not intended that the drawings shall show every pipe, fitting, and appliance. Furnish all parts as may be necessary to complete the system in accordance with the best trade practices and to be the satisfaction of the Architect, Engineer and General Contractor.

C. This Contractor shall keep other contractors fully informed as the shape, size and position of all openings required for his apparatus and shall give full information to the General Contractor or other contractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, supports, etc., specified or required.

D. In the case of failure on the part of this Subcontractor to give proper and timely

information as noted above, he shall do his own cutting and patching, or have same done by the General Contractor at this subcontractor's expense, but in any case, without extra expense to the Owner and General Contractor.

E. This Contractor shall obtain detailed information from the manufacturer of apparatus as to the proper method of installing and connecting same. He shall also obtain all information from the General Contractor and the other contractors which may be necessary to facilitate his work and the completion of the whole project.

3.2 CORE DRILLING

A. All holes through concrete or masonry for the passage of plumbing piping not provided by sleeves or openings at the time of casting, shall be cut by the Plumbing Contractor using an approved core boring machine with diamond edge bit and vacuum sludge removal device. The size of holes shall provide for fire stopping around a pipe. The location of all core drilled holes shall be coordinated with the structural reinforcing and be reviewed by the Architect prior to commencing work.

B. Prior to coring, the Plumbing Contractor shall submit a minimum 1/8 in. scale plan, dimensioning the location of proposed cored opening locations and indicating the core diameter. Prior to developing the coring plan, the Plumbing Contractor shall examine the site carefully in an attempt to determine whether there are structural, mechanical or electrical obstacles in the proposed coring locations. Once the plans are reviewed by the Architect and Owner's representative, the Plumbing Contractor may proceed with caution. If an electrical conduit, for example, was hit during coring operations, and it was determined that the Plumbing Contractor was negligent by not noting a conduit turning into the slab below, he would be responsible for the repair cost. If the Contractor were not found to be negligent, then the Owner would assume the cost of the repair.

3.3 TESTING PIPING SYSTEMS

A. Test all work in the presence of the Architect/Engineer and/or Owner, Owner's representative and Plumbing Inspector as called for in local codes.

B. After soil, waste and vent piping is in place and before being furred in, plug lower ends and fill. The system shall be left tight under these conditions and water level shall be maintained intact for a period of at least four hours.

C. Test domestic water piping and service by applying a hydrostatic pressure of 125 psi using a pump for this purpose. Make sure that all lines are properly plugged or capped, and that air has been vented before applying pressure, which shall remain constant without pumping for one hour at least.

D. This Contractor shall furnish all equipment, labor and materials, required for these tests.

E. Any leaks in joints or evidence of defective pipe or fittings disclosed by tests shall be immediately corrected by replacing defective parts with new joints or corrected materials. No makeshift repairs affected by caulking threaded pipe with lead wool, application of wicking or patented compounds being permitted. Perform smoke tests as required by local code or by the Architect/Engineer.

F. Testing of Medical Gas Systems and equipment shall be performed by an accredited third party testing company as required by NFPA 99.

3.4 PROTECTION AND CLEANING

A. Each subcontractor shall be responsible for his work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment, which are not immediately installed after delivery on site. Close open ends or work with temporary covers or plug during construction to prevent entry of obstructing materials.

B. Each subcontractor shall protect work and materials of other trades from damage that might be caused by his work or workman and make good damage thus caused.

C. The premises shall be kept reasonably clean at all times, and rubbish shall be removed as directed by the General Contractor.

D. Upon completion of this work, the Contractor shall clean all fixtures and equipment and replace damaged parts. Upon failure of this Contractor to fulfill his obligation, this work will be taken care of at his expense.

3.5 WORK COORDINATION AND JOB COORDINATION

A. Plumbing equipment shall not be installed in congested and possible problem areas without first coordinating the installation of same with the other trades and the General Contractor.

B. Particular attention shall be directed to the coordination of system with all equipment of other trades installed in and above the ceiling areas. Conflicts in heights and clearance above hung ceilings shall be brought to the attention of the General Contractor for a decision before equipment is installed.

C. Furnish to the General Contractor and other trades all information relative to the position of the plumbing installation that will affect them so that they may plan their work and installation accordingly.

3.6 SUPPLEMENTARY STEEL, CHANNEL AND SUPPORTS

A. Furnish and install all supplementary steel, channels and supports required for the proper installation, mounting and support of all equipment.

B. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Architect/Engineer.

C. The type and size of the supporting channels and supplementary steel shall be determined by the Plumbing Subcontractor and shall be sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All supplementary steel and channels shall be installed in a neat and workmanlike manner parallel to the walls, floor and ceiling construction. all turns to be made with 90 degree fittings, as required to suit the construction and installation conditions.

3.7 SLEEVES AND INSERTS

A. Sleeves shall be furnished, set and properly secured in place and at all points where piping passes through masonry or concrete. All sleeves shall be of sufficient diameter to

provide 1/4-in. clearance around the pipe.

B. Sleeves through concrete slabs, and interior concrete and masonry walls or partitions shall be steel pipe. Fire stop annular openings between sleeves and pipes at floor slab passages and make watertight. Galvanized sleeves and copper piping shall not be placed in concrete.

C. Install UL listed and FM approved inserts or other anchoring devices in concrete and masonry construction as required to support piping. Inserts shall be of the adjustable type as manufactured by Carpenter and Patterson, Grinnell, or Fee and Mason.

3.8 SYSTEM IDENTIFICATION

A. All valves on pipes of every description shall have circular brass valve tags of at least 1-1/2 in. in diameter, attached with brass hooks to each valve stem. Stamp number of the valve and the service, such as "HW", "CW", , etc., for hot water, cold water, etc., respectively. The numbers of each service shall be consecutive and shall correspond with the numbers indicated for valves and controls on the record drawings and on three printed valve lists. These printed lists shall state number and locations of each valve and control and the section, fixture or equipment which it controls.

B. The printed valve lists shall be prepared in a form to meet the approval of the Architect and Engineer and one copy shall be framed under glass and mounted in approved locations.

C. All plumbing lines and equipment shall be identified by pipe markings, which shall be provided by this Contractor. Markers shall be applied every 20 ft. Markings shall indicate pipe content and direction of flow. The markers shall be as manufactured by Seton Name Plate Corp. or equal.

3.9 SAFETY PRECAUTIONS

A. Furnish, place and maintain proper guards for the prevention of accidents and any other necessary construction required to secure safety of life and property.

3.10 INSERTS AND OPENINGS

A. Inserts: Install inserts or other anchoring devices in concrete and masonry construction as required to support piping. Inserts shall be of the adjustable type as manufactured by Carpenter and Patterson, Grinnell of Fee and Mason.

B. Escutcheons: All exposed pipe, uncovered, passing through walls, floors or ceilings shall be fitted with one piece chrome plated brass escutcheons with set screw holding in position. Floor escutcheons to be deep enough to fit over sleeves, fastened to pipe and extending down to floor.

3.11 PLANS AND SPECIFICATIONS

A. The drawing showing layout of the plumbing systems indicate the approximate location of outlets, apparatus and equipment are schematic. The final determination as to the routing shall be governed by structural conditions and other obstructions.

B. The right to make any reasonable change in the location of outlets, apparatus and equipment up to the time of the roughing-in is reserved by the Architect and Engineer without involving any expense to the Owner or the General Contractor.

C. The specifications supplement the drawings and provide specifics pertaining to the methods of material to be used in the execution of the work.

3.12 SANITARY WASTE AND VENT SYSTEMS

A. Furnish and install piping to take wastes from all soil and waste stacks, fixtures, drains and equipment as indicated and/or described in these plans and specifications.

B. Unless specifically noted otherwise on the plans, all horizontal piping 4 in. and larger shall be pitched at the rate of 1/8 in. per foot in the direction of the flow. Horizontal sanitary piping 3 in. and smaller shall be pitched at the rate of 1/4 in. per foot in the direction of the flow.

C. Vent System: Furnish and install piping to vent all stacks, fixtures, traps and appliances as indicated on the drawings and/or required to meet the Plumbing Code. All vent piping shall be concealed where possible with the horizontal pipe pitching back toward fixtures to allow connection to drain. Whether indicated on plan or not, offset vents below the roof to avoid air intakes, equipment, penthouse mansard etc., bring vents through the roof a minimum of 25 ft. away from air intakes, windows, and operable sash and 10 ft. away from other obstructions.

3.13 HOT AND COLD WATER SYSTEMS

A. Furnish and install complete cold and hot water systems to service all fixtures and equipment indicated on the drawings or specified as requiring cold or hot water. Cold water piping shall start at the connection to the water main indicated on plan and extend to all fixtures and equipment, including piping, fittings and valves requiring connections. Hot water piping shall extend from the hot water heater to all fixtures and equipment, including piping, fittings and valves. In general, piping shall pitch upward in the direction of flow with each branch and riser separately valved and with 1/2 in. hose end drains on the outlet side of the valve and at all low points in the systems. Install valves for each battery of fixtures and other valves as necessary to isolate all parts of these systems. All valves shall be accessible.

3.14 CHLORINATION

A. All water lines and water service shall be thoroughly flushed and chlorinated before being put into service. The domestic cold and hot water systems shall be chlorinated and flushed in accordance with the requirements of the State Plumbing Code and Local Inspector.

B. Submit a certificate of compliance when chlorination has been completed stating when performed, by whom and who witnessed the procedure.

END OF SECTION

SECTION 230000 – FIRE PROTECTION

PART I -- GENERAL

1.1 DESCRIPTION OF WORK

A. The work under this section shall consist of furnishing all labor, materials, equipment, supervision, transportation, construction, facilities, devices and incidentals necessary to provide complete fire protection systems as hereinafter described and as indicated on the drawings, including, but not limited to the following:

1. Complete wet pipe sprinkler system for renovated area.
2. Preparation of complete and detailed working plans in accordance with the latest editions of NFPA 13.
3. Hydraulic calculations.(if required by **A**uthority **H**aving **J**urisdiction
4. Submit drawings to insurer and local authorities and obtain necessary approvals, permits and certificates.
5. Sprinkler heads, piping, fittings and hangers.
6. Sleeves, escutcheons, hangers and supports.
7. Fire safing of penetrations through rated floor and wall assemblies.
8. Testing.
9. Completion and submission of NFPA 13 Contractor's material and test certificate for above ground piping.
10. Core drilling
11. Coordination of drawings.
12. Access panels

B. Furnish and install a complete automatic sprinkler system within the building, hydraulically designed on computer program.

The standpipe/sprinkler system shall be hydraulically designed in accordance with the following design densities:

Light Hazard Occupancies

Office, corridors, conference rooms and toilet rooms
Designed for .10 gpm over the most remote 1500 square feet.
Additional 100 gallon per minute flow for exterior fire hose flow
Maximum spacing of 225 square feet per sprinkler head unless otherwise noted or indicated.

Ordinary Hazard Occupancies Group 1
Mechanical Rooms
Storage Areas
Designed for .15 gpm over the most remote 1500 square feet.

C. Sprinklers located in elevator hoistways and machine rooms shall be required unless the standards of NFPA 8.14.5 Elevator Hoistways and Machine Rooms has been satisfied.

D. Sprinklers located in electrical rooms shall be required unless the standards of NFPA 8.14.10 Electrical Equipment has been satisfied.

E. The complete fire protection systems shall be flushed, fully tested, accepted by the local fire department, and in operation, prior to final acceptance by the Engineer. Flush fire service and fire protection piping prior to connecting to new piping and equipment.

1.2 CODES, ORDINANCES AND PERMITS

A. All material and work provided shall by in accordance with the following codes and standards:

1. NFPA Pamphlets 13 latest edition.
2. State Fire Safety Code (NFPA 1 and 101)
3. State Department of Public Safety
4. Standards of the Underwriter's Laboratories (UL)
5. State and Local Building Codes
6. Local Fire Department requirements
7. Local Water Department requirements
8. Owner's insurance company

B. Where the contract documents indicate more stringent requirements than the above codes and ordinances, the contract documents shall take precedence.

C. File all documents, pay all fees and secure all inspections and approvals necessary for the work of this section.

D. It shall be the responsibility of this Contractor to prepare drawings showing complete and fully coordinated sprinkler head and piping layouts in accordance with the requirements of NFPA and those authorities having jurisdiction over this project. It shall also be the responsibility of the Sprinkler Subcontractor to obtain all approvals from local authorities and the Owner's Insurance Underwriter prior to submission to the Architect. Revise head location as required for areas that have ornate ceiling work or as requested by the Architect. Provide side wall heads in area's as instructed.

1.3 SHOP DRAWINGS

A. Within thirty (30) days after the date of notice to proceed, and before purchasing any materials or equipment, submit for approval a complete list, in six (6) copies, of all materials to be incorporated in the work.

B. After the list has been processed, submit six (6) complete sets of shop drawings of all equipment. These shop drawing submittals shall be submitted within thirty (30) days after the processing date of the original submittal.

C. The approval of the equipment does not relieve the Subcontractor of responsibility of shop drawing errors related to details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the Specifications, and/or job conditions as they exist.

D. Refer to General Requirements for the substitutions of equipment and submittal of shop drawings. If apparatus or materials are substituted for those specified, and such substitution necessitates changes in, or additional connections, piping, supports, or construction, same shall be provided. The Sprinkler Subcontractor to assume cost and entire responsibility thereof.

1.4 RECORD DRAWINGS

A. All costs related to the following requirements shall be paid for by this Subcontractor.

B. Purchase and maintain at the job site a complete and separate black line set of prints of the Contract Drawings on which accurately indicate daily progress by coloring materials and apparatus as installed. Schedules shall be modified to reflect data consistent with that of the installed equipment. Clearly show all changes to the work as a result of change orders, instructions issued by the Architect or conditions encountered in the field. Accurately indicate the location, size, type and elevation of new utilities and their relationship to existing utilities.

C. The marked up and colored in prints will be used as a guide for determining the progress of the work installed. They shall be inspected weekly and shall be corrected immediately if found inaccurate or incomplete. Requisitions for payment will not be approved until the Drawings are accurate and up-to-date.

D. At the completion of the work, submit one (1) set of marked up prints for review and comment. After review and comment, these marked up prints shall be used in the preparation of the Record Drawings. The Record Drawings shall consist of these prints (corrected) previously indicated, as well as two (2) CAD disks of the Final Coordination Drawings, corrected on the basis of the Architect/Engineer's final comments.

1.5 WORKING PLANS

A. Submit Working Plans and hydraulic calculations signed and sealed by a Professional Engineer licensed to practice fire protection state in which project is located, to authorities that have jurisdiction, including: Architect, Insurance Underwriter and Fire Department

B. Working plans and computerized hydraulic calculations shall be prepared by a minimum Level 2 N.I.C.E.T. certified sprinkler layout designer. Drawings shall be signed and the N.I.C.E.T. certificate number indicated on plan.

C. Working plans shall be at least 1/8 in. = 1' 0" scale on sheets of uniform size. Working plans shall show all data required by NFPA 13. Submit working plans and hydraulic calculations in one complete package.

D. Working plans will be subject to Architect's final approval. Submit to Architect after review by other authorities. If necessary to submit plans to Architect before review by other authorities, identify authorities that have not reviewed plans and resubmit for final approval when review by all parties is complete.

1.6 MAINTENANCE MANUALS

A. Maintenance Manuals: At the completion of the project, turn over to the General Contractor four (4) complete manuals in 3-ring binders, indexed, containing the following:

1. Complete shop drawings of all material and equipment in Part 2 of this section.

2. Operation description of all systems.

3. Names, addresses and telephone numbers of all suppliers of system components.

4. Preventative maintenance instruction for all systems.

5. Spare parts list of all system components.

6. Copies of all valve charts.

1.7 GUARANTEE

A. The Contractor shall obtain in the General Contractor's and Owner's name, the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities which this Contractor may have by law or other provisions of the Contract Documents. The guarantee shall be for a period of one (1) year minimum from the date of acceptance or final payment.

1.9 COOPERATION WITH OTHER TRADES

A. Give full cooperation to other trades and furnish in writing to the Architect any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Coordination drawings, General: Prepare coordination drawings according to the requirements in individual sections and as noted below.

1. Content: Project specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:

2. Using architect provided base building Autodesk REVIT model (V2016), each sub-contractor shall indicate functional and spatial relationships pertaining to components of architectural, structural, mechanical, electrical, plumbing and fire protection systems. Each trade shall create 3-dimensional representation of their respective systems and components to be integrated into the base building Autodesk REVIT model by general contractor. Each trade shall utilize a unique color for their portion of the coordination model such that systems of different trades are visually distinct from one another.

3. Indicate dimensions shown on the drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide Alternate sketches to architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the contract.

C. Furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

D. The cost of preparing and reproducing these Drawings will be included as part of this Contract.

E. Coordination Drawings shall not be construed as replacing any Shop Drawings.

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

A. Above ground wet pipe sprinkler systems 2 in. or smaller: Pipe material shall be threaded steel pipe; Schedule 40; ASTM A53. Fittings shall be cast iron; Class 125 or 250, ANSI B16.4 with threaded joints.

B. Above ground wet pipe sprinkler/standpipe systems 2-1/2 in. or larger: Pipe material shall be steel pipe; Schedule 10; rolled groove without metal removal, ASTM A-135. Fittings for grooved end steel pipe shall be ductile iron, ASTM A-536, or steel, ASTM A-53, short radius or standard fittings with grooved or shouldered ends. Couplings shall be ductile iron conforming to ASTM A-536, with rigid joints, Victaulic style 75, 004, or 177 flexible joints with gasket, nuts and bolts.

C. Pipe fittings and couplings used in the sprinkler and/or standpipe systems shall be of the materials indicated above and shall be designed to withstand a working pressure of not less than 175 PSI.

2.2 HANGERS

A. Hangers and hanging methods shall be NFPA 13 Standards or more stringent requirements, as specified herein. All hangers, clamps, rods, shields, etc., shall be UL listed and FM approved. Fire protection Standpipe/Sprinkler piping shall be independently supported. Other piping shall not be supported on same supports as the Fire Protection piping.

B. Mains 4 in. and larger shall be supported using adjustable standard weight clevis hangers. Piping 3 in. and smaller shall be supported using standard adjustable flat iron hangers.

C. Provide additional supports on piping as necessary to prevent movement of piping as required by the Architect and Engineer. Of particular concern are vertical runs of piping, and the top and bottom of standpipe risers. Supports may consist of wall plates, properly secured to the building structure, threaded rods, and split ring pipe clamps.

D. Seismic Restraints: It is the intent of this seismic specification to keep all building system components in place during a seismic event.

1. All systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturer's or construction standards, the most stringent shall apply.

2. This contractor shall engage a professional structural engineer registered in the jurisdiction of this project to review the entire installation to determine all seismic restraint requirements and methods. Contractor shall submit a report outlining the structural engineer’s review as well as seismic restraint shop drawings and supporting calculations prepared by the professional structural engineer for review by the Architect.

3. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the applicable building code.

2.3 ALARM

A. All alarm devices shall be U.L. listed and FM approved. Alarm facilities shall include a water motor gong (complete with an electric bell as required by local authority) located

outside the building with hood and identification plate. The supply pipe from the water gong shall be I.P.S. brass or copper.

B. Supervisory switches shall be furnished and installed by the Sprinkler Subcontractor and wired by the Electrical Contractor. Potter-Electric 6220, Grinnell or Reliable.

C. Flow switches shall be furnished and installed by the Fire Protection Contractor and wired by the Electrical Contractor. Potter-Roemer Fig. 6200 Series, red, tamper-proof switch housings with flow paddle, adjustable pneumatic retard setting 0 - 70 seconds, voltage compatible with the fire alarm system. This Contractor shall set the retard as directed by the local fire department, or 45 seconds if there is no preference.

D. Pressure switches shall be provided by this Subcontractor. Provide pressure switches to announce main water flow on wet and dry alarm check valves.

2.4 DRAINS AND TEST CONNECTIONS

A. Furnish and install system drains so that all portions of the fire protection system can be drained. Drains shall be provided at the base or risers, low points or the ends of runs to ensure complete drainage. All drains that exit the building, will do so at ground level, in a manner approved by the Architect and Engineer. Victaulic Testmaster will be allowed.

B. All system drains shall be concealed or exposed in mechanical spaces. Location of system drains will be specifically shown on the shop drawings. Victaulic Testmaster shall be used to perform inspector's test and drain for each individual floor zone station.

2.5 VALVES

A. All valves shall be free from defects and shall be stamped or marked with the manufacturer's name, FM approved and UL listed, of US manufacturer, and be rated for 175 psi working pressure.

B. Gate valves shall be of the 175 psi Standard Class. Valves 2 inches and smaller, shall be all bronze, with rising stem and screwed ends. Over 2 in. sizes shall be bronze mounted, iron body, outside screw and yoke type, flanged. The interior main service valves must be OS&Y gate type valves.

C. Butterfly valves 2-1/2 in. and smaller shall be slow closing with visual position indicator, built-in supervisory tamper switch, ASTM 584 bronze body and housing, brass or cast iron handle, Type 304 stainless steel disc, EPDM elastomer seal, cast aluminum switch housing, grooved or threaded ends, Milwaukee Butterball BB SC Series or equal as manufactured by Central. The supervisory switch shall be SPDT rated for 10 amps, 115 VAC, .5 amps, 28 VDC. The entire assembly shall by UL listed, FM approved and rated for 175 psi working pressure. Butterfly valves shall not be used on the suction of the fire pump or as the main fire service valve.

D. Butterfly valves 3 in. and larger shall be slow closing with visual position indicator, built-in supervisory tamper switch, ASTM-66, ductile iron body and disc, EPDM seal, grooved or lug ends, Victaulic 765 (365 psi), or Victaulic 705 (300 psi), or equal. The supervisory switch shall be SPDT rated for 10 amps, 115 VAC, .5 amps, 28 VDC. The entire assembly shall be UL listed, FM approved and rated for minimum 175 psi of working pressure.

E. Check valves shall be installed horizontally, and be iron body, bronze mounted, swing type, flanged ends, automatic ball drip, with manufacturer's name, pressure rating, and year of manufacturer cast on body. (Victaulic S\717H (365 psi) or S/717 (300 psi) check valve with grooved ends is allowed subject to the approval of the local authority.)

2.6 SPRINKLER HEADS

A. All sprinkler heads shall be Quick Response UL listed and FM approved, and meet the specified criteria. Quick response concealed type sprinklers are not required to be FM approved.

B. Sprinkler heads to be installed in areas with finish hung ceilings, unless otherwise indicated, shall be quick response, concealed with white cover plate (for show room), recessed pendant mounted (toilet rooms, corridors, work rooms…etc.), 165 degree F. rating with C.P. adjustable escutcheon.

C. Sprinklers in unfinished areas without ceilings and in all concealed combustible areas shall be quick response, upright, brass, rough finish, conventional design, temperature rating as required by their location. In finished areas without hung ceilings, the upright sprinkler head finish shall be chrome plated.

D. Provide sprinkler head guards for all heads subject to accidental damage or vandalism. Gymnasium (4th Floor), Mechanical rooms and Work Rooms.

2.7 CHECK VALVE ON FIRE DEPARTMENT CONNECTION LINE

A. On the line to the fire department connection, provide an approved straightway check valve installed in horizontal position within the building. Piping shall be arranged to drain between check valve and Siamese connection by approved ball drip connection piped to nearest drain or through wall.

2.8 DOUBLE CHECK VALVE ASSEMBLY

A. Furnish and install where indicated on plan, an approved double check valve assembly having epoxy coated cast iron body with bronze seats and bronze body ball valve test cocks.

B. The double check assembly shall be provided with tight closing supervised Double Check Valve Assembly shall be Ames, Watts, Febco, Wilkins or Conbraco. The double check valve assembly shall consist of two independently operated spring loaded cam-check valves, required test cocks, and optional inlet and outlet resilient wedge shut-off valves. Each cam check shall be internally loaded and provide a positive drip tight closure against the reverse flow of liquid caused by backsiphonage or backpressure. The modular cam-check includes a stainless steel spring and cam-arm, rubber faced disc and a replaceable seat. The body shall be manufactured from 300 series stainless steel, 100% lead free through the waterway, with a single two-bolt access cover. UL/FM outside stem and yoke resilient seated gate valves shall be included.

2.9 ALARM CHECK VALVE ASSEMBLIES

A. Wet alarm check valve shall be approved vertical type for wet systems, complete with Series 752 retard chamber, alarm switch, drain valve, pressure gauges, electric alarm bell and other required trimmings. Valve internal components shall be replaceable without removing valve from the installed position.

2.10 FIRE SAFING

A. Where piping passes through fire rated walls, floors and ceilings, provide a fire safing system so as to maintain the integrity of the rated assemblies to the satisfaction of the Architect and the Building Inspector. The fire safing system shall be as manufactured by 3M, Dow, Bio-Fire Shield, or Nelson. Provide manufacturer's details or custom details

when there are no manufacturer's details for each condition with a UL listing referenced. Where there piping is insulated, pipe insulation shall run continuously through the rated opening. Details shall show the required depth and annular space width requirements and limitations and any packing requirements.

B. Refer to architectural drawings for rated walls and partitions. When there are not architectural drawings, or they do not indicate rated walls and partitions, the following guide lines shall be used: All floors, corridor walls, party walls, mechanical room walls, duct and pipe chase walls, stairwells, trash room and chute walls shall be considered minimum two hour fire rated walls.

2.11 FIRE DEPARTMENT RECESSED VALVE CABINET

A. Potter-Roemer 1810-A-10 series 22ga. Box; 20ga. Tubular steel door with 20ga. Frame and a continuous steel hinge. All components are powder coated with an electrostatically-applied, thermally-fused, re-coatable white polyester finish. All glass door styles provided with a clear tempered safety glass. Include 2-1/2” Potter-Roemer Fire Department Valve with 1-1/2” reducer with cap & chain.

2.12 PREACTION SYSTEM

A. Furnish and install a 2-1/2” Type D Supertrol Double Interlock Pre-action System for the Data room as manufactured by Reliable, or approved equal. The system shall utilize the Reliable Model A Deluge Valve and the Model G Right-Check Riser Valve. The system shall use fire detection devises and system air pressure as separate zones to a cross-zoned releasing control panel. The riser valve shall isolate the deluge valve from the system to enable the system to be pressurized with air and monitored by a low pressure switch. The solenoid releasing valve shall remain closed until energized by the releasing control panel. This shall occur only when both a fire detection device is operated and the low pressure switch has detected sufficient loss of system air pressure. The solenoid valve shall be furnished and installed by the sprinkler contractor and wired by the electrical contractor.

B. Furnish and install Reliable Model B Hydraulic Manual Emergency Station as part of the trim package. The station shall consist of an aluminum nameplate mechanically attached to a ball valve. The valve handle in its OFF position is guarded against accidental turning to the ON position by a nylon cable tie provided with the Wet Pilot Trim Kit. The nylon cable tie shall be designed to allow, in case of an emergency, forceful turning of the valve handle to the ON position.

C. Provide Reliable Model RP1001 Electric Releasing Control Panel. All releasing and detection devises shall be supervised by the Control Panel. The power supply, the standby emergency power supply, battery charger and the rectifier circuitry shall all be contained within the RP1001 panel. Reliable Model PS 12120 batteries that provide 90 hours of standby power are required for this system. The control panel and all accessories shall be furnished by the sprinkler contractor and wired by the electrical contractor.

D. The pre-action system, with associated trim, shall be rated for a minimum water supply pressure of 20 psi and a maximum water supply pressure of 175 psi. The double interlock pre-action system shall include Reliable Model 1 HAB-11T-M100x, 1/6 HP air compressor with tank to maintain a minimum of 7 psi pneumatic pressure to supervise the sprinkler system. The Model A-2 Pressure Maintenance Devise shall be used to maintain the system pneumatic pressure between 7 and 10 psi.

E. Provide the optional Drain Manifold Trim to facilitate an efficient drain system for all lines.

F. Provide Reliable Model PSD-7125 smoke detectors for the Archives Room. The fire alarm smoke detectors shall be furnished by the sprinkler contractor and wired by the electrical contractor.

G. Provide remote alarm and water flow bells as manufactured by Reliable. Each bell shall be furnished by the sprinkler contractor and wired by the electrical contractor.

H. The complete system and all its components shall be U.L. listed and F.M. approved. The system shall also be in complete accordance with NFPA 13 and all state and local codes.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. The entire work provided in this specification shall be constructed and finished in every respect in a workmanlike and substantial manner. It is not intended that the drawings shall show every pipe, fitting, and appliance. Furnish all parts as may be necessary to complete the system in accordance with the best trade practices and to be the satisfaction of the Architect, Engineer and General Contractor.

B. This Contractor shall keep other contractors fully informed as to the shape, size and position of all openings required for his apparatus and shall give full information to the General Contractor or other contractors sufficiently in advance of the work so that all openings may be built in advance. Furnish and install all sleeves, supports, etc., specified or required.

C. In the case of failure on the part of this Subcontractor to give proper and timely information as noted above, he shall do his own cutting and patching, or have same done by the General Contractor at this Subcontractor's expense, but in any case, without extra expense to the Owner.

D. This Contractor shall obtain detailed information from the manufacturer of apparatus as to the proper method of installing and connecting same. He shall also obtain all information from the General Contractor and the other contractors which may be necessary to facilitate his work and the completion of the whole project.

3.2 CORE DRILLING

A. All holes through concrete or masonry for the passage of fire protection piping not provided by sleeves or openings at the time of casting, shall be cut by the Fire Protection Contractor using an approved core boring machine with diamond edge bit and vacuum sludge removal device. The size of holes shall provide for fire stopping around a pipe. The location of all core drilled holes shall be coordinated with the structural reinforcing and be reviewed by the Architect prior to commencing work.

3.3 TESTING PIPING SYSTEMS

A. Test all work in the presence of the Architect/Engineer and/or Owner, Owner's representative and Fire Inspector as called for in local codes in the following manner:

1. Upon completion and prior to acceptance of the installation, the new fire Protection work shall be tested as required by the National Fire Protection

association Pamphlet No. 13 and Insurance Underwriter and arrangements made for approval. Piping shall be tested to a hydrostatic test pressure of 200 psi for a period of two hours.

2. Provide 48 hours notice prior to commencing tests.

B. Testing shall include piping from the fire department connection to the alarm check valve.

C. Any leaks in joints or evidence of defective pipe or fittings disclosed by tests shall be immediately corrected by replacing defective parts with new joints or materials. No makeshift repairs affected by caulking threaded pipe with lead wool, application of wicking or patented compounds being permitted. Perform smoke tests as required by local code or by the Architect/Engineer.

D. This subcontractor shall furnish all equipment, labor and materials, required for these tests.

3.4 PROTECTION PIPING

A. Each subcontractor shall be responsible for his work and equipment until finally inspected, tested and accepted. Carefully store materials and equipment which are not immediately installed after delivery on site. Close open ends or work with temporary covers or plug during construction to prevent entry of obstructing materials.

B. Each subcontractor shall protect work and materials of other trades from damage that might be caused by his work or workman and make good damage thus caused.

C. The premises shall be kept reasonably clean at all times, and rubbish shall be removed as directed by the General Contractor.

D. Upon completion of this work, this Contractor shall clean all equipment and replace damaged parts. Upon failure of this Contractor to fulfill his obligation, this work will be taken care of at his expense.

3.5 WORK COORDINATION AND JOB COORDINATION

A. Sprinkler system and equipment shall not be installed in congested and possible problem areas without first coordinating the installation of same with the other trades and the General Contractor.

B. Particular attention shall be directed to the coordination of system with all equipment of other trades installed in and above the ceiling areas. Conflicts in heights and clearance above hung ceilings shall be brought to the attention of the General Contractor for a decision before equipment is installed.

C. Furnish to the General Contractor and other trades all information relative to the position of the sprinkler/standpipe installation that will affect them so that they may plan their work and installation accordingly.

3.6 SUPPLEMENTARY STEEL, CHANNEL AND SUPPORTS

A. Furnish and install all supplementary steel, channels and supports required for the proper installation, mounting and support of all equipment.

B. Supplementary steel and channels shall be firmly connected to building construction in a manner approved by the Architect/Engineer.

C. The type and size of the supporting channels and supplementary steel shall be

determined by the Sprinkler Subcontractor and shall be sufficient strength and size to allow only a minimum deflection in conformance with the manufacturer's requirements for loading.

D. All supplementary steel and channels shall be installed in a neat and workmanlike manner parallel to the walls, floor and ceiling construction. All turns to be made with 90 degree fittings, as required to suit the construction and installation conditions.

3.7 SLEEVES AND INSERTS

A. Sleeves shall be furnished, set and properly secured in place and at all points where piping passes through masonry or concrete. All sleeves shall be of sufficient diameter to provide 4 in. clearance around piping 4” and greater and 2 in. clearance around pipe less that 4” in diameter.

B. Sleeves through concrete slabs, and interior concrete and masonry walls or partitions shall be steel pipe. Fire stop annular openings between sleeves and pipes at floor slab passages and make watertight. Galvanized sleeves and copper piping shall not be placed in concrete.

C. Install UL listed and FM approved inserts or other anchoring devices in concrete and masonry construction as required to support piping. Inserts shall be of the adjustable type as manufactured by Carpenter and Patterson, Grinnell, or Fee and Mason.

3.8 WATER SUPPLY

A. Water supply data shall be recent and shall include static pressure and residual pressure flowing at greater than the demand GPM. Flow tests shall be dated less than one year from date of receipt of the contract. Flow tests dated later than one year shall not be valid, and a new test shall be performed by this Contractor to the requirements of NFPA. Tests shall be taken at hydrants in close proximity (within 500 ft.) of the building to be serviced.

3.9 INSTALLATION OF SPRINKLER PIPING

A. Pipe, fittings and hangers shall be installed in accordance with the recommendations of NFPA 13 and 14, in a neat and workmanlike manner.

B. Where possible, all piping shall be concealed. Where it is not possible to conceal piping, it shall be located as inconspicuously as possible to minimize the visual impact and shall be approved by the Architect prior to installation.

C. Care shall be taken to insure that all new piping shall be installed in practical alignment. Pitch piping to drain or draw-off points.

D. Test valves and flushing connections shall be provided in the piping system as required for proper operation and by code.

SECTION 230000 – MECHANICAL

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.2 SUMMARY OF WORK

A. Provide complete functional Heating, Ventilating and Air Conditioning system as shown on Mechanical Construction Documents.

1.3 REFERENCE STANDARDS

A. NFPA Standards

B. ANSI Standards

C. ASME Standards

D. ASTM Standards

E. AWWA Standards

F. ASHRAE Standards

G. SMACNA Standards

H. OSHA Standards

I. NEBB Standards

J. Local Codes and Ordinances

K. Owner's Insurance Company Requirements

L. Where the contract documents indicate more stringent requirements than the above codes and ordinances, the contract documents shall take precedence.

M. File all documents, pay all fees and secure all permits, inspections and approvals necessary for the work of this section.

1.4 CONTRACT DRAWINGS & SPECIFICATIONS

A. The Contract Drawings are generally diagrammatic and convey the Scope of Work and General Arrangement of apparatus and equipment. The locations of all items shown on the drawings or called for in the specifications that are not definitely fixed by dimensions are approximate only. The exact locations necessary to secure the best conditions and results must be determined at the project and shall have the approval of the Architect and Engineer before being installed. The Subcontractor shall follow drawings in laying out work and shall check drawings of the other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. If directed by the General Contractor, Engineer and/or Architect, the Subcontractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or before proper execution of the work.

B. Specifications: The specifications are intended only to complement the drawings; however, work detailed and/or noted only on the drawings or work described only in the specifications

shall all be considered as part of the scope of work.

1.5 CONFLICT BETWEEN PLANS AND SPECIFICATIONS

A. In case of conflict between the contract drawings and specifications, the Engineer shall determine which takes precedence.

1.6 SHOP DRAWINGS AND PRODUCT DATA

A. SUBMITTALS: Submit shop drawings, manufacturers data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, and have them approved before procurement, fabrication, or delivery of the items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry, and technical society publication references, and other information necessary to establish contract compliance of each item the Contractor propose to furnish.

B. Submit in accordance with Division 1.

C. It is the intent of the these specifications that all equipment, materials and workmanship used on this project be in complete conformance with all local, state and national codes, ordinances and standards.

D. Substitutions shall be equivalent to specified equipment in all aspects of quality and performance and shall conform to the intent stated above. It is the contractor's responsibility to submit only those items that meet these requirements. Should any non-conforming items be installed, they shall be replaced by the contractor at no additional cost to the owner.

E. The approval of the equipment does not relieve the Subcontractor of responsibility of shop drawing errors related to details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the Specifications, and/or job conditions as they exist.

F. Refer to General Requirements for the substitutions of equipment and submittal of shop drawings. If apparatus or materials are substituted for those specified, and such substitution necessitates changes in, or additional connections, piping, supports, or construction, it shall be provided. Contractor to assume cost and entire responsibility thereof.

1.7 INSPECTION AND TESTS

A. During the progress of the work it shall be subject to the inspection of the Owner and to such other inspectors, as may have jurisdiction.

B. At completion of the work, Contractor shall submit to the Owner's representative in writing a statement stating: (1) that the work is complete; (2) that the entire installation is in accordance with the specification; (3) that preliminary tests have been made; and (4) that the work is ready for final inspection and test.

C. A final inspection of the installation to determine compliance with the drawing and specifications will be made by the Owner's representative. Work will be checked for quality of materials, quality of workmanship, proper installation and finished appearance. This Contractor shall provide the services of the project foreman for inspection purposes. The foreman shall remove and reinstall access panels, ceiling tiles, etc., as required to facilitate any inspections required by the Owner's representative.

D. The Contractor shall arrange and conduct operating tests on all equipment in the presence of the Owner's representative. The component parts of systems and the various systems shall be demonstrated to operate in accordance with the requirements and intent of this

specification. Any non-complying or defective materials or workmanship disclosed as a result of the inspection and the Contractor shall correct tests promptly, and the tests repeated as often as necessary until approved and accepted by the Owner's representative.

1.8 ELECTRICAL EQUIPMENT

A. Electrical components of mechanical equipment and systems, such as motors, factory mounted motor starters, disconnects, and control equipment shall be provided under the related Section of Division 15.

B. Temperature control equipment, including thermostats, zone valves, relays, aquastats, etc. shall be provided under related sections of Division 15. Temperature control wiring not specifically shown on electrical drawings shall be provided under related Section of Division 15.

C. Upon completion of temperature control system wiring, the responsibility of the control system will fall under Division 15.

D. All electrical equipment installed in concealed spaces shall be provided with a hard-wired electrical connection. Plug-type disconnects shall not be allowed in concealed spaces. Equipment provided with plug-in cords shall not have their cords modified.

1.9 OPENINGS IN EXTERIOR WALLS OR ROOF

A. Openings in exterior walls or roof shall be kept properly plugged and caulked at all times, except when being worked on to preclude the possibility of flooding due to storm or other causes. After completion of work, openings shall be permanently sealed and caulked in a manner approved by the Architect.

1.10 GUARANTEE

A. Except as otherwise specified, all work, materials and equipment shall be guaranteed against defects resulting from the use of inferior materials, equipment, or workmanship for one year from the date of final completion of the contract, or from full acceptance by the Owner, whichever is earlier.

B. If, within any guarantee period, repairs or changes to guaranteed work are required as a result of the use of defective materials or equipment, inferior workmanship or work that is not in accordance with the terms of the contract, and upon receipt of notice from the Owner, the following shall be done without expense to the Owner.

C. Place in satisfactory condition in every particular all of such guaranteed work and correct all defects therein.

D. Repair all damage to the building or site/equipment or contents thereof which is the result of the use of defective materials or equipment or inferior workmanship, or of work not in accordance with the terms of the contract.

E. Make good any work or materials, or the equipment and contents of said building or site disturbed in fulfilling any such guarantee.

F. In fulfilling the requirements of the contract or of any guarantee embraced in or required thereby, any work guaranteed under another contract is disturbed, restore such disturbed work to original condition and guarantee such restored work to the same extent as it was guaranteed under such other contract.

G. If upon failure to proceed promptly after notice to comply with the terms of the guarantee, the Owner may have the defects corrected and Contractor and his surety shall be liable for all expenses incurred.

H. This Contractor shall obtain in the General Contractor's and Owner's name, the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities, which the Contractor may have by law or other provisions of the Contract Documents. The guarantee shall be for a period of one (1) year minimum from the date of acceptance or final payment.

1.11 CLEANING OF SYSTEM

A. Thoroughly clean piping, ducts, fixtures and equipment of all foreign substances inside and out before placing in operation. All air handling equipment shall be provided with “construction filters” for use during construction. Once construction is substantially complete and prior to final testing adjusting and balancing, furnish and install new filters for each piece of equipment.

B. If any foreign matter should stop any part of a system after being placed in operation, clean and reconnect system.

C. Remove all covers of interior floor drains and cleanouts, clean of all dirt, concrete traces, etc., then lightly grease and reinstall.

D. Existing HVAC systems which are being tied into or otherwise modified shall be thoroughly cleaned and refurbished prior to being placed back in service.

1. Duct Systems shall be cleaned of all foreign contaminants, dust and debris.
2. Hydronic Systems shall be fully flushed, cleaned, refilled and treated.
3. During contractor shall bring to the attention of the owner and engineer any perceived deficiencies in existing systems including but not limited to:
   a) Code deficiencies
   b) Inoperable equipment
   c) Leaking ductwork and/or piping
   d) Missing or deteriorating insulation
   e) Excessive noise

1.12 TEMPORARY OPENINGS

A. Coordinate construction and provide temporary openings in the building as required for the admission of equipment furnished under this Division.

1.13 DEFINITIONS

A. "Piping" includes, in addition to pipe, all fittings, valves, hangers, and other accessories relating to such piping.

B. "Concealed" means hidden from sight in trenches, chases, furred spaces, shafts, hung ceilings, embedded in construction or in crawl spaces.

C. "Exposed" means not installed underground or "concealed" as defined above.

D. "Provide" means furnish and install complete and ready to operate.

1.14 EQUIPMENT DEVIATIONS

A. Where proposals to use an item of equipment other than that specified which requires any redesign of the structure, partitions, foundations, piping, wiring or any other part of the

mechanical, electrical or architectural layout, all such redesign, and all new drawings and detailing required therefore, shall be prepared by the Architect at the Contractor's expense.

B. Where such approved deviation requires a different quantity and arrangement of ductwork, piping, wiring, conduit, and equipment from that specified or indicated on the drawings, furnish and install any such ductwork, piping, structural supports, insulation, controllers, motors, starters, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

1.15 ELECTRICAL ROOM REQUIREMENTS

A. Do not install any piping, ductwork or equipment in or through electrical rooms, transformer rooms, electrical closets, telephone rooms or elevator machine rooms, unless piping or ductwork of equipment is intended to serve these rooms. Additionally, no ductwork or piping will be installed above electric panels. If the Contractor violates this requirement, he shall remove and/or relocate all items as required at his expense and to the satisfaction of the Architect.

1.16 COOPERATION WITH OTHER TRADES

A. Give full cooperation to other trades and furnish in writing to the Architect any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

B. Coordination drawings shall be initiated by this contractor. It this contractor's responsibility for preparation of project coordination drawings showing the installation of all equipment, piping, ducts and accessories to be provided under Section 230000 of the Specifications. These drawings shall be prepared at not less than 1/4 in. = 1 ft. scale, and shall show building room layouts, structural elements, ductwork and lighting layouts of function. Drawings shall indicate horizontal and vertical dimensions, to avoid interference with structural framing, ceilings, partitions, and other services. A reproducible copy of each drawing prepared shall then be submitted to each Contractor working under Sections 210000, 220000, and 260000, who shall be responsible to coordinate his equipment and systems and shall show these on the drawings submitted. After each Contractor has fulfilled his obligation, he shall return the drawings to the HVAC Contractor. After each drawing has been coordinated between trades, and appropriate revisions made, each trade shall sign each drawing, indicating acceptance of the installation. The HVAC Contractor shall then print the coordination original and these prints submitted through the General Contractor to the architect for review and comment, similar to shop drawings. Comments made on these drawings shall result in a correction and re-submittal of the drawings.

C. Furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

1.17 PROJECT RECORD DOCUMENTS:

A. Each Contractor shall record clearly, neatly, accurately, and promptly as work progresses the following data:

1. Changes made resulting from change orders or instructions issued by the Architect.
2. Changes in routing made to avoid conflict with other trades or structural conditions.
3. Final location of equipment and panels if different than contract documents.

B. Upon completion of the project submit to the Architect a set of electronic media noting "as built" conditions indicating all variations and deviations of his work from contract documents.

1.18 OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS

A. Operating Instructions: Provide operating instructions to the Owner's designated representative with respect to the operation functions and maintenance procedures for all equipment and systems installed. The cost of providing a manufacturer's representative at the site for instructional purposes shall be included in the Contract Price.

B. Maintenance Manuals: At the completion of the project, turn over to the General Contractor four (4) complete manuals in 3-ring binders, indexed, containing the following:

1. Complete shop drawings of all material and equipment of this section.
2. Operation descriptions of all systems.
3. Names, addresses and telephone numbers of all suppliers of system components.
4. Preventative maintenance instructions for all systems.
5. Spare parts list of all system components.
6. Copies of all valve charts.

1.19 PROTECTION

A. Protect all work and material from damage by work and workmen, and accept liability for all damage thus caused.

B. Be responsible for work and equipment until finally inspected, tested, and accepted. Protect work against theft, injury or damage; and carefully store material and equipment received on site, which is not immediately installed. Close open ends of work with temporary covers or plugs during storage and construction to prevent entry of obstructing material.

C. All openings in stored & installed ductwork shall be covered & sealed when not in use to prevent contamination from dust & debris.

1.20 SCAFFOLDING, RIGGING AND HOISTING

A. Provide scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of material, equipment and apparatus furnished under this division. Remove same from premises upon completion of work.

B. Coordinate propose routing with architect prior to rigging and protect all existing building components against damage.

1.21 MATERIALS AND WORKMANSHIP

A. All materials and apparatus required for the work, except as specifically specified otherwise, shall be new, of first-class quality, and shall be furnished, delivered, erected, connected and finished in every detail, and shall be so selected and arranged as to fit properly into the building spaces. Where no specific kind or quality of material is given, a first-class standard article as approved by the Architect shall be furnished.

B. Furnish the services of an experienced foreman who shall be constantly in charge of the installation of the work, together with all skilled workmen, fitters, metal workers, welder, helpers, and labor required to unload, transfer, erect, connect, adjust, start, operate, and test each system.

C. All equipment and materials shall be installed in strict accordance with the manufacturer’s recommended installation instructions as well as UL Listing instructions and all Local, State and National codes.

1.22 QUIET OPERATION AND VIBRATION

A. Work shall operate under all conditions of load without any objectionable sound or vibration. In case of moving machinery, sound, or vibration noticeable outside of room in which it is installed, or annoyingly noticeable inside its own room, will be considered objectionable. Sound or vibration conditions considered objectionable shall be corrected in an approved manner at no expense to the Owner. Vibration control shall be means of approved vibration eliminators in a manner as recommended by the manufacturer of the eliminators.

1.23 ACCESSIBILITY

A. Assure and be responsible for the adequacy of shafts and chases, the adequate clearance in double partitions and hung ceilings for the proper installation of the work. Cooperate with all other trades whose work is in the same space. Such spaces and clearances shall, however, be kept to the minimum size required.

B. Locate all equipment, which must be serviced, operated, adjusted or maintained fully accessible positions. Equipment shall include, but not be limited to, valves, traps, cleanouts, motors, controllers, filters, dampers, starters, coils, fire dampers, smoke dampers and drain points. If required for better accessibility, furnish access doors for this purpose. Minor deviations from drawings may be made to allow for better accessibility, and the engineer shall approve any change.

C. Provide access panels for installation in concrete block walls or gypsum wallboard ceilings and partitions in locations, which require access for service to the items located behind the permanent gypsum wallboard or concrete block finish.

D. Access panels shall be installed where required to gain access to valves, dampers, controls, etc. Panels shall be flush, insulated, contain continuous steel hinge and screwdriver operated latch. Panels shall be rated equal to the assembly that they are being installed in panels shall be UL listed.

E. Access panels located in fire rated partitions shall be fire panels. The frame and panel assembly of these fire panels shall be manufactured under the Factory Inspection Service of the Underwriters' Laboratories, Inc., and shall bear a label reading: "Frame and Fire Panel Assembly, Rating 2 hours. (B) Temperature Rise 30 Minutes, 250° F. Maximum." Rated panels shall be equipped with automatic closing mechanism and be self-latching.

F. Panels shall be provided with screwdriver operated flush cam locks.

G. Panel size shall be 12 inches x 12 inches except furnish a larger size if required to service a particular item. The exact location and size of each access panel shall be reviewed with, and approved by, the Engineer.

1.24 CUTTING AND PATCHING

A. Provide all cutting and patching necessary to install the work specified in this division. Patching shall match adjacent surfaces.

B. At floor slabs & wall openings to be cored drilled or cut, contractor shall find and mark on both faces all reinforcing, rebar, conduits, utilities, etc.. by means of x-ray, pach-ometer or prof-ometer. Submit sketch showing locations of all findings and proposed cuts or cores for review.

C. No structural members shall be cut without the approval of the Structural Engineer, and all such cutting shall be accomplished in a manner directed by the Structural Engineer.

1.25 GROUNDING

A. All components of mechanical piping systems shall be properly grounded to building ground. Where ground path is interrupted by non-conductive materials, appropriate bonding or grounding to building ground shall be provided.

1.26 WATERPROOFING

A. Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Architect before work is started. Furnish all necessary sleeves required.

1.27 DESIGN BUILD PROVISIONS (WHERE APPLICABLE)

A. The Work will be performed based on a Design/Build approach in which the Mechanical Subcontractor provides the engineering needed to satisfy performance criteria and other requirements listed herein. The criteria and requirements are meant to establish the general intent and do not always give specific sizes and types. This proposal must therefore include both system design and engineering services.

B. Shop Drawings shall clearly describe the limits of the Work and identify related work by other trades. Work that the Mechanical Subcontractor requires to be done by other trades should also be noted. Formal coordination drawings will not be produced. Instead each major subcontractor will circulate their drawings to the other trades for review and comments. This will conclude with a coordination meeting in which all conflicts will be identified and resolved.

C. The responsibility to insure that all Work items fit in the space available lies with the Mechanical Subcontractor. The Shop Drawings must in turn include dimensioned details drawn to scale.

D. The Mechanical Subcontractor shall revise the Shop Drawings to include all required changes. Final revised drawings shall be issued prior to starting work.

1.28 REBATES

A. The contractor shall make the owner aware of all applicable “upstream” energy rebates available for this project.

B. The contractor shall provide the owner all necessary information and documentation for completion and submission of energy rebate applications.

PART 2: PRODUCTS

2.1 IDENTIFICATION, MARKING AND TAGGING

A. Systems and equipment to be identified and marked and valves tagged include, but are not limited to the Heating, Air Conditioning & Ventilating systems.

B. Submit samples of marking and tagging devices and wording, lettering and numbering scheme for each system.

C. Equipment Identification:

1. Manufacturer's nameplates or trademark shall be permanently affixed to all equipment and materials furnished under this division. Manufacturer's nameplates shall include all pertinent data relative to the piece of equipment including model number, serial number, and operating characteristics as applicable.

2. Separate Equipment Identification Markers shall identify each item of equipment with a permanently attached marker indicating designation and/or number corresponding

to design documents.

3. Markers shall be of rigid black Bakelite or phenolic construction with white engraved or incised letters.

4. Lettering on equipment markers shall be of adequate size to be legible from floor levels. In all cases marker lettering shall no be less than 1 inch high.

D. Piping System Identification:

1. Piping Systems shall be identified as indicated herein or as required by applicable codes and/or officials having jurisdiction.

2. Pipe Markers shall be color coded according to " Designations to Colors" - ASME A13.1-2007.

3. All piping and equipment shall be identified by pipe markings, which shall be provided by this Contractor. Markers shall be applied every 20 ft. Markings shall indicate pipe content, system, operating pressure & temperature, and direction of flow. The markers shall be as manufactured by Seton Name Plate Corp. or equal

4. Pipe Markers shall be of the pressure sensitive type as manufactured by the Seton Nameplate Corp. (F10-Code)

5. Valve Identification: Provide laminated plastic nameplates on all valves installed under Division 15, except stop valves in supplies to fixtures. Tags shall be constructed of 0.125 inches thick melamine plastic conforming to Fed. Spec. L-P-387. Surface shall be matte finish. Accurately align lettering and engrave into white core. Nameplates shall be to 2 inches round or hexagonal. Lettering shall be minimum of 0.375 inch high normal block lettering. Key the nameplates to a chart and schedule for each system. Frame one chart and schedule for each system under glass and place where directed in mechanical room. Furnish four copies of each chart and schedule. Each inscription shall identify its function. Attach nameplates with "S" hooks and chain to each valve. Valve nameplates shall be numbered and "keyed".

2.2 SLEEVES, INSERTS AND ESCUTCHEONS

A. Provide sleeves for all work passing through floor, wall, and ceiling construction. Locate and provide sleeves and inserts before the floor, wall or ceiling is constructed. If this contractor does not comply with the above, he shall bear all costs incurred for cutting and patching required for the installation of sleeves and inserts. Holes required for sleeves in existing walls and floors, or to conform to the above shall be saw cut or core drilled. This Contractor shall provide all drilling required for the installation of hangers.

B. Pipe sleeves through outside walls shall be Schedule 80 black steel pipe with 150 lb. black steel slip-on welded flanges welded at the center of the outside. Extend sleeves 1/2 inch beyond each side of the wall. Pack the space between sleeve and pipe with oakum to within 2 inches of each face of the wall. Pack the remaining space and make watertight with an approved waterproof compound.

C. Pipe sleeves through concrete floors or interior masonry walls shall be Schedule 40 black steel pipe, set flush with finished wall or ceiling surfaces, but extending 2 inches above finished floors. Plastic, PVC, or light metal sleeves shall not be installed.

D. Provide individual or strip type inserts pressed steel construction with accommodation for removable nuts and threaded rods up to 3/4-inch diameter, permitting lateral adjustment. Individual inserts shall have an opening at the top to allow reinforcing rods to 1/2 inch diameter to be passed through the insert body. Strip inserts shall have attached rods with

hooded ends to allow fastening to reinforcing rods.

E. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe and the insulation. Check floor and wall construction finishes to determine proper length of sleeves for various locations.

F. Provide 22 gauge galvanized steel duct sleeves through interior walls, floors and ceilings set flush with finished surfaces.

G. Pack the space between sleeves and structure, and sleeves and pipes or ducts passing through fire rated interior walls, floors, and ceilings with an approved fire and smoke proof packing material. Fire-stopping material shall maintain its dimensions and integrity while preventing the passage of flame, smoke, and gases under conditions of installation and user when exposed to the ASTM E119 time-temperature curve for a time period equivalent to the rating of the assembly penetrated. Cotton waste shall not ignite when placed in contact with the non-fire side during the test. Fire-stopping material shall be non-combustible as defined by ASTM E136; and in addition, for insulation materials, melt point shall be a minimum of 1700 degrees F. for 1-hour protection and 1850 degrees F. for 2-hour protection.

H. Fasten sleeves securely in floors, walls, etc. so that they will not become displaced when concrete is poured or when construction is built around them. Take precautions to prevent concrete, plaster, or other materials being forced into the space between pipe and sleeve during construction.

I. In all areas where ducts are exposed and pass through floors, the hole shall be surrounded by a 4-inch high by 3-inch wide concrete curb, or otherwise protected as determined by the Engineer.

J. Escutcheon plates shall be provided for all exposed un-insulated pipes passing through walls, floors, and ceilings. Plates shall be nickel plated, of the split ring type, of size to match the pipe. Where plates are provided for pipes passing through sleeves, which extend above the floor surface, provide deep recessed plates to conceal pipe sleeves.

2.3 SUPPORTS & ATTACHMENTS

A. Provide all necessary supports and bases required for all equipment, piping and for all other equipment furnished under this contract. Submit shop drawings to the Architect for approval before purchase, fabrication or construction of same.

B. All equipment, unless shown otherwise, shall be securely attached to the building structure in an approved manner. Attachments shall be of a strong and durable nature and any attachments that are not strong enough shall be replaced as directed.

C. Vibration Isolation: All mechanical equipment, piping and ductwork shall be mounted on vibration isolators/inertia bases to prevent the transmission of vibration and mechanically transmitted sound to the building structure.

1. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.

2. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.

2.4 SEISMIC RESTRAINTS

A. It is the intent of this seismic specification that this contractor shall provide all necessary seismic restraints required to keep all mechanical building system components in place during a seismic event as required by the Building Code.

B. All mechanical systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a conflict occurs between the manufacturer's or construction standards, the most stringent shall apply.

C. This contractor shall engage a professional structural engineer registered in the jurisdiction of this project to review the entire installation to determine all seismic restraint requirements and methods. Contractor shall submit a report outlining the structural engineer's review as well as seismic restraint shop drawings and supporting calculations prepared by the professional structural engineer for review by the Architect.

1. Any questions relative to Component Importance factors shall be issued to the Architect/Engineer for resolution prior to seismic analysis.

D. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the applicable building code.

2.5 ELECTRIC MOTORS/STARTERS/VARIABLE FREQUENCY DRIVES

A. Electric motors and starters shall conform to requirements of the AIEE, NEMA, UL, and NEC and shall be suitable for load duty, voltage, phase, frequency, service and location required. Provide inverter duty rated motors for use with variable frequency drives. Provide shaft grounding rings for all VFD controlled motors.

B. All motors shall be rated at 85% power factor at full rated load. Motors less than 85% power factor shall be corrected to 90% power factor at the factory. All motors shall be rated high efficiency.

C. Starters shall be Cerus International or equal.

1. Enclosed Non-Combination Starter

a) Motor Starter shall be enclosed in a Type 1 or Type 4 UL rated enclosure.

b) Motor Starter shall be rated for NEMA class B motors for AC-3 switching and AC-4 switching.

c) Controls and annunciation shall include Hand- OFF- Auto keypad. LED indication shall include Hand, Off, Auto, Run and Overload. Overload reset shall be available.

d) Control inputs shall include: Auto Wet input, Auto Dry input, Permissive Auto input, Damper Status Input and Override Input. Automatic control inputs shall be capable of accepting a transistorized input without the need for interposing relays. Wet control inputs shall accept AC or DC inputs from 10 to 138VACor DC.

e) Damper control shall be built into the starter to provide 24VAC or 120VAC damper control and monitoring.

f) Override input shall disable the starter from operating in either Hand or Auto mode.

g) Protective Functions

(i) Electronic Overload shall provide phase failure and phase loss protection, stall, and class 1 - 30 selectable overload protection. Phase failure protection shall initiate when phase loss is greater than 70% for 3 seconds or phase unbalance is greater than 50% for more than 5 seconds.

(ii) Cycling fault protection shall be integral to the starter. Cycling fault shall be enabled whenever the starter is cycled more than 1000 times in a one hour period. This feature shall be selectable to be

disabled. Cycling fault shall cause overload LED to blink rapidly.

2. Enclosed Combination Starter

a) Enclosed combination starter shall include all of the above descriptions in addition to either a motor circuit protector with lock-out mechanism, a UL 508 breaker, or a fused disconnect with lock-out mechanism.

b) The Motor Circuit protector shall be a UL listed 508 manual motor starter with magnetic trip elements only. The breaker and shall carry a UL 508F rating (up to 100A frame size) which provides for coordinated short circuit rating for use with the motor contactor and provides an interrupting rating for the breaker and contactor combination.

c) Fused disconnect shall be UL 98 suitable for service entrance protection.

d) UL 508 breaker shall include thermal and magnetic trip mechanisms.

D. Variable Frequency Drives:

1. Furnish and install variable frequency drives as required by sequence of operation. Drives shall be provided with line reactors as required to eliminate harmonics transmitted upstream and downstream of drive and as required by local utility. Furnish VFDs with bypass to allow operation of motor in case of VFD failure. Drives shall be commissioned and tested and a report prepared by a company specializing in the field. Division 230000 will energize drives.

E. Disconnects provided by this contractor will be installed by Division 260000, with the exception of factory mounted disconnects.

F. Motors smaller than 1/2 HP shall be capacitor-start or split phase type, single phase, 60-hertz alternating current for voltage required. Motors 1/2 HP and larger shall be squirrel-cage induction three phase 60 hertz alternating current for voltage required, unless specifically noted otherwise.

G. Where available, starters and disconnects shall be factory mounted by the unit manufacturer.

2.6 USE OF INSTALLATION

A. The Owners shall have the privilege of using any part of the installation when sufficiently complete, but such use thereof, or partial or final payment shall not be considered as an acceptance of such work in lieu of a written certificate from the Engineer.

2.7 DUCTWORK

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, supports and sealing for operating pressures indicated.

B. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90.

1. Sealant: As recommended by manufacturer specifically for sealing joints and seams in ductwork.

2. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

3. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

C. Hanger Rod: ASTM A36; steel, galvanized; threaded both ends, threaded one end,

or continuously threaded.

D. Flexible Ductwork: Duct shall be Flexmaster Triple Lock Buck Insulated Duct as manufactured by Buckley Associates or approved equal.

1. Flexible duct shall be Underwriters Laboratory Listed (UL 181 Class 0 Airduct) and constructed in accordance with NFPA Standards 90A and 90B. It shall have a smoke/flame spread rating of 50/25.
2. Flexible Ductwork shall be made from a tape of dead soft aluminum sheet, spiral wound into a tube and spiral corrugated to provide strength and stability. The joint shall consist of a triple lock that is mechanically performed without the use of adhesives to make a durable airstream seam. A double lock is not acceptable.
3. Insulated flex shall have a fire retardant polyethylene outer jacket with a 1/2 lb. density, 1-1/2” thick fiberglass insulation blanket, factory wrapped.
4. The flexible duct shall be supported as required to prevent sagging. Flexible duct with excessive sagging will not be approved.
5. Flexible ductwork shall be rated at 12” positive pressure and 12” negative pressure for sizes up to 16”. Negative pressure for 18” to 20” shall be 8”.
6. Length of installed flexible duct shall not exceed 6’-0” in developed length.

E. Flexible Connections

1. Flexible connections shall be provided where a fan connects to a duct or casings to prevent transmission of vibration to ductwork.
2. Flexible connections shall fit tightly around ducts and fans and be securely bolted or clamped in place. Taping shall not be allowed.
3. Flexible duct connections shall be 6” long and made of straight, waterproof, flame retardant fabric having a flame spread rating of not over 25 and a smoke development rating of not over 50

F. Fire Dampers:

1. Provide fire dampers throughout air distribution system as required by applicable codes, standards and authorities. Provide access door for each fire damper of sufficient size to repair internal link. Fire dampers indicated on drawings may not fully represent the exact number required for this project. It is the Contractor’s responsibility, at no additional cost to the Owner, to provide all required dampers.
2. Dampers shall be approved fusible-link self-closing spring loaded type, Buckley Model 150B or equal.
3. Dampers shall be dynamic type when serving a system that is not shut down during fire alarm activation.
4. Frame shall be fitted with angle iron stop and stainless steel spring latch, and shall be securely fastened to building construction.
5. Seal spaces between damper frames and walls and between damper frames and floor with approved fire-retardant material.
6. Use of dampers shall NOT reduce net free area of duct below that shown on drawings. Fire dampers shall be Type B with blades of dampers out of air stream.
7. Samples of fire dampers shall be submitted to and approved by local authorities having jurisdiction.

8. Dampers shall bear 1-1/2 hour UL-rating fire damper label and shall be constructed and installed as required by UL-555.
9. Fire dampers shall be Buckley, Ruskin, Nailor Industries or Prefco for use in the proper duct pressure classification.
10. Dampers shall be installed per SMACNA with breakaway connections and nose pieces on duct liner (see SMACNA HVAC Duct Construction Standards).
11. All dampers in ductwork served by equipment not subject to fan shut down upon fire alarm activation shall be dynamic type.

G. Ceiling Radiation Dampers and Fire-Rated Blankets:

1. For fire-rated ceiling assemblies, provide at all ceiling diffusers, registers and grilles: Radiation dampers (Nailor Industries Series 0700 or approved equal) and Fire Blanket (Nailor Industries 0725 or approved equal) or fire assembly: radiation damper and blanket already assembled Nailor or equal.

H. Volume Dampers:

1. Provide Young Regulator manual adjustable rectangular opposed blade dampers for duct heights less than 12” with factory-installed locking hand quadrants extended 2” for all dampers installed in externally insulated duct:
   a) On each supply, return and general duct take-off.
   b) At each take-off to register, grille or diffuser (not all are shown on drawing).
2. Dampers are manufactured approximately 5/16” smaller in width and 1/8” smaller in height than size of duct in which they are installed; e.g., nominal damper size is 24” x 10”; actual size is approximately 23-11/16” x 9-7/8”.
3. Damper frame shall be constructed of #6063 extruded aluminum reinforced channel with minimum thickness of .050”. Opposed damper blades shall be #6063 extruded aluminum with minimum thickness of .050” and shall include reinforcing ribs. Each blade shall be supported in the damper frame by individual Teflon axle bearings, and shall be driven by stainless steel connecting slide linkage controlled by 3/8” square steel control shaft.
4. Note: All required volume dampers may not be indicated on drawings but dampers shall be provided as necessary for systems balancing.
5. Dampers 12” and larger in height shall be opposed multi-blade equal to Greenheck, Nailor or Vent Products.
6. Where dampers are inaccessible, use Young Rectangular locking type ceiling regulators and miter gear or worm gear for all horizontal dampers. Bearing coupling for bottom duct control may be used for shaft on vertical blade dampers. The 3/8” rod between ceiling regulator and damper shall be provided by Contractor.
7. Where dampers are to be located above hard ceilings Young Regulator Bowden Cable Control Dampers shall be utilized. Controllers (actuators) shall be of the concealed ceiling type. Controller type, finish & locations to be approved by architect prior to purchase & installation. The cable between the damper and controller shall be provided by the contractor.
8. Damper blades shall be two gauges heavier than adjoining ductwork, and shall be riveted to supporting rods. Hem over edges parallel to rods.

9. Brackets shall be galvanized metal, secured to ductwork with sheetmetal screw with locking quadrant arms (see seal class section for additional requirements). Provide 2" handle extension for all dampers on externally insulated ductwork.

10. Note: All required volume dampers may not be indicated on Drawings but dampers shall be provided as necessary for system balancing.

2.8 DUCT INSULATION

A. Compliance: Insulation thickness, conductivity and installation shall comply with local Mechanical and Energy Codes.

B. Concealed supply & return ducts for heating, cooling and air intakes:

1. Insulation: ASTM C553; flexible, foil faced, noncombustible blanket.

a) Interior Concealed/Tempered: R-Value of 8.0 installed.

b) Interior Ventilated/Untempered: R-Value of 12.0 installed

2. Vapor Barrier Jacket:

a) Kraft paper with glass fiber yarn and bonded to aluminized film.

(i) Moisture vapor transmission: ASTM E96; 0.02 perms.

(ii) Secure with pressure sensitive tape.

3. Vapor Barrier Tape:

a) Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

C. Exhaust Ductwork:

1. Interior Concealed/Tempered:

a) Direct Exhaust: No Insulation Required.

b) Upstream of an ERV: Refer to Concealed supply & return ducts for heating, cooling and air intakes; Interior Concealed/Tempered:

2. Interior Ventilated/Untempered: Refer to concealed supply & return ducts for heating, cooling and air intakes; Interior Ventilated/Untempered.

D. Exterior Ductwork (All Types)

1. Material: Insulate with R-Value of 12.0 installed.

2. Jacket: Insulation jacket may be integral or field applied and shall be reflective, watertight and listed for this usage.

3. Install per latest installation instructions from the manufacturer.

E. Fire Wrap

1. Provide fire wrap on Ductwork as indicated on drawings and/or after ductwork penetrates a fire barrier/partition or where proper clearance to combustibles (as required by NFPA 96 and local codes and ordinances) cannot be achieved.

2. Acceptable Manufacturer: Thermal Ceramics; 2102 Old Savannah Rd., Augusta, GA 30906. ASD. Toll Free Tel: (800) KAOWOOL. Tel: (706) 796-4200. Fax: (706) 796-4398. Email: firemaster@thermalceramics.com. Web: http://www.thermalceramics.com.

2.9 INTERIOR DUCT LINER

A. Polymer Foam insulation (EPFI) equal to IMCOA “IMCOSHEET” Engineered Polymer Foam Insulation, 1 inch thick, R = 4.0, closed cell. Insulation shall be installed as required by the insulation manufacturer. Insulation shall be in compliance with NFPA 90 and 90B. Flame spread shall be less than 25 and smoke density less than 50 per ASTM E-84, NFPA 255, UL 723 Class I and UL 181.

B. Duct lining shall be applied in the following locations:

1. 20’ upstream and downstream from all air handling units exceeding 10 tons.
2. 10’ upstream and downstream from all air handling unit of 10 tons or less.
3. 5’ downstream from all other fan powered units including, but not limited to, fan powered VAV boxes.

C. Areas provided with interior duct lining shall also be provided with exterior duct insulation as indicated by these specifications.

2.10 PIPING

A. Equipment Drains and Overflows

1. Copper Tubing: ASTM B88, Type L, hard drawn.
   a) Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
   b) Joints: Solder, lead free, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F (220 to 280 degrees C) or Victaulic grooved joints.
2. PVC Pipe: ASTM D1785, Schedule 40 and Schedule 80 for sizes 8 inch (200 mm) and larger or ASTM D2241, SDR 21 or 26.
   a) Fittings: ASTM D2466 or D2467, PVC.
   b) Joints: ASTM D2855, solvent weld.
3. Provide di-electric ~~fittings~~ waterways wherever copper pipe meets steel pipe or other dissimilar metals.

B. Refrigerant Piping Copper Tubing: ASTM B280, Type ACR hard drawn.

1. Fittings: ASME B16.22 wrought copper.
2. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
3. Provide all valves and accessories required for complete installation.

C. Plenum Return Applications

1. Where piping is installed in a return air plenum piping shall be plenum rated.
2. PVC and/or PEX piping shall not be allowed in return air plenums.

2.11 PIPING INSULATION

A. Insulation

1. Hydronic Piping: Preformed glass fiber meeting ASTM C547, "k" value of 0.24 @ 75°F with all service jacket (ASJ). Service temperature 0°F to +850°F, 25/50.
2. Low Temperature Fluid Applications: Provide insulation with integral wick material. Product shall include a factory applied integral vapor retarder extending under the

evaporator area of the wick and covering not less than 98% of the circumference of the product. Exposed evaporator area shall be not less than 0.1 sq. ft./linear ft. of product.

3. Refrigerant Piping: Flexible closed cell insulation.
4. Plenum Return Applications: All insulation, jackets and accessories shall be rated for use in return air plenums.

B. Compliance: Insulation thickness, conductivity and installation shall comply with local Mechanical and Energy Codes.

C. Minimum Pipe Insulation:

FLUID	NOMINAL PIPE DIAMETER	
	≤1.5”	>1.5”
Hot Water	1 1/2"	2”
Chilled Water, Cold Condensate, or Refrigerant	1 1/2"	1 1/2"

D. Condensate Piping

1. All condensate piping, regardless of temperature, shall be provided with insulation.
2. Condensate generated by cooling coils shall be considered Low Temperature Fluid.

E. Fittings: Factory precut insulation inserts, thickness to be same as adjacent. Enclose in premolded, PVC fitting covers.

1. Low Temperature Applications: Fittings and valves shall be wrapped continuously with wicking material prior to installing insulation to ensure a continuous path for removal of condensation.

F. Jackets:

1. Interior: Factory applied, all service jacket of white Kraft bonded to aluminum foil reinforced with fiberglass yarn and suitable for painting. Longitudinal and butt joints shall be made with factory applied pressure sensitive material.
2. Exterior/Exposed (Low Temperature): Field applied, 20 mil, PVC sheet material.
3. Exterior/Exposed (High Temperature): Field applied, Aluminum sheet material.
4. All jackets exposed to the weather shall be reflective, UV resistant and sealed watertight.

G. Preparation

1. Install materials after piping has been tested and approved.

H. Installation

1. Install materials in strict accordance with manufacturer's instructions.
2. Continue all insulation through penetrations.
3. In piping exposed to view, locate insulation and cover seams in least visible locations.

4. On piping that requires condensation control, (i.e. chilled or cold) insulate fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
5. On piping not requiring condensation control (i.e. steam, condensate hot water) do not insulate flanges and unions at equipment, but bevel and seal ends of insulation at such locations.
6. Provide pipe insulation with weatherproof jacket on exterior piping that has heat trace.

I. Supports:

1. All piping shall be supported in such a manner that the insulation is not compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the circumferential joint may be made outside the hanger. Cover the evaporating holes with contractor supplied VaporWick Sealing Tape for the length of the metal saddle.
2. Piping systems 3" (75 mm) in diameter or less, insulated with fiberglass pipe insulation, may be supported by placing saddles of the proper length and spacing under the insulation as designated in Owens Corning Pub. 1-IN-14210.
3. For hot or cold piping systems larger than 3" (75 mm) in diameter, operating at temperatures less than +200F (93C) and insulated with fiberglass, inserts such as foam or high-density fiberglass with sufficient compressive strength shall be used to support the weight of the piping system.
4. On vertical runs, insulation support rings shall be used.

J. Accessories:

1. Insulation Bands: ¾ inch wide; 0.015 stainless steel
2. Metal Jacket Bands: ½ inch wide; 0.015 thick aluminum.
3. Insulating Cement: ANSI/ASTM C195; hydraulic setting mineral wool.
4. Finishing Cement: ASTM C449.
5. Fibrous Glass Cloth: Untreated; 8oz/sq. yd. Weight.
6. Adhesives: Compatible with insulation.
7. Wick material for wrapping valves and fittings
8. Closure Materials –Sealing Tape, and mastics.
9. Support Materials - Hanger straps, hanger rods, saddles, support high-density blocks, and support rings.
10. All accessory materials shall be installed in accordance with project drawings and specifications, manufacturer's instructions, and/or in conformance with the current edition of "Commercial & Industrial Insulation Standards."

2.12 FIRESTOPPING

A. Provide Firestopping systems for penetrations in fire-resistance-rated assemblies, including both membrane and through penetrations. This contractor shall thoroughly review architectural plans for assembly type and location and shall prepare bid accordingly.

B. Materials and systems shall be designed to meet the requirements of the intended application and shall be installed per manufacturer’s guidelines.

C. Submittals: Provide for review Manufacturer’s product literature and tested assembly for each

type of fire protection material including product characteristics, typical uses, installation procedures, performance and limitation criteria.

2.13 DRIP PANS & LEAK DETECTION

A. Drip pans shall be provided where indicated on plans and under all new and existing piping within critical spaces.

B. Drip pans shall be constructed of continuously welded sheet metal. Each section shall be provided with a wire type leak detection sensor compatible with fluids present in piping. Leak detection alarms shall be tied back to Building Management System.

C. Provide new leak detection sensors in all existing drip pans. Tie alarms back to Building Management System.

2.14 SECONDARY DRAIN PANS

A. A secondary drain pan shall be provided under each piece of concealed (above ceilings, in closets, etc.) HVAC equipped which produces condensate.

B. The pan shall have a minimum depth of 1.5” and shall not be less than 3” larger than the unit or the coil dimensions in width and length and shall be constructed of corrosion resistant material. Metallic pans shall have a minimum thickness of not less than 0.0276-inch galvanized sheet metal and non-metallic pans shall have a minimum thickness of not less than 0.0625 inch.

C. The secondary drain pan with a separate drain shall discharge to a conspicuous point of disposal to alert occupants in the event of a stoppage of the primary drain. The overflow drain line shall connect to the drain pan at a higher level than the primary drain connection.

D. A secondary drain pan without a separate drain shall be equipped with water level detection device that will shut off the equipment served prior to overflow of the pan

PART 3: EXECUTION

3.1 OPERATING INSTRUCTIONS

A. Instruction to the Owner's Personnel - After completion of all work and all tests and at such times as designated by the Architect, provide the necessary skilled personnel to operate the entire installation until receipt of owners acceptance.

B. During the operating period, instruct the Owner's representative in the complete operation, adjustment, and maintenance of the entire installation.

C. Give at least forty-eight (48) hours advance notice to the Owner to coordinate scheduling of this instructional period.

D. Furnish to the Architect five (5) complete bound sets of typewritten or blueprinted instruction manuals for operating and maintaining all systems and equipment included in the contract. All instruction manuals shall be submitted in draft, for approval, prior to final issue. Manufacturer's advertising literature or catalogs will not be acceptable for operating and maintenance instructions.

E. The above-mentioned instructions shall include the maintenance schedule for the principal items of equipment furnished under this contract.

3.2 MANUFACTURER'S RECOMMENDATIONS:

A. Where installation procedures or any part thereof are required to be in accordance with the

recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Architect prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.

3.3 TESTING, ADJUSTING, STARTING UP AND COMMISSIONING

A. Testing: All work must be proved satisfactory. The tests herein specified shall be applied in the presence of, and to the satisfaction of, the Architect before the work is covered, concealed or made inaccessible to testing, repair, correction or replacement. Accommodate the testing operation to the progress of the project as a whole. Correct all defects appearing under test and repeat the tests until all parts of the work have been successfully tested. Apply the specific tests herein described. Present all work for acceptance in clean condition, properly adjusted and in good working order; for instance, all machinery must be quiet, well balanced, and must be in place and reading accurately. All systems, equipment, controls, and devices in this work shall be tested in operation and must prove for their purposes in the judgment of the Architect or his authorized representative. All internal surfaces of all lines and equipment shall be blown or flushed clean. Where pressure tests are specified, the apparatus shall be clean before the tests are applied. Contractor shall provide adequate protection of piping and duct systems to prevent vandalism and/or accidental damage, blockage, etc., that will hinder or prevent proper operation of the finished systems.

1. Provide instruments, pumps, gauges, supplies, equipment, materials, and labor for testing and starting up. Dispose of test water and wastes after test, in a manner approved by all applicable codes.

2. Perform tests which may be required by authorities or agencies in addition to those herein specified.

3. Piping for steam, hot water, chilled water, supply and return, drain, escape and relief valve discharge shall be tested with water and made tight under pressure of 150 pounds per square inch gauge maintained for one hour without pumping or as long as required to inspect all joints. Repair all leaks and retest. Piping shall be made tight without caulking. Apply pressure tests to piping only before connection of equipment. In no case shall piping, equipment or accessories be subjected to a pressure exceeding it's rating. Low-pressure elements shall be isolated or removed before tests are conducted.

4. Test valve bonnets for tightness. Test operate all valves at least once from closed-to-open-to-closed positions while valve is under pressure. Test all automatic valves for proper operation at the settings indicated. Test pressure relief valves at least three (3) times.

5. Test piping specialties for proper operation. Test air vent points to ensure that air has been vented.

6. Furnish certified shop test records for all pressure vessels. After installation, test at full operating pressures and temperatures maintained for one hour. Set and test all pressure control, relief and safety devices.

7. Repair or replace all defective work and repeat tests until the particular system and component parts thereof receive the approval of the Architect.

8. The duration of tests shall be as determined by authorities having jurisdiction, but in no case less than the time prescribed in each section of the specifications.

9. Test equipment and systems, which normally operate during seasons of the year during the appropriate season. Perform tests on individual equipment, systems and

their controls. Whenever the equipment or system under test is interrelated with and depends upon the operation of other equipment, systems and controls for proper operation, function, and performance; the latter shall be operated simultaneously with the equipment of system being tested.

B. Adjusting, Balancing and Starting Up

1. Flush clean all systems prior to starting up the system. Any damages to the building or system components caused by failure to clean the systems properly shall be corrected to the satisfaction of the Architect or his authorized representative at no additional cost to the Owner.
2. In duct and piping systems, eliminate all noise and vibration and take all measures to secure proper circulation.
3. Run motor-driven equipment continuously for at least two hours in the presence of the Architect. Correct all defects of noise, vibration, alignment and balance. Replace all motors, which overheat or are noisy.
4. Balance systems completely for temperature, volume, and pressure per NEBB performance standards. Balancing subcontractor shall provide proof of certification by NEBB.
5. Air and water volumetric flow rates shall be within ten (10) percent of those specified. Air and water quantities and pressures shall be tested, balanced and recorded at all terminal devices. Volumetric flows and pressures shall be recorded on suitable forms and submitted for approval.
6. Provide any and all labor and equipment necessary to properly balance the installation including but not limited to dampers, valves, flow stations, test ports, sheaves, belts, etc.
7. All sequences of the system shall be checked and all temperature controls operated and commissioned as required to insure that all systems operate per Engineers intent.

C. Commissioning

1. This Contractor shall provide the deliverables to the engineer/owner.
2. Copies of all records shall be provided to the Engineer by this Contractor including, but not limited to:
   a) Equipment manuals including the name of at least one service agency;
   b) Testing and Balancing reports;
   c) Functional performance testing of the equipment, controls, economizers, and lighting control systems.
3. All commissioning shall be performed as indicated here and elsewhere in the specifications and shall comply with provisions of the applicable Energy Conservation Code.

3.4 SEQUENCE OF OPERATIONS

A. Sequence of Operations: This is a performance-based specification intended to convey the control intent of the various systems. The contractor shall provide detailed shop drawings including P&ID diagrams, equipment lists and finalized sequences for review by the Engineer prior to installation. Any questions concerning specific details shall be referred to the engineer for clarification.

B. System: It is the intent of this specification that a complete Building Management System (BMS) utilizing Direct Digital Control (DDC) be provided to control and monitor all HVAC systems within the facility. Provide a single workstation for building maintenance personnel to interface with system sequences, setpoints and values.

C. Equipment and Wiring: This contractor shall provide all control equipment, and wiring (regardless of voltage) to accomplish the sequence of operations as detailed below.

D. Control and Monitoring: Sensors shall be provided throughout the HVAC systems (hydronic and air) as required to control and monitor their operation and verify performance at BMS. Provide sensors with remote mounted stats where indicated on the drawings. Where multiple space mounted sensors are required for a given unit they shall be located in the same general area.

E. Safety Controls: This contractor shall provide all safety controls required to protect the building and all controlled equipment from damage as well as those controls necessary to signal abnormal operation or malfunction of equipment. These shall include but not be limited to high limits, low limits, freezestats, flow switches, interlocks and relays.

F. Energy Efficiency: All controls and sequences shall be configured to provide maximum energy efficiency while maintaining occupant comfort.

G. Functional Performance Testing: The contractor shall perform complete and thorough Control Functional Performance Test (FPT) and Commissioning of the control systems. Upon completion of the FPT, a report shall be submitted to the engineer for review and comment. The FPT shall include testing of:

1. Safeties in every mode, i.e., in manual run mode as well as auto mode.
2. Signals to and from the fire alarm, security and entry systems.
3. Sequences of operation step by step in every mode and possible situation.
4. The operation of all control loops under actual operating conditions.
5. The interlocked operation of all equipment (i.e., the operation of starters in manual and off modes as well as auto mode, damper end switch interlock, etc.)
6. Where the BAS performs computations, the actual computation of any formulas and simulation of actual conditions to check the BAS computations.
7. Review of BAS programs for errors and omissions.
8. Hard copy graphs of trend logs of most, if not all, operational parameters.
9. Commissioning should test every conceivable life safety scenario and every conceivable operational scenario that the system will encounter and document this testing with printed graphs of trend logs.

H. Building Management System

1. System interface shall be web-based and accessible & adjustable from any web browser. System alarms and alerts shall be able to be programmed to be directed to a phone or email address.
2. System shall monitor all associated equipment & points in real-time.
3. System shall be capable of providing multiple occupancy schedules. Schedules shall be able to be programmed on a daily or monthly basis. Schedules shall allow for holidays. All schedules shall be able to be temporarily overridden at the request of the system operator though the web portal or at the space mounted user interface.
4. The following points shall be monitored by the BMS:

a) Outside Air Temperature (DB/WB)

b) Outside Air Relative Humidity

5. The BMS shall provide alerts for the following:

a) Alarm/Trouble from any of the monitored systems

b) Loss of motor function and/or flow (all monitored equipment)

6. The following control points shall be monitored at the BMS and adjustable where indicated.

a) Operating Mode (Occupied/Unoccupied/Economizer)

b) Supply Fan (on/off, status)

c) Return Fan (on/off, status)

d) Damper Actuators (% open)

e) Discharge Air Temperature (°F - adj.)

f) Return Air Temperature (status)

g) Mixed Air Temperature (status)

h) Discharge SP (adj.)

i) Humidification (status, input & average from space mounted sensors, setpoint, adj.)

j) Filter Sections Pressure Drops (status)

k) Indicate Filter change required for all filters at 1.5x initial pressure drop.

7. All required fan & flow monitoring of belt drive systems shall be directly detected. Motor CTs shall not be accepted on belt drive equipment.

I. Economizer Fault Detection and Diagnostics (FDD)

1. Air-cooled unitary direct-expansion units and variable refrigerant flow units equipped with an economizer shall include fault detection and diagnostics (FDD) complying with the following:

a) The following temperature or enthalpy sensors shall be permanently installed to monitor system operation:

(i) Outside Air

(ii) Supply Air

(iii) Return Air

b) Temperature sensors shall have an accuracy of ±2°F over its range.

c) Refrigerant pressure sensors, where used, shall have an accuracy of ±3% of full scale.

d) The unit controller shall be capable of providing system status by indicating the following:

(i) Free cooling available

(ii) Economizer enabled

(iii) Compressor enabled

(iv) Heating enabled

(v) Mixed air low limit cycle active

(vi) The current value of each sensor

e) The unit controller shall be capable of manually initiating each operating mode so the operation of compressors, economizers, fans and the heating system can be independently tested and verified.

f) The unit shall be capable of reporting faults to the BMS (where applicable) or annunciated locally at the unit thermostat.

g) The FDD system shall be capable of detecting the following faults:

(i) Air temperature sensor failure/fault

(ii) Not economizing when the unit should be economizing

(iii) Economizing when the unit should be not economizing

(iv) Damper not modulating

(v) Excess outdoor air

END OF SECTION

SECTION 260000 - ELECTRICAL REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED SECTIONS

A. Drawings and General Provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this section.
B. This Contractor shall also include allowances for startup and for making the systems fully operational, and for scope and design contingencies. Future changes in price for items not shown on these drawings will not be allowed if the system itself is shown on these Drawings.
C. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction as required to perform work in accordance with all legal requirements and with Specifications, Drawings, Addenda and Change Orders, all of which are part of Contract Documents.
D. The drawings show the layout of the electrical systems and indicate the approximate locations of outlets, apparatus, and equipment. The runs of feeders and branches as shown on the drawings are schematic only. The exact routing of branch circuits and feeders shall be determined by the structural conditions and possible obstructions. This shall not be construed to mean that the design of the systems may be changed, but refers only to exact runs between given points. The Engineer reserves the right to revise the drawings from time to time to indicate changes in the work.
E. The Contractor shall consult and review all contract and reference drawings which may affect the location of any outlets, apparatus and equipment to avoid any possible interference and permit full location of outlets, apparatus and equipment up to the time of rough-in is reserved by the Engineer and such change shall be made without additional expense to the Owner.
F. It shall be the responsibility of this Contractor to see that all electrical equipment such as junction and pull boxes, panelboards switches, controls and such other apparatus as may require maintenance and operation from time to time is made accessible. Although the equipment may be shown on the drawings in certain locations, the construction may disclose the fact that such locations do make its position accessible. In such cases this Contractor shall call the attention of the Engineer to the condition before advancing the construction to a state where a change will reflect additional expense to the Owner.

1.2 SUMMARY

A. This Section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 1.
B. These documents have been prepared with the intention that they call for finished, tested work, in full operating condition and complete with necessary accessories.
C. The contract drawings are generally diagrammatic and convey the scope of work and general arrangement of apparatus and equipment. The locations of all items shown on the drawings or called for in the specifications that are not definitely fixed by dimensions are approximate only. The exact locations necessary to secure the best conditions and results must be determined at the project and shall have the approval of the Architect/Engineer before being installed. The Contractor shall follow the drawings in laying out work and shall check drawings of the other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. If directed by the General Contractor, Engineer

and/or Architect, the Contractor shall, without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades or for proper execution of the work.

D. These contract documents are complementary. What is called for by one shall be as binding as if called for by all. Materials or work described in words, which have well-known technical, or trade meaning shall be held to refer to such recognized standards. Incidental devices and accessories needed for complete, operational systems shall be provided even though they may not be indicated or identified in the documents.

E. If apparatus have been omitted, notify the Architects/Engineers of such belief. It is understood that bidder has included all required items and work in his bid, and will not if bid is successful, claim extra compensation for furnishing a complete and satisfactory system. If a particular item is called for or specified more than once in these contract documents, the higher grade shall be considered specified.

F. Should it appear that the character of the work is not sufficiently explained in these specifications or on the drawings, apply to the A/E for further information. Conform to the A/E's decision and directions as shall become part of these contract documents. The A/E reserves the right to be sole interpreter of the drawings and specifications, and all decisions shall be conclusive, final and binding on the parties.

G. Materials called for in these documents shall be new, unused equipment and of the latest recognized standards.

H. The work to be done under Division 16 is shown on the electrical drawings.

1.3 OUTLINE SCOPE OF WORK

A. The work under this contract, without limiting the generality thereof, includes all materials, labor, equipment, services, and transportation, unless otherwise specified, necessary to complete all systems of electrical wiring and equipment required by the drawings and/or as specified herein. It is the intent of this section and accompanying electrical drawings that these systems be furnished complete in every respect. The Electrical Contractor shall furnish all wiring, equipment and labor needed for a complete operating installation.

B. The Electrical Contractor shall fully indemnify the Owner against any damages, removals and alteration work. This is in addition to the requirements of the General Conditions of the Specifications.

C. The Electrical Contractor shall review architectural, interior design and all other trades plans, elevations and details prior to any work and identify any conflicts between furnishings, furniture, art-work, molding, casework, televisions, signage, awnings, canopies, diffusers, fixtures, etc.. and electrical, fire alarm, audio/visual and communications devices shown on the electrical plans and details. The Electrical Contractor shall prepare 8.5” x 11” sketches showing the conflicts and submit to the Architect for resolution prior to any work. Failure of the electrical contractor to coordinate, identify and obtain a field-directive on any conflict herein noted, that results in installed electrical work to be relocated to the Owner/Architects liking shall be the sole-responsibility of the Electrical Contractor. The Electrical Contractor shall assume and cover all costs associated with conflicts not coordinated, identified and submitted to the Architect, inclusive of material, labor, overtime pay, etc.. and shall not affect the project schedule.

1.4 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
B. Refer to equipment specifications in Divisions 2 through 25 for rough-in requirements.

1.5 SURVEYS AND MEASUREMENTS

A. Base measurements, both horizontal and vertical, on established bench marks. Work shall agree with these established lines and levels. Verify measurements at site and check the corrections of same as related to the work.
B. Should the Contractor discover any discrepancy between actual measurements and those indicated, which prevents following good practice or the intent of the drawings and specifications, he shall notify the A/E.

1.6 EXAMINATION OF SITE

A. Prior to submitting bid, visit the site where the work is to be performed and the materials are to be delivered. Failure in this respect shall not excuse the Contractor from his obligation to supply and install the work in accordance with the plans and specifications and under all conditions, as they exist.
B. By submitting a bid, this Contractor warrants that all specification sections and drawings showing equipment for plumbing, heating, ventilation, air conditioning, electrical, and architectural, have been examined and is familiar with the conditions and extent of work affecting this contract.

1.7 EQUIPMENT AND MATERIALS

A. All equipment and materials for permanent installation shall be the products of recognized manufacturer's and shall be new, unless noted for re-use, without damaged, functional or aesthetic components.
B. New equipment and materials shall:
    1. Be Underwriters Laboratories, Inc. (UL) labeled and/or listed where specifically called for, or where normally subject to such UL labeling and/or listing services
    2. Be without blemish or defect.
    3. Be in accordance with the latest applicable NEMA standards.
    4. Be products, which will meet with the acceptance of the agency inspecting the electrical work. Where such acceptance is contingent upon having the products examined, tested and certified by UL or other recognized testing laboratory, the product shall be so examined, tested and certified.
C. For all equipment, which is to be installed but not purchased as part of the electrical work, the electrical work shall include:
    1. The coordination of their delivery.
    2. Their unloading from delivery trucks driven in to any point on the property line at grade level.
    3. Their safe handling and field storage up to the time of permanent placement in the project.
    4. The correction of any damage, defacement or corrosion to which they may have been subjected.
    5. Their field make-up and internal wiring as may be necessary for their proper operation.

6. Their mounting in place, including the purchase and installation of all dunnage, supporting members and fastenings necessary to adapt them to architectural and structural conditions.

D. Equipment, which is to be installed but not purchased as part of the electrical work, shall be carefully examined upon delivery to the project. Claims that any of these items have been received in such condition that their installation will require procedures beyond the reasonable scope of the electric work will be considered only if presented in writing within one week of the date of delivery to the project of the items in question. The electric work includes all procedures, regardless of how extensive, necessary to put into satisfactory operation, all items for which no claims have been submitted as outlined above.

1.8 ELECTRICAL INSTALLATIONS

A. All materials and labor called for, specified in Division 16 of the specifications, and or shown on the electrical drawings furnished under this contract shall be provided under Division 16 unless called for otherwise in the Division 16 documents. The word “provide” as used in the Division 16 documents, shall mean to furnish, install, connect up, complete with all accessories ready for operation and warranted.
B. Coordinate electrical equipment and materials installation with other building components. Fully coordinate work with that of other trades. Furnish information in writing that is needed for the coordination of clearances, etc., with the work of others, and such information shall be given in a timely fashion so as not to impede the progress of two or more trades. Confer and resolve the conflict immediately. If so directed by the A/E, prepare composite drawings to resolve any space or clearance conflict.
C. Verify all dimensions by field measurements.
D. Arrange for chases, slots, and openings in other building components to allow for electrical installations.
E. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
F. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
G. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
H. Where mounting heights are not detailed or dimensioned, the exact location shall be determined by the A/E, install electrical services and overhead equipment to provide the code and/or utility requirements.
I. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
J. Coordinate the installation of electrical materials and equipment above ceilings with suspension systems, mechanical equipment and systems, and structural components.
K. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
L. Attention is directed to areas and items indicated on the drawings by the notations "HOLD", "N.I.C.", "BY OTHERS" and words of similar intent. The work indicated in these areas is shown for information and continuity only. Work or items furnished and installed in these

areas solely for the convenience of this Contractor or others, without prior written approval of the Owner, shall be removed at the option of the Owner and at the Contractor's expense.

M. Provide all required staging and scaffolding for all the work under this section.

1.9 ALTERATION WORK

A. Maintain continuity of service in areas where occupancy is to be maintained during alterations. If it becomes necessary to disconnect or interrupt service, obtain written consent of the Owner, and only disconnect service at the convenience of, and with the consent of the Owner. A copy of the written request for a shutdown shall be forwarded to the A/E.

1.10 CUTTING AND PATCHING

A. Cutting and patching of electrical equipment, components, and materials specified under Division 16 (conduit, sleeves, equipment, etc.) shall be performed by Electrical Contractor.
B. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 Section: "Cutting and Patching" for definitions, requirements, and procedures.
C. Cutting and patching of existing structures (thru walls, floors, ceilings, etc.) to accommodate equipment, components, and materials of all Contractors, including Mechanical and Electrical Contractors, shall be performed by General Contractor and/or his designated Subcontractor.
D. Cutting and patching of new structures (thru walls, floors, ceilings, etc.) to accommodate installation of ill-timed work or removal and replacement of defective work or work not conforming to requirements of Contract Documents, shall be performed by General Contractor and/or his designated Subcontractor and costs shall be back charged to appropriate trade Contractor.
E. Do not endanger or damage installed work through procedures and processes of cutting and patching.
F. Arrange for repairs required to restore other work, because of damage caused as a result of electrical installations.
G. Arrange to have ducts, raceways, conduit, panelboards, boxes, and such other pertinent parts, set in place ahead of construction work so that they will be built-in with structures and eliminate need for cutting and patching. Failure to conform to this paragraph will require that this Contractor perform any cutting and patching required for his work at his expense. Cutting shall be neatly finished to match adjoining work in a manner acceptable to the A/E. Cutting and patching shall not affect the fire rating of walls or structural parts. Cutting and patching required to correct work, due to error or negligence of the Contractor, or to defects in his material or workmanship, shall be corrected at no additional cost to the Owner. Patching shall meet or exceed quality of adjacent surfaces. Cutting must be accomplished as not to weaken adjacent structural members and must be approved by the Structural Engineer before proceeding.
H. Perform cutting, fitting, and patching of electrical equipment and material required to:
    1. Uncover work to provide for installation of ill-timed work.
    2. Remove and replace defective work.
    3. Remove and replace work not conforming to requirements of the contract documents.
    4. Remove samples of installed work as specified for testing.
    5. Install equipment and materials in existing structures.
    6. Upon written instructions from the A/E, uncover and restore work to provide for A/E observation of concealed work.

I. Cut, remove and legally dispose of selected electrical equipment, components and materials as indicated, including, but not limited to, removal of electrical items indicated to be removed and items made obsolete by the work.
J. Protect the structure, furnishing, finishes, and adjacent materials not indicated or scheduled to be removed. Protect the electrical work and the work of others in a manner best suited to the particular case. Correct any damage done to any work at no additional cost.
K. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
L. Locate, identify, and protect electrical services passing through areas that are to under-go remodeling or demolition. Electrical services serving other areas required to be maintained, and transit services must be interrupted, provide temporary services for the affected areas and notify the Owner prior to changeover.

1.11 SUBMITTALS

A. Within fifteen (15) business days after the date of notice to proceed and before purchasing any materials or equipment, submit for approval a complete list, in six (6) copies, of all materials to be incorporated in the work.
B. Shop drawings/manufacturer's cuts are required for:
    1. Wire & Cable.
    2. Lighting Fixtures.
    3. Panelboards.
    4. Transformers.
    5. Disconnect Switches.
    6. Wiring Devices and Plates.
    7. Fire Alarm System.
    8. Fire Stopping Materials.
    9. Generator & Transfer Switches.
    10. Seismic Restraint Components.
C. After the list has been processed, submit complete shop drawings of all equipment. These shop drawings submittals shall be submitted within thirty days after the processing date of the original submittal.
D. All submittals shall be complete and submitted electronically to all applicable parties. No consideration will be given to partial submittals except with prior approval. No consideration will be given to faxed submittals.
E. Explanation of Shop Drawing Stamp:
    1. Approved: indicates that we have not found any reason why this item should not be acceptable within the intent of the documents.
    2. Approved with Comments: indicates that we have found questionable components which, if corrected or otherwise explained, make the product acceptable.
    3. Resubmit for Final Review: indicates that this item should be resubmitted for approval before further processing.
    4. Does Not Conform: indicates that the item will not meet the intent of the Contract.
F. No shop drawing stamp or note shall constitute an order to fabricate or ship. Such notification can only be performed by the Project Manager for construction, the Contractor scheduling his own work, or the Owner.
G. Submittal of shop drawings, product data, will be reviewed only when submitted by the Contractor. Data submitted from Sub-contractors and material suppliers directly to the A/E will not be processed.

H. If shop drawing is not in compliance after two submissions, a third submission for the same manufacturer will not be considered for review.
I. Check shop drawings and other submittals to assure compliance with contract documents before submittal to A/E.
J. Review of shop drawings is final and no further changes shall be considered without written application. Shop drawing review does not apply to quantities, dimensions, nor relieve this Contractor of his responsibility for furnishing materials or performing his work in full compliance with these contract drawings and specifications. Review of these shop drawings shall not be considered a guarantee of the measurements of this building or the conditions encountered.
K. General requirements for the substitution of equipment and submittal of shop drawings as follows. If apparatus, systems or materials are substituted for those specified, and such substitution necessitates changes in, or additional connections, wiring, supports, or construction, it shall be provided by this Contractor at no additional cost to the Owner. This Contractor shall assume all cost and entire responsibility thereof. The approval of substituted equipment does not relieve the contractor of his/her responsibility of shop drawing errors related to details, sizes, quantities, wiring diagram arrangements and dimensions which deviate from the Specifications, and/or job conditions as they exist. It is the contractor's responsibility to submit only those items that meet the specified apparatus, systems and material. Should any non-conformance code items be installed, they shall be replaced by this Contractor at no additional cost to the Owner. The construction means and methods used in the project shall be reviewed and approved through the local building department or a deputy inspector to insure compliance with the current codes, project specifications and general building practices.
L. Coordination drawings shall be submitted and shall show all HVAC, Electrical, Plumbing and Fire Protection systems superimposed in order to identify conflicts and ensure inter-coordination of all trades. Coordination drawings shall be initiated under this Section of the Specifications. It is this Contractors responsibility for preparation of project coordination drawings showing the installation of all electrical equipment, switchgear, motor control centers, panelboards, transformers, transfer switches, disconnect switches, enclosed circuit breakers, conduits, outlets, switches and accessories to be provided under this Section of the Specifications. These drawings shall be prepared at not less than 3/8 in. = 1 ft. scale, and shall show building room layouts, structural elements, ductwork and lighting layouts of function. A reproducible copy of each drawing prepared shall then be submitted to the Mechanical, Plumbing and Sprinkler Contractors, who shall be responsible to coordinate his equipment and systems and shall show these on the drawings submitted. After this Contractor has fulfilled his obligation, he shall notify all other Contractors. After each drawing has been coordinated between trades, each trade shall sign each drawing, indicating acceptance of the installation. This Contractor shall then print the coordination original and these prints submitted through the General Contractor to the architect for review and comment, similar to shop drawings. Comments made on these drawings shall result in a correction and re-submittal of the drawings. A Subcontractor who fails to promptly review and incorporate his work on the drawings shall assume full responsibility of any installation conflicts affecting his work and of any schedule ramifications. Review of coordination drawings shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, and Electrical Contractors.

1.12 PRODUCT OPTIONS AND SUBSTITUTIONS

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 for definitions, requirements, and procedures.
B. If materials of equipment are substituted for specified items that alter the systems shown or its physical characteristics, or which have different operating characteristics, clearly note the alterations or differences and call it to the attention of the A/E. Under no circumstances shall substitutions be made unless identical material or equipment has been successfully operated for at least three consecutive years.
C. All substitution made by the Contractor shall require the Contractor to fully coordinate the substitution with other trades. The Contractor must make any modifications required by the substitution at no additional cost to the Owner. In addition the Contractor must notify the A/E of any changes required and obtain approval for the changes. The review of the shop drawings by the A/E shall not relieve the Contractor from his responsibility as set forth in this specification.

1.13 NAMEPLATE DATA

A. Provide permanent operational data nameplate on each item of power operated equipment, conduits with pull string, indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data. Locate nameplates in a readily accessible location.

1.14 DELIVERY STORAGE AND HANDLING

A. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
B. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. All devices shall be stored in a locked room. Assume responsibility for the devices until the date of final inspection.
C. Coordinate deliveries of electrical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.

1.15 RECORD DOCUMENTS

A. As work progresses and for the duration of Contract, maintain a complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings clearly and accurately including work installed as a modification or addition to the original design. Work shall be updated on a weekly basis and shall be made available for review by Architect. Failure to perform this work shall be reason for withholding requisition payments. In addition, take photographs of all concealed equipment in gypsum board ceilings, shafts, and other concealed, inaccessible work. At completion of work, make copies of photographs with written explanation on back. These shall become part of Record Documents.
B. At completion of work prepare a complete set of Record As-Built Drawings in AutoCAD, Computer Aided Drafting (CAD) software, showing all systems as actually installed, including all fire alarm and electrical circuitry. The Record As-Built Drawings computer files shall be made available to the Architect, Engineer and Owner prior to final payment.

C. The Architect will not certify the accuracy of the Record Drawings. This is the sole responsibility of the Electrical Contractor.
D. This trade shall submit the record set for approval by the Fire and Building Departments in a form acceptable to the departments, when required by the jurisdiction.
E. Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.16 WARRANTIES

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 for definitions, requirements, and procedures.
B. All work and equipment furnished under this Section shall be guaranteed free from defects in workmanship or materials for a period of one (1) year, unless specifically noted otherwise for a particular system, from the date of final acceptance of the systems as set forth in this Contract. The Subcontractor shall replace any defective work developing during this period, unless such defects are clearly the result of misuse of equipment by persons not under the control of the Subcontractor, without cost to the Owner. Where such defective work results in damage to work of other Sections, all such work shall be restored to its original condition by mechanics skilled in the affected trade, at the expense of the Subcontractor. The Subcontractor shall submit a separate written guarantee stipulating the aforesaid conditions.
C. Prior to or at the time of Substantial Completion for the work and during administrative close-out of the project, submit one (1) copy of all specified warranties and guarantees to the Architect for review, approval and subsequent transmittal to the Owner.
D. Warranties and guarantees, including those specified in excess of the general one (1) year guarantee, shall be complete for all specific materials, systems, sub-systems, equipment, appliances and products specified and required by the Contract Document.
E. Warranties and guarantees shall clearly define what is to be guaranteed; the extent, terms, conditions, time and effective dates.
F. Copies of the same warranties and guarantees shall be included in the “Operating and Maintenance Manual” as specified herein.

1.17 CLEANING

A. Refer to the Conditions of the Contract (General and Supplementary) and Division 1 for definitions, requirements, and procedures.
B. Upon completion of work, the Contractor shall clean, polish and leave bright, fixtures and lamps, and shall remove dust, dirt, debris and loose plaster from panelboards, controls, and switchboards. Unused openings in pull boxes, junction boxes, equipment and raceways shall be capped or closed by an approved means. Replace all inoperative lamps.

1.18 DEFINITION OF TERMS

A. "This Contractor" or "E.C." specifically means, the Electrical Contractor working under this section of the specifications.
B. "Concealed" means hidden, in chases, furred spaces, walls, above ceilings or enclosed in construction.
C. "Exposed" means visible in sight or not installed "concealed" as defined above.

D. "Approved Equal" means any equipment or material which is approved by the Engineer and equal in quality, durability, appearance, strength, design and performance to the equipment or material originally specified.
E. "Conduit" shall mean all conduit including fittings, joints, hangers and supports.
F. "Furnish" shall mean to purchase and deliver to the project site complete with every necessary appurtenance and support, all as part of the electrical work.
G. "Install" shall mean to perform every operation necessary to establish secure mounting and correct operation at the proper location in the project, all as part of the electrical work.
H. "Provide" shall mean to furnish and install.

1.19 QUALITY ASSURANCE

A. Obtain services of manufacturer's representatives of electrical equipment, during erection and construction of their respective equipment to insure proper installation of same.
B. A letter is required from each system manufacturer's representative certifying to the A/E that requirements have been checked and are properly installed and operating.

1.20 PERFORMANCE TESTS - ELECTRICAL

A. Test and adjust the electrical systems and equipment during the progress of the work.
B. Upon completion of work and after preliminary tests to assure that all systems are complete and in proper working order, arrange with the A/E to conduct performance tests of the electrical systems. These tests may be witnessed by the A/E prior to acceptance of systems and shall be arranged for the purpose of demonstrating compliance with contract documents. During this period, visually inspect all electrical equipment. Lighting fixtures shall be tested with specified lamps in place for not less than six (6) hours. Check voltages to assure that all transformer taps are properly set.
C. General operating tests shall be performed under as near design conditions as possible, for a period of not less than one (1) hour for each system, and shall demonstrate that all equipment is functioning in accordance with specifications. Furnish all instruments, ladders, test equipment and personnel required for tests. Any equipment or systems found by test to be deficient or unsatisfactory shall be replaced and tests repeated as often as necessary to assure compliance with contract documents.
D. Test all feeders, sub-feeders and all branch wiring for amperage, voltage, phase balance, phase sequence of A,B,C and insulation resistance, then submit the results of this test to the A/E neatly typed in triplicate for review. This test may be conducted at any time up to, through and including, the guarantee period if requested by the A/E, at no additional cost to the Owner.
E. Phase balance the complete electrical system, phase balance all panels as near as loads will permit under normal working conditions.
F. Test all ground conductors for current flow, as near design operating conditions as possible. If any measured current exceeds one (1) ampere, determine and correct the cause. Also, if measured resistance is greater than 5 ohms indoor or 10 ohms outdoor, determine and correct the cause.
G. During the progress or completion of the work it shall be subject to the inspection of the Owner and to such other inspectors, as may have jurisdiction, including those of the Electric Company, Fire Department and the Telephone Company.
H. The Contractor shall be responsible for correct voltages, tap settings, trip settings and correct phasing on all equipment. Secondary voltages shall be measured at the line side of the main

breakers with the breakers in an open position, at panelboards, and at such other location on the distribution systems and branch circuits as directed by the Engineer.

I. At completion of the work, Contractor shall submit to the Owner's representative in writing a statement stating: (1) that the work is complete; (2) that the entire installation is in accordance with the drawings and specifications; (3) that preliminary tests have been made; and (4) that the work is ready for final inspection and test.

J. A final inspection of the installation to determine compliance with the drawings and specifications will be made by the Owner's representative. Work will be checked for quality of materials, quality of workmanship, proper installation and finished appearance. The electrical contractor shall provide the services of the project electrical foreman for inspection purposes. The foreman shall remove and reinstall wiring devices, junction box covers, panelboard trims, switchboard covers, terminal box covers, ceiling tiles, lighting fixtures, etc. as required to facilitate any inspections required by the Owner's representative.

K. The Contractor shall arrange and conduct operating tests on all equipment in the presence of the Owner's representative. The components parts of systems and the various systems shall be demonstrated to operate in accordance with the requirements and intent of this specification. Any non-complying or defective materials or workmanship disclosed as a result of the inspection and tests shall be corrected promptly by the Contractor, and the tests repeated as often as necessary until approved and accepted by the Owner's representative.

L. The Contractor shall visit the site to acquaint himself with existing conditions. No extra compensation will be paid for failure to comply with this paragraph.

M. The Electrical Contractor shall provide supervision, labor, materials, tools, test equipment, and all other equipment or services and expenses required to test, adjust, set, calibrate, and operationally check work and components of the electrical systems and circuitry throughout this section.

N. The electrical contractor shall pay for all tests including expences incident to retests occasioned by defects and failures of equipment to meet specifications at no additional cost to the owner.

O. Any defects or deficiencies discovered in any of the electrical work shall be corrected at no cost to the owner.

P. All testing shall be compatible with the manufacturer’s installation instructions.

1.21 SEISMIC RESTRAINT

A. It is the intent of this seismic specification to keep all electrical building system components in place during a seismic event.

B. All electrical systems must be installed in strict accordance with seismic codes, component manufacturer's and building construction standards. Whenever a Conflict occurs between the manufacturer's or construction standards, the most stringent shall apply.

C. This contractor shall engage a professional structural engineer registered in the jurisdiction of this project to review the entire installation to determine all seismic restraint requirements and methods. Contractor shall submit a report outlining the structural engineer’s review as well as seismic restraint shop drawings and supporting calculations prepared by the professional structural engineer for review by the Architect.

D. Seismic restraints shall be designed in accordance with seismic force levels as detailed in the applicable building code.

1.22 TEMPORARY LIGHT AND POWER

A. Under this Section of the specifications, this Contractor shall provide temporary electric service, sized suitable for construction for each trade. This contractor shall provide all material and labor for temporary electrical service per the local power company's requirements and standards with all necessary panelboards, disconnect switches, transformers, conduit, wiring, etc. as required. This contractor shall pay all associated costs, up front.
B. Where temporary electrical service cannot be obtained from the local power company, this contractor shall provide a temporary, on-site, electric generator with all necessary panelboards, disconnect switches, transformers, conduit, wiring, etc. as required. The fuel used for the generator shall be provided and paid for by this Contractor.
C. This contractor shall provide a distribution system with circuits for receptacles and lighting as required for construction. This contractor shall maintain the temporary electrical system during construction and remove the system when construction is complete.
D. Under this section of the specifications, this Contractor shall provide and maintain temporary lighting based on using not less than one 100-watt lamp for each 100 square feet of building floor area and one duplex GFCI receptacle for each 200 square feet of building floor area. Where higher lighting intensities are required by Federal or State laws or otherwise specified, the above specified wattage shall be increased to provide the increase intensities.
E. This contactor shall provide temporary power and telephone services from the local telephone company for site trailers, fax machines, computers, etc., per the general contractor's direction.
F. The service shall incorporate ground fault protection and comply with NEC Article 527 and OSHA requirements.

1.23 PERMITS

A. Obtain all required electrical permits and pay all fees for same.
B. Provide to Engineer, in duplicate, a certificate of final inspection from the authority having jurisdiction for the electrical and systems.

1.24 OPERATING, INSTRUCTION, AND MAINTAINANCE MANUALS

A. Refer to Section 01700 – CONTRACT CLOSEOUT for submittal procedures pertaining to operating and maintenance manuals.
B. Each copy of the approved operating and maintenance manual shall contain copies of approved shop drawings, equipment literature, cuts, bulletins, details, equipment and engineering data sheets and typewritten instructions relative to the care and maintenance for the operation of the equipment, all properly indexed.

1.25 BIDDERS REPRESENTATION

A. By the act of submitting a bid for the proposed contract, the Bidder represents that:
    1. The Bidder and all subcontractors the Bidder intends to use have carefully and thoroughly reviewed the drawings, specifications and other construction contract documents and have found them complete and free from ambiguities and sufficient for the purpose intended; further that,
    2. The Bidder and workmen, employees and subcontractors the Bidder intends to use are skilled and experienced in the type of construction represented by the construction contract documents bid upon; further that,
    3. Neither the Bidder nor any of the Bidder's employees, agents, intended suppliers or subcontractors have relied upon any verbal representations, allegedly authorized or

unauthorized from the Owner, or the Owner's employees or agents including architects, engineers or consultants, in assembling the bid figure; and further that,

4. The bid figure is based solely upon the construction contract documents and properly issued written addenda and not upon any other written representation.

1.26 UTILITY COMPANY & AGENCY COORDINATION

A. This section includes, but is not limited to coordination with the following utilities, agencies and authorities having jurisdiction:
   1. Power Company: This Contractor shall coordinate with the local utility power company and provide all material & labor required to comply with the utility power company's requirements and standards, prior to ordering any electrical equipment, such as, switchgear, panels, transformers, disconnect switches, TVSS, etc. This Contractor shall confirm metering sequence (hot or cold) and make the appropriate provisions and/or changes for the utility companies approved metering sequence arrangement. Notify Engineer of discrepancies between the plans and the local utility company's standards. No extra compensation will be given for corrections required to this Contractor for failure to coordinate with the utility company, but corrections shall be made. All A.I.C. ratings, grounding, bonding, concrete pads & curbs, protective bollards, raceways, ductbank, manholes, etc., shall be in accordance with the utility company's standards.
   2. Telephone Company: This Contractor shall coordinate with the local telephone company and provide all material & labor required to comply with the telephone company's requirements and standards, prior to ordering any electrical or telephone equipment, such as, terminal boards, grounding systems, raceways, ductbanks, manholes, etc. This Contractor shall confirm the telephone company's requirements and provide as necessary. Notify Engineer of discrepancies between the plans and the telephone company's standards. No extra compensation will be given for corrections required to this Contractor for failure to coordinate with the telephone company, but corrections shall be made.
   3. Cable TV Company: This Contractor shall coordinate with the local cable TV company and provide all material & labor required to comply with the cable TV company's requirements and standards, prior to ordering any electrical or cable TV equipment, such as, terminal boards, grounding systems, raceways, ductbanks, manholes, etc. This Contractor shall confirm the cable TV company's requirements and provide as necessary. Notify Engineer of discrepancies between the plans and the cable TV company's standards. No extra compensation will be given for corrections required for failure to coordinate with the cable TV company, but corrections shall be made.
   4. Local Fire Marshal: This contractor shall verify with the local fire alarm official, the type of master-box or municipal connection required for this project. This contractor shall provide all material & labor to comply with the local municipality. Notify Engineer of discrepancies between the plans and the municipality's standards. No extra compensation will be given for corrections required for failure to coordinate with the municipality, but corrections shall be made.
   5. Electrical Inspector: Review plans and specifications with the local electrical and/or wiring inspector(s). Obtain and pay for all permits.
   6. Building Inspector: Review plans and specifications with the local building inspector, if not done so by the General Contractor.
   7. OSHA Representative: Review plans and specifications with the local OSHA representative, if not done so by the General Contractor.

8. Dig Safe: This contractor shall notify and coordinate with Dig Safe prior to any excavation; digging; trenching; grading; tunneling; augering; boring; drilling; pile driving; plowing-in or pulling-in pipe, cable, wire, conduit, or other sub-structure; backfilling; demolition; and blasting related to this Contractor.

B. The Electrical Contractor shall pay for all permits, inspections, labor, material and fees associated with the various Utility Companies coordination requirements mentioned in this section and for this Contractor's work under this project.

C. The Electrical Contractor shall carry a minimum of $15,000 of utility expenses. In the case the expenses are less than the carried expense, the difference will be credited to the owner. In the case the utility charges are more than the carried expense, the remaining payment shall be coordinated between the Electrical Contractor, General Contractor and Owner.

D. HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structural and other trades and to meet Architectural requirements.

E. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Architect. Where the electrical work shall interfere with the work of other trades, assist in working out the space conditions to make satisfactory adjustments before installation. Without extra cost to the Owners, make reasonable modifications to the work as required by normal structural interferences. Pay the General Contractor for additional openings, or relocating and/or enlarging existing openings through concrete floors, walls, beams and roof required for any work which was not properly coordinated. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

F. If any electrical work has been installed before coordination with other trades so as to cause interference with the work of such trades, all necessary adjustments and corrections shall be made by the trades involved without extra cost to the Owners.

G. Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Architect and Engineer for review and approval.

PART 2 – PRODUCTS

2.1 CONDUIT

A. Minimum Size: ¾-inch, unless otherwise specified.

B. Underground Installations:
   1. More than Five Feet from Foundation Wall: Use thick wall nonmetallic conduit concrete encased.
   2. Within Five Feet from Foundation Wall: Use rigid steel conduit concrete encased.
   3. In or Under Slab on Grade: Use plastic coated conduit.
   4. Minimum Size: 1-inch.

C. Outdoor Locations, Above Grade: Use rigid steel conduit.

D. In Slab Above Grade:
   1. Use rigid steel conduit.
   2. Maximum Size Conduit in Slab: ¾ inch (19 mm); ½ inch (13 mm) for conduits crossing each other.

E. Wet and Damp Locations: Use rigid aluminum conduit.

F. Dry Locations:

1. Concealed and in Cable-Tray: Use metal clad (MC) cable (see Division 1)
2. Exposed: (Unfinished or utility spaces) Use electrical metallic tubing.

G. Metal conduit: Rigid Steel Conduit shall comply with ANSI C80.1 and be heavy wall zinc coated steel. Rigid Aluminum Conduit shall comply with ANSI C80.5. Intermediate Metal Conduit (IMC) shall be rigid steel. Fittings and Conduit Bodies shall comply with ANSI/NEMA FB 1 and material to match conduit. Acceptable manufacturers are Western Tube and Conduit Company, Allied Tube and Conduit Company and Triangle Wire and Cable, Inc.

H. Flexible metal conduit shall be interlocked aluminum contruction. Fittings shall comply with ANSI/NEMA FB 1. Acceptable manufacturers are AFC Cable Systems, Electri-Flex Company and Eastern Flexible Conduit Technologies. All flexible conduits shall include a grounding conductor.

I. Electrical metallic tubing (EMT) shall comply with ANSI C80.3; galvanized zinc coated steel tubing. Fittings and Conduit Bodies shall comply with ANSI/NEMA FB 1; steel, compression or set screw type. Acceptable manufacturers are Western Tube and Conduit Company, Allied Tube and Conduit Company and Triangle Wire and Cable, Inc.

J. Nonmetal conduit shall comply with NEMA TC 2; Schedule 40 PVC, or as indicated on plans. Fittings and Conduit Bodies shall comply with NEMA TC 3. Acceptable manufacturers are Carlon or approved equal.

K. Flexible nonmetallic conduit (Sealtite) shall be UL and CSA listed for purpose specified and shown. Acceptable manufacturers are Carlon or approved equal.

L. Install conduit in accordance with NECA "Standard of Installation." Install nonmetallic conduit in accordance with manufacturer's instructions.

M. Arrange supports to prevent misalignment during wiring installation. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits. Fasten conduit supports to building structure and surfaces under provisions of Division 1. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports. Do not attach conduit to ceiling support wires.

N. Arrange conduit to maintain headroom and present neat appearance. Route exposed conduit parallel and perpendicular to walls. Route conduit installed above accessible ceilings parallel and perpendicular to walls. Route conduit in and under slab from point-to-point. Do not cross conduits in slab.

O. Maintain adequate clearance between conduit and piping. Maintain 12-inch (300 mm) clearance between conduit and surfaces with temperatures exceeding 104 degrees F (40 degrees C).

P. Cut conduit square using saw or pipe cutter; de-burr cut ends. Bring conduit to shoulder of fittings; fasten securely. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

Q. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender to fabricate or factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.

R. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control and expansion joints. All expansion and deflection fittings shall have a ground

strap. Provide suitable pull string in each empty conduit except sleeves and nipples. Use suitable caps to protect installed conduit against entrance of dirt and moisture.

S. Ground and bond conduit under provisions of NEC 250.

2.2 DUCT BANK

A. Verify that field measurements are as indicated. Verify routing and termination locations of duct bank prior to excavation for rough-in. Verify locations of manholes prior to excavating for installation. Duct bank routing is shown in approximate locations unless dimensions are indicated. Route as required to complete duct system. Manhole locations are shown in approximate locations unless dimensions are indicated. Locate as required to complete duct bank system.

B. Underground Warning Tape: Provide 3-inch wide plastic tape 12” below finished grade, colored yellow with suitable warning legend describing buried electrical lines; Model #47586 as manufactured by Seton or equal.

C. Install duct to locate top of duct bank at 30” below finished grade or at depths as indicated on drawings. Install duct with minimum slope of 4-inches per 100-feet. Slope duct away from building entrances.

D. Provide suitable fittings to accommodate expansion and deflection where required. Terminate duct at manhole entries using end bell. Stagger duct joints vertically in concrete encasement 6 inches minimum. Use suitable separators and chairs installed not greater than 4 feet (1200 mm) on centers. Band ducts together before backfilling and placing concrete. Securely anchor duct to prevent movement during concrete placement.

E. Place concrete as required and under provisions of Division 3. Use mineral pigment to color concrete red. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Provide two No. 4 steel reinforcing bars in concrete ductbank under paved areas. Connect to existing concrete encasement using dowels. Connect to manhole wall using dowels.

F. Provide suitable pull string in each empty duct except sleeves and nipples. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

G. Backfill trenches as required and under provisions of Division 2. Interface installation of underground warning tape with backfilling specified in Division 2. Install warning tape 12-inches below finished surface.

2.3 BUILDING WIRE & CABLE

A. Building Wire and Cable shall be copper with 600V insulation rated at 75°C minimum, Type XHHW insulation for feeders and branch circuits larger than #3 AWG; Type THHN/THWN insulation for feeders and branch circuits #4 AWG and smaller.

B. Conductors shall be of soft drawn 98% minimum conductivity properly refined copper, solid construction where No. 10 AWG and smaller, stranded construction where No. 8 AWG and larger.

C. Exterior of wires shall bear repetitive markings along their entire length indicating conductor size, insulation type and voltage rating.

D. Exterior of wires shall be color coded, so as to indicate a clear differentiation between each phase and between each phase and neutral. In all cases, grounded neutral wires and cables shall be identified by the colors “white” or “gray”. In sizes and insulation types where factory applied colors are not available, wires and cables shall be color coded by the application of colored plastic tapes in overlapping turns at all terminal points, and in all boxes in which

splices are made. Colored tape shall be applied for a distance of 6 inches along the wires and cables, or along their entire extensions beyond raceway ends, whichever is less.

E. Final connections to motors shall be made with 18" of neoprene sheathed flexible conduit.
F. Minimum branch circuit conductor size shall be No. 12 AWG installed in conduit. Motor control circuit wiring shall be minimum No. 14 AWG installed in conduit.
G. Fire alarm and security system wiring shall be No. 16 twisted non-shielded pairs for alarm and trouble circuits and a minimum of #14 AWG for device power, control and alarm annunciation circuits. Fire alarm system riser circuits shall be 2-hour rated, CI type (circuit integrity) cable per NFPA 72 and NEC 760.
H. Other wires and cables required for the various systems described elsewhere in this section of the Specifications shall be as specified herein, as shown on the Contract Drawings, or as recommended by the manufacturer of the specific equipment for which they are used, all installed in conduit.
I. Metal clad sheathed cable NFPA 70, type MC may be used for branch circuitry where shown and where run concealed and not subject to physical damage. All branch circuits shall be run in conduit from the panelboard to the first outlet. All type MC cable used shall contain a full size insulated ground conductor. All conductors shall be copper. All type MC cable insulation used shall have voltage rating of 600 volts, shall have a temperature rating of 75° C, and shall be thermoplastic material. Armor material shall be steel and armor design shall be interlocked metal tape. Fire alarm rated MC cable may be used for fire alarm work where concealed and approved by the Authority Having Jurisdiction.
J. Metal-Clad cable (Type MC) for circuits supplying computer equipment, electronic discharge lighting and other sensitive electronic equipment shall consist of 90°C THHN copper conductors with insulated ground and oversized neutral conductor (or one full size neutral conductor for each phase conductor). Cable shall be U.L. listed/labeled, and shall meet the requirements of NEC Art. 334 and 675.
K. Use armored cable (AFC Type HCF-90 or equal) for branch circuits and feeders in areas of patient care in hospitals, nursing homes and medical centers, medical office buildings and nurses' office areas of schools. This cable shall consist of 90°C THHN copper conductors with combined armor/bond wire (equipment) plus a green insulated ground (redundant). Use insulated bushings. Cable shall be U.L. listed/labeled, and shall meet the requirements of NEC Art. 333, 517 and 645.
L. Use armored cable (AFC Type HCF-90 or equal) for branch circuits and feeders in all buildings in the following areas; data processing systems, places of assembly, under raised floors, above suspended ceilings and in other environmental air-handling spaces. This cable shall consist of 90°C THHN copper conductors with combined armor/bond wire (equipment) plus a green insulated ground (redundant). Use insulated bushings. Cable shall be U.L. listed/labeled, and shall meet the requirements of NEC Art. 333, 517 and 645.
M. Wiring materials except MI cable shall be manufactured by Triangle, Essex, General Cable, AFC, Southwire or equal.
N. Concealed Dry Interior Locations: Use only building wire Type THHN/THWN or XHHW insulation in raceway, or metal clad cable where concealed and code acceptable.
O. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
P. Above Accessible Ceilings: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway or metal clad cable where code acceptable.
Q. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.

R. Exterior Locations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
S. Underground Installations: Use only building wire, Type THHN/THWN or XHHW insulation, in raceway.
T. Wiring methods, in general, are as follows:
    1. Galvanized rigid steel conduit shall be used for telephone system sleeves for main cable runs between floors, closets, etc. and for sweeps, bends, etc. in ductbanks and as specifically noted on the plans. EMT shall be used generally for exposed circuiting in unfinished spaces. Metal clad cable (type MC) may be used for branch circuiting and fire alarm rated MC cable for fire alarm circuiting where run concealed and where code acceptable.
    2. To prevent transmittal of vibration to conduit, connections to any vibration producing equipment (i.e. transformers, motors, etc.) shall be terminated by 18 inches of flexible metal conduit. Where flexible connections are exposed to grease and oil, liquid-tight flexible metal conduit shall be used.
    3. In general, no splices or joints shall be permitted in either feeders or branches except at outlets or accessible junction boxes. Splices in wire #8 AWG and smaller shall be pigtail type, made mechanically tight. All conduit systems shall be complete.
    4. Raceway, boxes, etc., run on walls in wet areas which are subject to being washed down, shall be mounted on the walls with 1/4" stand-offs. All boxes shall be cast type.
U. Route wire and cable as required to meet the Project Conditions. Install cable in accordance with the NECA "Standard of Installation." Use solid conductor for feeders and branch circuits 10 AWG and smaller. Use stranded conductors for control circuits. Use conductor not smaller than 12 AWG for power and lighting circuits. Use conductor not smaller than 16 AWG for control circuits. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m). Use 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet (160 m). Pull all conductors into raceway at same time. Use suitable wire pulling lubricant for building wire 4 AWG and larger. Protect exposed cable from damage.
V. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure or ceiling suspension system, cables that are not part of the ceiling system cannot be supported from ceiling supports. Do not rest cable on ceiling panels. Use suitable cable fittings and connectors. Neatly train and lace wiring inside boxes, equipment, and panelboards.
W. Clean conductor surfaces before installing lugs and connectors. Make splices, taps, and terminations to carry full ampacities of conductors with no perceptible temperature rise. Use suitable reducing connectors or mechanical connector adapters for connecting aluminum conductors to copper conductors. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape un-insulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller. Identify and color code wire and cable. Identify each conductor with its circuit number or other designation indicated.

2.4 BOXES

A. Outlet Boxes:
    1. Each outlet in wiring or raceway systems shall be provided with an outlet box to suit conditions encountered. Boxes installed in normally wet locations shall be of cast-

metal type having hubs. Concealed boxes shall be cadmium plated or zinc coated sheet metal type. Old work boxes with Madison clamps are not allowed in new construction.

2. Each box shall have sufficient volume to accommodate number of conductors in accordance with requirements of NFPA 70. Boxes shall not be less than 1-1/2” deep unless shallower boxes are required by structural conditions and are specifically approved by Architect. Ceiling and bracket outlet boxes shall not be less than 4” octagonal except that smaller boxes may be used where required by particular fixture to be installed. Flush or recessed fixtures shall be provided with separate junction boxes when required by fixture terminal temperature requirements. Switch and receptacle boxes shall be 4” square or of comparable volume. Luminaire and equipment supporting boxes shall be rated for weight of equipment supported; include 1/2 inch (13 mm) male fixture studs where required.
3. Acceptable Manufacturers:
    a. Appleton
    b. Crouse Hinds
    c. Steel City
    d. RACO

B. Pull and Junction Boxes: Where necessary to terminate, tap off, or redirect multiple raceway runs or to facilitate conductor installation, furnish and install appropriately designed boxes. Boxes shall be fabricated from code gauge steel assembled with corrosion resistant machine screws. Box size shall be as required by Code. Where intermediate cable supports are necessary because of box dimensions, provide insulated removable core brackets to support conductors. Junction boxes are to be equipped with barriers to separate circuits. Where splices are to be made, boxes shall be large enough to provide ample work space. All conductors in boxes are to be clearly tagged to indicate characteristics. Boxes shall be supported independently of raceways. Junction boxes in moist or wet areas shall be galvanized type. Boxes larger than 4-inches square shall have hinged covers. Boxes larger than 12-inches in one dimension will be allowed to have screw fastened covers, if a hinged cover would not be capable of being opened a full 90 degrees due to installation location.

C. Fiberglass Handholes shall be die molded glass fiber. Cable Entrance shall be pre-cut 6-inch x 6-inch (150 mm x 150 mm) cable entrance at center bottom of each side. Cover shall be glass fiber weatherproof cover with nonskid finish.

D. Install boxes in accordance with NECA "Standard of Installation." Install in locations as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

E. Set wall mounted boxes at elevations to accommodate mounting heights indicated or specified in section for outlet device. Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 10-feet (3m) if required to accommodate intended purpose. Orient boxes to accommodate wiring devices. Maintain headroom and present neat mechanical appearance.

F. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 7.

G. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes. Locate outlet boxes to allow luminaires positioned as shown on reflected

ceiling plan. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

H. Use flush mounting outlet box in finished areas. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening. Do not install flush mounting box back-to-back in walls; provide minimum 6-inches (150 mm) separation. Provide minimum 24 inches (600 mm) separation in acoustic rated walls. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Use stamped steel bridges to fasten flush mounting outlet box between studs. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

I. Use adjustable steel channel fasteners for hung ceiling outlet box. Do not fasten boxes to ceiling support wires. Support boxes independently of conduit. Use gang box where more than one device is mounted together. Do not use sectional box. Use gang box with plaster ring for single device outlets. Use cast outlet box in exterior locations exposed to the weather and wet locations. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations. Set floor boxes level.

J. Large Pull Boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

K. Adjust floor box flush with finish flooring material. Adjust flush-mounting outlets to make front flush with finished wall material. Install knockout closures in unused box openings.

2.5 WIRING DEVICES

A. Provide wiring device type plates for all wall-mounted devices. All wall plates shall be either brushed aluminum or smooth high impact nylon for all public areas as directed by the Architect. Provide galvanized steel for all Utility, Electric and Mechanical Rooms. Colors of wall plates as directed by the Architect.

B. Wiring devices standard for the project (i.e., with no specific type indicated) shall conform to the following:
   1. Visible part colors of wiring devices shall be as directed by the Architect for all public areas. Provide Ivory colored devices for all Utility, Electrical and Mechanical rooms.
   2. Exclude compact type devices.

C. Wiring device switches shall be toggle type, A.C. quiet design, specification grade, 20 amps on 120 volt circuits. Switches shall be mounted 48-inches to center line above finished floor unless noted otherwise. Equivalent 277volt, 20 amp switches shall be used where required.

D. Standard duplex convenience receptacles shall be 125volt, 20 amps, three wire (two circuit wires plus ground), “U-slot” ground NEMA configuration 5-20R, specification grade. Receptacles shall be mounted 18” to center line above finished floor unless noted otherwise. Where indicated on plans provide receptacles with ground fault current interrupters, UL Class A; 20A, 125V.

E. Non-standard convenience receptacles and special purpose power supply receptacles shall be as listed on plans.

F. Provide ground fault circuit interrupter (GFCI), weather-resistant type receptacles in all wet and damp locations as defined by the National Electrical Code. All outdoor receptacles and where indicated on the plans shall be installed in a weatherproof while-in-use enclosures.

G. Weatherproof Receptacle Enclosures shall be NEMA 3R rated for rain-tight while-in-use, gasketed, impact resistant thermoplastic with hinged gasketed device cover.

H. Provide extension rings to bring outlet boxes flush with finished surface. Clean debris from outlet boxes. Install devices plumb and level. Install receptacles with grounding pole on top.

Connect wiring device grounding terminal to branch circuit equipment grounding conductor. Use jumbo size plates for outlets installed in masonry walls. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

I. Install wall switch 48 inches above finished floor to top of handle. On position, shall be up. Install convenience receptacles 18-inches above finished floor. Install convenience receptacle 6-inches above backsplash of counter. Install dimmer switches 48 inches above finished floor to top.

J. Verify that each receptacle device is energized. Test each receptacle device for proper polarity. Test each GFCI receptacle device for proper operation.

2.6 CABINETS & ENCLOSURES

A. Cabinets shall be as follows: Boxes: Galvanized steel. Box Size: As required and/or indicated on plans. Backboard: Provide 3/4-inch thick plywood backboard for mounting terminal blocks. Paint matte white. Fronts: Steel, flush type with concealed trim clamps, door with concealed hinge, and flush lock keyed to match branch circuit panelboard. Finish with gray baked enamel. Knockouts: As required and/or indicated on plans. Provide metal barriers to form separate compartments wiring of different systems and voltages. Provide accessory feet for free-standing equipment.

B. Hinged Cover Enclosures shall be as follows: Construction: NEMA 250, Type 1, 3R, or 4 steel enclosure, as required and/or indicated on plans. Covers: Continuous hinge, held closed by flush latch operable by key or hasp and staple for padlock. Provide interior plywood panel for mounting terminal blocks and electrical components; finish with white enamel. Enclosure Finish: Manufacturer's standard enamel.

C. Install in accordance with NECA "Standard of Installation." Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner under the provisions of Section 16190. Install cabinet fronts plumb.

D. Clean electrical parts to remove conductive and harmful materials. Remove dirt and debris from enclosure. Clean finishes and touch up damage.

E. ICS 4 - Terminal blocks for industrial control equipment and systems. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts. Provide ground bus terminal block, with each connector bonded to enclosure.

F. Provide grounding provisions for all cabinets/enclosures and bond to grounding system as required per Code.

2.7 GROUNDING & BONDING

A. Ground all systems and equipment in accordance with best industry practice, the requirements of NFPA 70 and the following:
   1. The ground bus of the main switchboard shall be connected to the main grounding electrode specified below by means of insulated conductors run in conduit.
   2. The main grounding electrode shall be an accessible point on the nearest metallic main water service pipe. Connection shall be made on the street side of the main valve utilizing a ground clamp of a type specifically manufactured for the purpose. Bonding jumpers shall be provided around the water meters and around insulating joints and/or sections.

3. Establish a ground bonding connection from the effectively grounded structural building steel to each cold-water main entering the building. Each bonding connection shall consist of insulated conductors run in conduit.
4. The water pipe ground shall be supplemented by an additional electrode consisting of three (3) buried 3/4" diameter by 10’-0” long copperweld ground rods spaced 10’-0” apart, and provided in sufficient quantity so as to have measured resistance to ground of not more than 10 ohms. Provide independent certification confirming this. Establish a bonding connection from the electrode consisting of green insulated conductors run in conduit and sized as indicated hereinafter for main and supply side of service bonding jumpers.
5. Provide grounding bonds between all metallic conduits of the light and power system which enter and leave cable chambers or other non-metallic cable pulling and splicing boxes. Accomplish this by equipping the conduits with bushings of the grounding type individually cross connected.
6. Bond metallic conduits containing grounding electrode conductors and main bonding conductors to the ground bus service enclosure and/or grounding electrode at both ends of each run utilizing grounding bushings and jumpers.
7. Provide grounding bonds for all metallic conduits of the light and power system which terminate in pits below equipment for which a ground bus is specified. Accomplish this by equipping the conduits with bushings of the grounding type connected individually to the ground bus.
8. Provide supplementary ground bonding where metallic conduits terminate at metal clad equipment (or at the metal pull box of equipment) for which a ground bus is specified. Accomplish this be equipping the conduits with bushings of the grounding type connected individually by means of jumpers to the ground bus. Exclude the jumpers where directed. This exclusion will be required where an isolated ground for electronic equipment is to be maintained.
9. Each grounding type bushing shall have the maximum ground wire accommodation available in standard manufacture for the particular conduit size. Connection to bushing shall be with wire of this maximum size.
10. Bonding conductors on the load size of the service device and equipment grounding conductors shall be sized in relation to the fuses or trip size of the overcurrent device supplying the circuit.
11. The central equipment for the fire protective alarm system and telephone system shall have its grounding terminal connected to the grounding electrode by means of a No. 6 green coded insulated conductor, run in 3/4" conduit. Utilize a ground clamp of a type specifically manufactured for the purpose.
12. Install rod electrodes per this section & in compliance with Code. Install additional rod electrodes as required to achieve specified resistance to ground. Install 4/0 AWG bare copper wire in foundation footing as required. Provide isolated grounding conductor for circuits supplying personal computers as indicated on the plans. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing. Provide a 3/4” raceway with #6 AWG ground wire from main telephone terminal board to the service ground.
13. Perform inspections and tests listed in NETA ATS, Section 7.13. Document test results in Record Documents.
14. Grounding means shall never exceed 10 ohms when located outdoors, or 5 ohms when located indoors.

15. An acceptable means of grounding is to provide an underground 2" thick, concrete-encased electrode of either ½" diameter, electrically conductive reinforcing bar of #4/0 bare copper conductor (minimum of 20-feet in length) per NEC 250.52(A)(3).

2.8 EQUIPMENT WIRING SYSTEM

A. Cords & Caps: Manufacturers: Hubbel, Pass & Seymour or Arrow Hart. Attachment Plug Construction: Conform to NEMA WD 1. Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment. Cord Construction: ANSI/NFPA 70, Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

B. Motor Control Equipment: Each motor shall have a starter furnished under this Section where it is not being supplied by other sections. Wire and installed under this Section, unless otherwise noted herein or on the drawings.
   1. Connect the motor starting devices for all motors, except where otherwise specifically provided for under other sections, furnish all necessary connections between controllers and motors, in conduit and leave motors ready to start. Change connections, if necessary, to secure proper rotation of motors.
   2. Perform all the necessary wiring in connection with the motor starting and remote control equipment, where so designated, furnished under other sections. Where control or starting equipment is sent to the job as individual units, they shall be installed, wired up complete and left ready for operation under work of this section.
   3. Wiring to motor shall be in rigid conduit with watertight flexible conduit from wall to motor only.

C. Included in the general requirements for motor control equipment wiring and connections, the following specified items shall be performed:
   1. Installation and connection of motor controls which will be furnished under the heating, ventilating and air conditioning section and the plumbing section.

D. Starters by This Contractor: Where starters are not provided under other sections, this Contractor shall furnish starters for motors 1/2 HP and larger and where required by the control sequence for smaller motors and shall be magnetic across the line starters with adjustable overload protection in each phase line, all in NEMA 1 enclosures. Starters shall be solid state or acceptable substitute. Combination starters shall be with fused or non-fusible disconnect as required.
   1. Magnetic starters shall have 120 volt holding circuits, integral transformers, auxiliary contacts as required by the control sequence and integral selector switches with push-to-test pilot lights. One side of each pilot light shall be connected on the load side of the motor starter.
   2. Integral transformers shall have overload protection on the secondary section and, also, the secondary neutral shall be grounded.
   3. Starters shall be as manufactured by Square D Company or General Electric.

E. Temperature control wiring shall be by others as indicated under the heating, ventilating and air conditioning section.

F. Provide a suitable plywood backboard on a wall and/or angle iron or unistrut framework with plywood for all starters. Starters will be installed and wired under this section.

G. All starters shall be located next to the panel feeding same, if panel is in a closet or utility space, unless noted otherwise on the drawings. If panel is located in a finished space (i.e.

corridor, gymnasium, etc.) starters shall be located in nearby utility closet or space acceptable to the Engineer.

H. Nameplates: Each starter shall have a 1.0" x 2.5" hot stamped nameplate identifying the unit and panel it is fed from. The lettering shall be white 1/2" high in a black background.

I. Connections to systems: Make electrical connections in accordance with equipment manufacturer's instructions. Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations. Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes. Install disconnect switches, controllers, control stations, and control devices as indicated. Modify equipment control wiring with terminal block jumpers as indicated. Provide interconnecting conduit and wiring between devices and equipment where indicated

2.9 SUPPORTING DEVICES

A. Materials and Finishes: Provide adequate corrosion resistance. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products. Steel channel shall be galvanized.

B. Anchors and Fasteners:
   1. Concrete Structural Elements: Use precast insert system, expansion anchors.
   2. Steel Structural Elements: Use beam clamps, or welded fasteners.
   3. Concrete Surfaces: Use self-drilling anchors or expansion anchors.
   4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts or hollow wall fasteners.
   5. Solid Masonry Walls: Use expansion anchors or preset inserts.
   6. Sheet Metal: Use sheet metal screws.
   7. Wood Elements: Use wood screws.

C. Installation: Install products in accordance with manufacturer's instructions. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation". Do not fasten supports to pipes, ducts, mechanical equipment, and conduit. Do not use spring steel clips and clamps. Do not use powder-actuated anchors. Do no drill or cut structural members. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts. Install surface-mounted cabinets and panelboards with minimum of four anchors. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

2.10 ELECTRICAL IDENTIFICATION

A. Nameplates: Engraved three-layer laminated plastic, black letters on white background. Locations: Each electrical distribution and control equipment enclosure, communication cabinets. Letter Size: Use 1/8 inch letters for identifying individual equipment and loads. Use 1/4 inch letters for identifying grouped equipment and loads.

B. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use for identification of individual power receptacle faceplates indicating panel & circuit number the outlet is fed from and control device stations. In addition to nameplates as described above, use labels on all panelboards, disconnect switches and enclosed circuit breakers to identify where the equipment is fed from, voltage & phase.
C. Wire markers: Tape, or tubing type wire markers. Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection. Power and Lighting Circuits shall be marked with panel and branch circuit or feeder number as indicated on drawings. Control Circuits shall be marked with control wire number indicated on schematic and interconnection diagrams on drawings
D. Conduit markers: Corrosion and abrasion resistant. Location: Furnish markers for each conduit longer than 6 feet (2 m). Spacing: 20 foot on center. Indicate voltage and phase.
E. All panelboards shall be provided with a typed (hand written is not allowed) circuit directory indicating the load fed by each circuit breaker and it's location in the building.

2.11 TWO-WINDING TRANSFORMERS

A. Division 1 - Material and Equipment: Product Options and Substitutions.
B. Manufacturers:
   1. Square D Company.
   2. Cutler Hammer
   3. Siemens
   4. Substitutions: Under the provisions of Division 1.
C. Description: NEMA ST 20, factory-assembled, air cooled dry type transformers, ratings as indicated in schedule on plans. Transformers shall comply with NEMA TP-1, Energy Star Requirements and Department of Energy Efficiency Standards.
D. Primary Voltage: 480 volts, 3 phase unless otherwise noted on plans.
E. Secondary Voltage: 208Y/120 volts, 3 phase unless otherwise noted on plans.
F. Insulation system and average winding temperature rise for rated kVA as follows:
   1. 1-15 kVA: Class 185 with 115 degrees C rise.
   2. 16-500 kVA: Class 220 with 115 degrees C rise.
G. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.
H. Winding Taps:
   1. Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
   2. Transformers 15 kVA and Larger: NEMA ST 20.
I. Sound Levels: NEMA ST 20.
J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.
K. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
L. Mounting:
   1. 1-15 kVA: Suitable for wall mounting.
   2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
   3. Larger than 75 kVA: Suitable for floor or trapeze mounting.
M. Coil Conductors: Continuous windings with terminations brazed or welded.
N. Enclosure: NEMA ST 20, Type 1. Provide lifting eyes or brackets.
O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.
Q. Set transformer plumb and level.
R. Use flexible metal conduit, 2-feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
S. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.
T. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Provide 4” high concrete housekeeping pad for transformers.
U. Mount trapeze-mounted transformers as indicated.
V. Provide seismic restraints.
W. Provide grounding and bonding per Code.

2.12 ENCLOSED SWITCHES

A. Fusible Switch Assemblies shall be provided in accordance with the following. Description: NEMA KS 1, Type GD with externally operable handle interlocked to prevent opening front cover with switch in ON position, enclosed load interrupter knife switch. Handle lockable in OFF position. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses. Provide NEMA 3R where located outdoors, kitchens or other interior wet areas.
B. Non-fusible switch assemblies shall be provided in accordance with following. Description: NEMA KS 1, Type GD with externally operable handle interlocked to prevent opening front cover with switch in ON position enclosed load interrupter knife switch. Handle lockable in OFF position. Provide NEMA 3R where located outdoors, kitchens or other interior wet areas.
C. Install in accordance with NECA "Standard of Installation”. Install fuses in fusible disconnect switches. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

2.13 PANELBOARDS

A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.
B. Panelboard Bussing: Bus bars shall be copper. Provide copper ground bus bar in all panelboards.
C. Minimum Integrated Short Circuit Rating: 10,000 amperes RMS symmetrical for 240 volt panelboards; 65,000 amperes RMS symmetrical for 480 volt panelboards, or as indicated.
D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
E. Enclosure: NEMA PB 1, Type 1.
F. Cabinet Box: 6 inches deep, 20 inches wide for 240 volt and less panelboards, 20 inches wide for 480 volt panelboards.
G. Cabinet Front: Flush or Surface cabinet front as scheduled with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard ANSI 49 enamel.

2.14 ENCLOSED CIRCUIT BREAKERS

A. Enclosed Molded Case Circuit Breaker: Comply with NEMA AB 1. Include provisions for padlocking. Provide insulated grounding lug in each enclosure. Provide Products suitable for use as service entrance equipment where so applied. Fabricate enclosure from steel.
B. Install enclosed circuit breakers where indicated, in accordance with manufacturer's instructions. Install enclosed circuit breakers plumb. Provide supports in accordance with these specifications. Height: 5 ft (1.6 M) to operating handle. Provide engraved plastic nameplates.
C. Inspect each circuit breaker visually. Perform several mechanical ON-OFF operations on each circuit breaker. Verify circuit continuity on each pole in closed position. Determine that circuit breaker will trip on overcurrent condition, with tripping time to NEMA AB 1 requirements. Include description of testing and results in test report.

2.15 FUSES

A. All fuses shall be rated for proper voltage in which they are applied. Interrupting ratings shall be greater than the short circuit current available at the terminals of the switch.
B. Fuse types:
   1. Fuses for branch circuits shall be time delay class J.
   2. Fuses for equipment other than motor loads shall be general fast acting RK-5 or Class J.
   3. Control power transformers for motor controller circuits shall be as recommended by motor starter and motor control center manufacturer.
   4. Fuses for motors shall be sized at 250% of the motor FLA.
   5. Fuses for non-motor loads shall be sized at 125% of the rated FLA of equipment served.
   6. Fuses for elevator lifts shall be dual element type and sized in accordance with the elevator manufacturer’s recommendations.
C. Spare Fuses
   1. Provide spare fuses in the amount of 20% (not less than three (3) nor more than nine (9) of all sizes and types).
   2. Spare fuses shall include general purpose fuses, motor fuses, and control fuses used in motor control centers, starters etc.
   3. A complete list and quantity of spare fuses shall be submitted with record drawings for review.

2.16 ENCLOSED MOTOR CONTROLLERS

A. The Electrical Contractor shall review the mechanical drawings and coordinate with the Mechanical Contractor for electrical components of the mechanical equipment and systems such as motors, factory mounted motor starters, factory mounted disconnect switches, variable frequency drives and controls to be provided under Division 15 (by the Mechanical Contractor).
B. The Electrical Contractor shall provide motor starters, variable frequency drives and disconnect switches for equipment shown on the drawings where the Mechanical Contractor is not providing such equipment.
C. The electrical contractor shall provide all power wiring for all HVAC equipment.
D. Manual Motor Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller with thermal overload elements on each phase, red pilot light, NO, NC auxiliary contact, and push button or toggle operator.

E. Fractional Horsepower Manual Controller: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload elements on each phase, red pilot light, and toggle operator.
F. Motor Starting Switch: NEMA ICS 2, AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload elements on each phase, with red pilot light and toggle operator.
G. Enclosures: NEMA ICS 6; Type 1 for indoors and Type 3R for outdoors and wet/damp locations (kitchens, mechanical rooms, pool equipment rooms, etc...).
H. Automatic Magnetic Motor Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower. Reversing Controllers: Include electrical interlock and integral time delay transition between FORWARD and REVERSE rotation. Two Speed Controllers: Include integral time delay transition between FAST and SLOW speeds. Coil operating voltage: 120volts, 60 Hertz. Overload Relay: NEMA ICS; bimetal or melting alloy. Enclosure: NEMA ICS 6, Type 1 for indoors or Type 3R for outdoors and wet/damp locations (kitchens, mechanical rooms, pool equipment rooms, etc...).
I. Product Options and Features as follows. Auxiliary Contacts: NEMA ICS 2, 2 each normally open and closed contacts in addition to seal-in contact. Cover Mounted Pilot Devices: NEMA ICS 2, standard duty type. Pilot Device Contacts: NEMA ICS 2, Form Z, rated A150. Pushbuttons: Recessed type. Indicating Lights: LED type. Selector Switches: Rotary type. Relays: NEMA ICS 2. Control Power Transformers: 120 volt secondary, in each motor starter. Provide fused primary and secondary, and bond un-fused leg of secondary to enclosure.
J. Installation Requirements: Install enclosed controllers where indicated, in accordance with manufacturer's instructions. Install enclosed controllers plumb. Provide supports in accordance with these specifications. Height: 5 feet to operating handle. Install fuses in fusible switches. Select and install overload heater elements in motor controllers to match installed motor characteristics. Provide engraved plastic nameplates under these specifications. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

2.17 ENCLOSED CONTACTORS

A. General purpose contactors: NEMA ICS 2, AC general purpose magnetic contactor. Coil Voltage as indicated. Poles as indicated. Size as indicated. Enclosure per ANSI/NEMA ICS 6, Type as scheduled.
B. Lighting contactors: NEMA ICS 2, magnetic lighting contactor. Coil Voltage as indicated. Poles as indicated. Size as indicated. Contact Rating shall match branch circuit overcurrent protection, considering de-rating for continuous loads.
C. Accessories: Provide Pushbuttons and Selector Switches per NEMA ICS 2, heavy duty type. Provide indicating lights per NEMA ICS 2, push-to-test type. Provide auxiliary contacts per NEMA ICS 2, Class A300 or A600 as required per equipment served.

2.18 INTERIOR LUMINAIRES

A. Lighting fixtures shall be in accordance with identifications as follows:
B. All lamping shall be of the highest quality available.
C. Finishes shall be as selected by the Architect or as indicated on the plans.
D. Any additional appurtenances required for installation and operation, where same are not covered by the identification used on the drawings, shall be included. Lighting fixtures and

equipment shall be furnished complete, wired and assembled, including canopies, lamps and other incidental items. Install specified lamps in each luminaire.

E. Recessed fixtures shall be coordinated with ceiling construction by the Electrical Contractor prior to Bid. Refer to the Architect's plans, details and elevations for ceiling types by area. Provide plaster trim kits as required by ceiling construction.

F. Exact location of all fixtures shall be confirmed with Architect prior to rough-in. Install surface mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.

G. Recessed fixtures throughout shall have their components, wiring and external connections coordinated for use in ceilings utilized as air handling plenums. Install recessed luminaires to permit removal from below. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating. Install clips to secure recessed grid-supported luminaires in place

H. Fixtures for use outdoors or in areas designated as damp locations, shall be suitably gasketed and UL listed for such applications.

I. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire

J. Emergency batteries for exterior fixtures shall be remote mounted within the building. Verify maximum distances for remote mounting the emergency batteries with the manufacturer prior to installation. Locate remote emergency batteries above accessible ceilings or utility rooms as required. Provide test switches for all emergency batteries as required.

K. Unless noted otherwise, all fixtures shall be 3500K and have a minimum CRI of 85.

L. The Contractor shall obtain all information relative to the exact type of hung ceilings and suspension systems to be installed before ordering any recessed fixtures. This Contractor shall furnish the proper type fixtures applicable to the ceiling framing system. If, other than the type of fixtures specified are required for installation due to the type of ceiling construction, this Contractor shall furnish and install the proper type fixtures and mounting appurtenances required at no extra charge.

M. The Contractor shall coordinate the exact locations of all lighting fixtures with the ceiling pattern during the construction period and before installation of the fixtures. Interferences between lighting fixtures, and other equipment, shall be brought to the attention of the General Contractor.

N. Include the aiming and/or adjustments of all lighting fixtures requiring same in accordance with instructions issued by the Architect in the field. Aim and adjust luminaries as indicated or as directed by the Owner, Architect or Engineer. Position exit sign directional arrows as indicated. Operate each luminaire after installation and connection. Ensure proper connection and operation.

O. Lighting fixtures shall be supported from building structure only, not from hung or suspended ceiling, by means of chains or threaded rods. The use of tie wire will not be allowed. All fixtures shall include seismic clips and shall be supported to comply with seismic regulations. Install suspended luminaires using pendants supported from swivel hangers or other suitable leveling means. All rows of fixtures shall be level, aligned with building lines and run parallel to each other. Provide pendant length required to suspend luminaires at indicated height. Support luminaires to building structure, independent of ceiling framing.

2.19 FIRE ALARM SYSTEM

A. GENERAL

1. The contractor shall submit complete documentation for the Fire Alarm/Life Safety System Data Sheets for all items to ensure compliance with these specifications. Copies of this information shall be submitted as required to the Architect award of this work and shall be subject to the approval of the architect.
2. The contractor shall submit, as part of the complete bid documentation package, certification that the engineered system distributor is a fully authorized factory trained and certified distributor of the system detailed within this specification.
3. All equipment and material shall be new and unused, and listed by Underwriter's Laboratories for the specific intended purpose. All control panel components, field peripherals and interactive computer peripherals shall be designed for continuous duty operation without degradation of function or performance.
4. All equipment covered by this specification or noted on installation drawings shall be the best equipment suited for the application and shall be provided by a single manufacturer.
5. Provide all equipment and accessories and compatible devices for a complete and fully functioning fire alarm system. The fire alarm system shall be coordinated with and inspected by the local fire department, and any inconsistency mentioned during any inspection shall be corrected by contractor at no additional cost to owner.
6. The control panel shall contain a microprocessor with 10/100 ethernet media access controller (MAC). The system shall be designed specifically for fire detection, and notification applications.
7. The installing contractor shall coordinate master-box, radio-box, and/or dialer requirements with local fire department.

B. FIRE ALARM LIFE SAFETY SYSTEM SEQUENCE OF OPERATION

1. The operation of a manual station or activation of any automatic alarm initiating device (system smoke, heat, waterflow) shall automatically:
   a. Initiate the transmission of the alarm to the Municipal Fire Station or approved Central Station via the Local Energy or Radio Master-box.
   b. Sound a code 3 temporal evacuation signal over all audio circuits, except in designated areas of assembly. In designated areas of assembly (sound a pre-recorded voice message) and/or conduct manual voice evacuation from the system microphone(s) located at the FACP or remote location(s) in accordance with the local requirements.
   c. Flash all visual signals throughout the building in a synchronized manner.
   d. Flash an alarm LED and sound an audible signal at the FACP. Upon acknowledgement, the alarm LED shall light steadily and the audible shall silence. Subsequent alarms shall re-initiate this sequence.
   e. Upon alarm initiation by an elevator lobby smoke detector or other designated recall device, recall all elevators that serve the floor of initialization to the main egress level. If the alarm initiates on the main egress level, return the elevator to the alternate floor as directed by the local authority having jurisdiction.
   f. Visually indicate the alarm initiating device type and location via the LCD display located at the FACP (and at any remote annunciators) and (illuminate the appropriate alarm zone LED at the remote annunciator).
   g. Automatically shut down or control HVAC equipment to initiate smoke control functions as required. Manual override controls and programmable relay interface shall serve as an interface to the Building Automation System.
   h. Operate prioritized outputs to release all magnetically held smoke doors and magnetically locked doors throughout the building.
   i. Activate the exterior weatherproof beacon.

C. WIRING

1. Provide in accordance with manufacturer's instructions all wiring, conduit and outlet boxes required for the installation of complete system as described herein and as shown on the drawings. Wiring shall be Class A.
2. Installation and fire alarm system wiring shall be installed in metal raceway. An equipment bonding conductor shall be provided in all flexible metallic raceways.
3. Color code for fire alarm systems shall be per the State Fire Alarm code.
4. DC supply to the main fire alarm panel shall be white and black. Fire alarm primary power source shall be on dedicated branch circuit. Circuit breaker locks shall be used. If a separate feed is required for the battery charger it shall be black and white unless the main fire alarm panel required only AC feed. In this case the conductors to the battery charger shall be red and white and shall be on a circuit breaker of fits own.
5. Conductors shall be minimum #14-gauge solid copper type THHN/THWN. Conductor's size shall be increased as required to maintain voltage drop to a maximum of 3%. All AC and DC portions of the system shall be installed in separate raceway. Addressable loop wiring may be #16 providing manufacturer's recommended distance is observed. Systems requiring shielded wiring for addressable loops shall not be acceptable.
6. Red painted terminal cabinets with hinged local covers shall be provided at all junction points. All conductor splices shall be made on screw type terminal blocks, wire nuts shall not be used. All terminals within terminal cabinet shall be properly labeled. Provide terminal cabinet at each building cable entrance and at other locations as required.
7. All fire alarm initiating zone and signal wiring shall be wired Class A.
8. Final connections between the equipment and the wiring system shall be made under the direct supervision of a representative of the manufacturer.
9. Upon completion of the installation of fire alarm equipment, the electrical contractor shall provide to the engineer a signed statement substantially in the form as follows:
   a. The undersigned having been engaged as the electrical contractor on this project confirms the fire alarm equipment was installed in accordance with the specifications and in accordance with wiring diagrams, instructions, and directions provided to us by the manufacturer.

D. GUARANTEE AND FINAL TEST
1. All testing (pre-testing, final testing, quarterly testing and program change testing) to be coordinated with the owner and scheduled in advance so that owners and personnel can be present during testing. Contractor to certify that all tests comply with the "State Fire Code", latest edition.
2. Before this installation shall be considered complete and acceptable to the awarding authorities, a complete test on the system shall be performed as follows:
   a. A pre-test will be held by the electrical contractor with the manufacturer's authorized representative present. After certification of a complete pre-test, the installing contractor shall inform the authority having jurisdiction of the outcome of the test and will re-inspect in the presence of the authority having jurisdiction and the manufacturer's authorized representative.
   b. Final test: The electrical contractor in the presence of authorized representative of the manufacturer and the fire department shall operate every manual station, smoke detector, and thermodetector. Each station/detector circuit and horn circuit shall be opened in at least two locations to check for the presence of correct supervisory circuitry. When this testing ahs been completed to the satisfaction of both the electrical contractor's job foreman and the representative of the manufacturer, a letter from the contractor cosigned by the manufacturer attesting t the satisfactory completion of said testing, shall be forwarded to the owner.

3. The electrical contractor shall guarantee all equipment and wiring to be free from inherent mechanical and electrical defects for a period of one year from the date of final acceptance.
4. The contractor shall provide the Owner with a formal written equipment guarantee upon completion of the installation and testing of the system. The guarantee period shall begin on the day of acceptance of the system by the Owner and shall provide for a period of one year. This guarantee shall be indicated in the manufacturer's submission prior to approval. This guarantee shall be as normal policy by the equipment manufacturer.
5. The manufacturer shall maintain a full-time service and parts facility, with seven days per week, 24 hour per day service available.
6. All service technicians shall be licensed by the State Fire Code covering service and maintenance of systems.
7. Include as part of the contract, the four quarterly tests following the final acceptance test. Provide quarterly testing in conformance with the State Fire Code latest addition.

2.20 DATA

A. The Electrical Contractor shall provide and install the data outlets and wiring per the Owner's specifications and direction per data outlet and wiring as shown on the plans. Each data connection shall include the following:
   1. Data outlet installed flush in the wall unless otherwise required by the site conditions and approved by the Owner. The outlet shall include faceplate, ID label, inserts, jacks and all other required accessories for a complete installation.
   2. Wiring consisting of Category 6, 24AWG, copper cabling installed from outlet to patch panel. All wiring shall be installed concealed in finished & public spaces unless otherwise required by the site conditions and approved by the Owner. shall be used from the outlet to an accessible ceiling. In unfinished or utility spaces, the data cabling shall be installed in EMT conduit where not concealed. Accessible above ceiling installations shall use J-hooks unless cable tray is used. Use plenum rated cable where installed in plenum return spaces per the Mechanical Contractors direction prior to bid.
   3. Patch panel and outlet terminations. Provide identification labels at each end of the cable per the Owners requirements. Coordinate with Owner for nomenclature.
   4. Test each cable for signal strength per EIA/TIA standards and record all results to be submitted to the Owner. All defective cable and/or termination shall be replaced at no cost to the Owner.
B. Provide patch panel(s) to accommodate each outlet plus 10% spare. Provide rack(s) to accommodate each patch panel.
C. Provide a copper ground bar (1/4" thick x 4" high x 36" long) with wall mounting brackets, insulators and a #6AWG copper exothermically welded pigtail in each telephone / data closet, server room and/or IDF closet. Connect pig tail to building steel or electrical service grounding system.
D. Servers, switches, routers and active electronic equipment by Owner.

2.21 TELEPHONE

A. Provide incoming telephone service raceways and cable as indicated on Drawings or as required by the serving telephone company. Provide 8' x 8' x ¾" plywood board (and one double duplex outlet) on wall for telephone equipment. Provide 3/4-inch thick plywood board, fire-retardant-treated and stamped FRT, securely anchored to the wall.
B. The Electrical Contractor shall provide and install the telephone outlets and wiring per the Owner's specifications and direction as shown on the plans. Each telephone connection shall include the following:
   1. Telephone outlet installed flush in the wall unless otherwise required by the site conditions and approved by the Owner. The outlet shall include faceplate, ID label, inserts, jacks and all other required accessories for a complete installation.
   2. Wiring consisting of Category 6, 24AWG, copper cabling installed from outlet to patch panel. All wiring shall be installed concealed in finished & public spaces unless otherwise required by the site conditions and approved by the Owner. shall be used from the outlet to an accessible ceiling. In unfinished or utility spaces, the data cabling shall be installed in EMT conduit where not concealed. Accessible above ceiling installations shall use J-hooks unless cable tray is used. Use plenum rated cable where installed in plenum return spaces per the Mechanical Contractors direction prior to bid.
   3. Telephone terminal board or PBX (private branch exchange) equipment and outlet terminations. Provide identification labels at each end of the cable per the Owners requirements. Coordinate with Owner for nomenclature.
   4. Test each cable for signal strength per EIA/TIA standards and record all results to be submitted to the Owner. All defective cable and/or termination shall be replaced at no cost to the Owner.
C. Provide a copper ground bar (1/4" thick x 4" high x 36" long) with wall mounting brackets, insulators and a #6AWG copper exothermically welded pigtail in each telephone room and telephone terminal board. Connect pig tail to building steel or electrical service grounding system per the telephone company's requirements.
D. PBX (private branch exchange) equipment by Owner.

2.22 CABLE TELEVISION

A. Provide incoming cable television service raceways and cable as indicated on Drawings or as required by the serving cable television company. Provide 8' x 8' x ¾" plywood board (and one double duplex outlet) on wall for cable equipment. Provide 3/4-inch thick plywood board, fire-retardant-treated and stamped FRT, securely anchored to the wall. Provide flush mounted CATV outlets with 3/4-inch EMT conduit concealed from outlet box to cable terminal board. Leave a pull string in all empty conduits.
B. Provide a copper ground bar (1/4" thick x 4" high x 36" long) with wall mounting brackets, insulators and a #6AWG copper exothermically welded pigtail in each CATV terminal room and main CATV terminal board. Connect pig tail to building steel or electrical service grounding system per the CATV utility company's requirements.
C. The Electrical Contractor shall provide and install the CATV outlets and wiring per the Owner's specifications and direction as shown on the plans. The allowance for each CATV connection shall include the following:
   1. CATV outlet installed flush in the wall unless otherwise required by the site conditions and approved by the Owner. The outlet shall include faceplate, ID label, inserts, jacks and all other required accessories for a complete installation.

2. Wiring consisting of coaxial copper cabling per the CATV utility company's requirements installed from outlet to terminal board. All wiring shall be installed concealed in finished & public spaces unless otherwise required by the site conditions and approved by the Owner. be used from the outlet to an accessible ceiling. In unfinished or utility spaces, the data cabling shall be installed in EMT conduit where not concealed. Accessible above ceiling installations shall use J-hooks unless cable tray is used. Use plenum rated cable where installed in plenum return spaces per the Mechanical Contractors direction prior to bid. The length of cable to be used for the allowance shall be based on 100'-0".
3. CATV terminal board and outlet terminations. Provide identification labels at each end of the cable per the Owners requirements. Coordinate with Owner for nomenclature.
4. Test each cable for signal strength per CATV utility company's requirements and record all results to be submitted to the Owner. All defective cable and/or termination shall be replaced at no cost to the Owner.

2.23 ENGINE GENERATOR SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide diesel generator set of one of the following:
   1. Caterpillar
   2. Generac
   3. Kholer
B. Furnish and install one (1) standby electric generating system rated for continuous standby service as shown on the Drawings. Voltage shall be 480Y/277 volts, 3 phase, 4 wire at 60 hertz. The system shall be a package of new and current equipment consisting of:
   1. A four (4) cycle diesel engine driven electric plant to provide emergency electric power.
   2. Start-stop control system.
   3. Automatic and manual load transfer controls to provide automatic starting and stopping of the unit and switching of the loads.
   4. Mounted accessories as specified.
   5. Remote annunciator panel.
   6. Generator housekeeping concrete pad.
   7. Exhaust system and insulation.
   8. Sub-base fuel storage system and piping.
C. This system shall be built, tested and shipped by the manufacturer and by the alternator so there is one source of supply and responsibility. The performance of the electric plant shall be certified by an independent testing laboratory as to the plant's full power rating, stability and voltage and frequency regulation. Submit certificate of compliance with shop drawings. Furnish detailed summary of testing of unit of this rating in accordance with NFPA-110T.
D. The supplier of this equipment shall maintain a full-time "in-house" parts and service organization within 100 miles of the job site. The manufacturer of this set shall have a minimum of five (5) years of experience in building similar units in this part of this country. This supplier shall have his name, address, and telephone number clearly and visibly located on all equipment. Service shall be available on a 24-hour a day, 7-day a week basis. The supplier shall be authorized by the engine generator manufacturer to provide service and warranty for all generator components.
E. Enclosed with each submittal set shall be the following information:
   1. Unit drawings of all major components showing exact dimension data.

2. Catalog information on the engine, generator, battery charger, vibration isolators, exhaust silencer, flexible exhaust connector, automatic transfer switch.
3. A complete bill of material indicating exactly what is to be provided.
4. A list of at least two (2) similar installation using the same major components as specified herein.
5. Estimated time, in calendar days, for delivery after approval and release is received.
6. Furnish engine heat rejection data to jacket water, exhaust, and ambient and total DB measurement of engine, generator, and radiator measured at 23 feet. Mechanical noise shall not exceed 88 DBA at 23 feet and exhaust noise shall not exceed 94 DBA at 23 feet before the exhaust silencer. Exhaust flow shall not exceed 2500 CFM.

F. Any notation marked on submission of the equipment is outlined in this section by reviewing authority must be responded to in writing, by the equipment manufacturer.

G. Complete engineering submittal, catalog cuts, wiring diagrams, interface drawings, unit drawings, A.C. & D.C. schematics, termination chamber drawings, terminal strip drawings, foundation plan, annunciator panel layout and wiring, etc. must accommodate all shop drawings.

H. This Specification is for furnishing and installing one (1) diesel fueled engine driven generating set rated for continuous standby service 60KW rating. The KW rating shall be continuously available during any power outage whether the duration is minutes, hours, or days. The unit shall be complete with all accessories, controls, attachments, fuel and exhaust systems. Rating shall be with engine driven radiator fan attached regardless of cooling system specified herein.

I. The operation of this unit shall be automatic such that upon the closing of a remote starting contact, the engine shall start and attain rated voltage and frequency within ten (10) seconds.

J. All necessary accessories shall be provided to assure starting within the time described above under the ambient conditions described herein.

K. The diesel engine shall be water-cooled, 4 cycle industrial type with removable cylinder liners, 1800 rpm type. Other than 1800 rpm type engines or engines which utilize reduction from a higher rpm down to 1800 rpm shall not be approved.

L. Lubrication shall be a full pressure system, using an engine-driven gear-type lube oil pump with replaceable element full flow lube oil filter. Lube oil cooler shall be provided.

M. The engine-mounted fuel system shall include all equipment normally supplied and recommended by the generator set manufactured for emergency generator service.

N. In addition to the engine-mounted fuel system, there shall be a sub-base fuel tank system.
   1. The fuel tank system shall be a 1500 gallon UL listed tank, pressure tested, double walled, trim line construction, sub-base fuel tank. All piping and venting shall be completed by the housing manufacturer prior to shipment. Tank system shall comply with all State and Local Codes. Provide one (1) full tank of fuel after testing at the completion of the project for each generator.

O. Governor: The engine shall be equipped with a hydraulic/electronic isochronous governor capable of maintaining the engine speed from no load to full load within plus or minus .25% of the synchronous speed.

P. Starting System: The engine shall have a 24 VDC starting system with starting motor and starter solenoid switch.

Q. Batteries: One (1) set of starting batteries with cables and steel battery rack and heater shall be included for each starter. Batteries shall be sized for operation at -20° F.
   1. Batteries shall be heavy-duty lead acid type, rated not less than 210 ampere hours each.
   2. A float type battery charger shall maintain the starting batteries at full charge. The charger shall be suitable for wall-mounting and shall have a cranking disconnect relay or current

limiting feature. The charger shall be Charles AE2420, Lamarche A46 or equal. The charger shall have high and low voltage alarm relays, and have 20 amp outlet.

3. There shall be a belt-driven battery charging alternator with regulator and charge rate ammeter for charging the batteries while the engine is running.

R. Engine jacket water heaters and thermostats shall be provided to maintain the engine jacket water at a temperature high enough to assure starting the engine and attaining rated voltage and frequency within 10 seconds. The jacket heaters shall be of the capacity recommended by the engine generator manufacturer to meet above conditions. Input voltage to the heaters shall be 208 volts, 1 phase, 60 cycles.

S. Battery heater shall be thermostatically controlled and shall keep battery at optimum temperature for both operation and battery life.

T. Engine Cooling System:

1. Engine shall be provided with 130° F ambient unit mounted radiator. Radiator shall have sufficient capacity to dissipate not less than total British thermal units per hour rejected at 100% full-load under the condition specified. Filler cap shall be designed for pressure relief.
2. Cooling system shall be provided with initial charge of permanent type anti-freeze solution containing rust inhibitor.
3. Water-cooled manifold shall be furnished.

U. The engine shall be equipped with safety shutdown contacts for:

1. Low lube oil pressure, prewarn and shutdown.
2. High jacket water temperature, prewarn and shutdown.
3. Overspeed.
4. Overcrank.
5. Low water level, prewarn.
6. Low water temperature, prewarn.

V. The following manufacturer recommended electrical instruments and devices shall be included in the generator control panel.

W. The following engine instruments shall be included in the generator control panel:

1. Lube oil pressure.
2. Water temperature.
3. D.C. voltmeter.
4. Tachometer.
5. Any other instruments and devices considered necessary by the Manufacturer shall be included.

X. An exhaust silencer suitable for critical type silencing (complete with condensate drains) shall be supplied of the size recommended by the generator set manufacturer. Silencer shall be equal to Maxim Model M51. An octave band center frequency, in hertz, data sheet shall accompany all muffler shop drawings. Silencer shall include side inlet and companion flanges, nuts, boxes, and gaskets.

Y. A section of seamless, flexible stainless steel exhaust piping of the size and type recommended by the generator set manufacturer.

Z. The engine and generator shall be close-coupled and mounted on a structural steel base designed to maintain proper alignment of the unit.

AA. The unit shall be certified by the manufacturer to be free from any critical torsional vibrations within a range of plus or minus 10% of synchronous speed.

BB. Vibration isolators of spring type shall be supplied with the unit. The number of isolators shall be as recommended by the generator set manufacturer, and shall be mounted within the enclosure.

CC. Rating as shown on the drawings and with the following characteristics:
1. Type-revolving field, 4 pole, single-bearing, drip proof, 93% efficiency at nameplate rating.
2. Exciter: Brushless, direct connected, fully tropicalized, SCR rectifiers, static voltage regulator, rheostat, excellent motor starting capability.
3. Voltage Regulation: Plus or minus 1/2% of any preset valve over the 3 phase load range. Instantaneous voltage dip or rise when measured with an oscilloscope, will not exceed 20% upon full load application, and will return to preset valve within 0.5 seconds. Voltage regulator shall be 3 phase sensing, provide volts/hertz regulation, provide over-voltage and under-voltage protection, and shall include a solid state circuit to remove excitation when generator is overloaded for more than 10 seconds.
4. Waveform: Deviation factor of output voltage will not exceed 5% and the valve of any individual harmonic will not exceed 2% of the fundamental when operating with an unbalanced load.
5. Temperature Rise: Temperature rise of any component will not exceed the rise permitted by NEMA standards.
6. Rotor: One-piece lamination welded and secured to shaft by a key and press fit. Amortisseur windings installed and connected between poles as an acid to parallel operation and improve wave form during unbalanced loads. Field coil machine wound on insulated pole body and securely braced. Rotor statically and dynamically balanced.
7. Stator: One-piece lamination welded together. Stator coils from wound and place in insulated slots. Starter pressed and welded in a rigid steel frame.
8. Bearing: Double-sealed ball bearing, lubricated for life.
9. Insulation: NEMA Class F insulation.
10. Varnish: Three (3) coats modified polyester type, will not support fungus growth.
11. Cooling: Cast aluminum fan mounted on generator shaft.

DD. The engine generator shall be supplied with a flush mount remote annunciator panel with faceplate mounted to annunciation terminal strip to give remote indication of the running characteristics of the generator.

EE. The entire generator set shall be enclosed in a weatherproof enclosure constructed of aluminum throughout. The housing shall be designed to accommodate heavy snowloads and shall be equipped with motorized intake and exhaust louvers, prewired prior to shipment. Housing shall be Pritchard Brown #9930 and shall be constructed per BOCA requirements and certified by a Structural Engineer registered in the State where the job is being constructed.

FF. Housing shall have five (5) hinged, lockable, keyed alike doors with stainless steel hardware. The doors shall be so arranged as to provide access to vital parts of the generator set for service. Oil pan well and oil drain extension shall be included. Coolant drain and oil drain shall be extended outside housing with lockable rustproof valves.

GG. Housing shall be prepainted with aluminum exterior, finish as selected by the Architect at the time of submission. Interior shall be anodized aluminum. Floor of enclosure shall be 3/16” diamond plate backed by 3/4" plywood for rigidity.

HH. Housing shall include sound attenuation with thickness and type of sound insulation and intake and exhaust baffles necessary to achieve a sound level of 70 dB at 50-‘0” in any direction. There shall be no puretone. Walls and ceiling shall be lined with perforated aluminum liner. Intake louvers shall be located on opposite sides of enclosure. Complete exhaust system shall be furnished, installed/insulated and mounted within the housing, by Housing Manufacturer prior to shipment.

II. Housing shall be equipped with indoor/outdoor, LED fixtures with lamps and on/off switch to operate on normal power or generator power and a DC lighting unit to operate on generator battery. DC lights shall have time switch.
JJ. Housing shall be completely wired prior to shipment including circuit breaker panelboard and stepdown transformers, wired to battery charger, jacket water heaters and lighting. Service shall be 120/208V, 3 phase, 4 wire, 60 amp (minimum).
KK. Diesel fuel base tank shall be mounted beneath enclosure and pre-piped and vented in accordance with UL prior to shipment.
LL. Submit detailed generator pad requirements with Shop Drawings. Refer to plans for minimum requirements.

2.24 AUTOMATIC TRANSFER SWITCH

A. Furnish the automatic transfer switches to automatically transfer between the normal and emergency power source.
B. The automatic transfer switches covered by these specifications shall be designed, tested, and assembled in strict accordance with all applicable standards of ANSI, U.L. IEEE and NEMA.
C. The automatic transfer switch shall be furnished as shown on the drawings. Voltage and continuous current ratings and number of poles shall be as shown.
D. On 3 phase, 4 wire systems, utilizing ground fault protection, a true 4 pole switch shall be supplied with all 4 poles mounted on a common shaft. The continuous current rating and the closing and withstand rating of the 4th pole shall be identical to the rating of the main poles.
E. The transfer switch shall be mounted in a NEMA 1 enclosure, unless otherwise indicated. Enclosures shall be fabricated from 12 gauge steel. The enclosure shall be sized to exceed minimum wire bending space required by UL 1008.
F. The transfer switch shall be equipped with an internal welded steel pocket, housing an operations and maintenance manual.
G. The transfer switch shall be top and bottom accessible.
H. The main contacts shall be capable of being replaced without removing the main power cables.
I. The main contacts shall be visible for inspection without any major disassembly of the transfer switch.
J. All bolted bus connections shall have Belleville compression type washers.
K. When a solid neutral is required, a fully rated bus bar with required AL-CU neutral lugs shall be provided.
L. Control components and wiring shall be front accessible. All control wires shall be multiconductor 18 gauge 600 volt SIS switchboard type point to point harness. All control wire terminations shall be identified with tubular sleeve-type markers.
M. The switch shall be equipped with 90° C rated copper/aluminum solderless mechanical type lugs.
N. The complete transfer switch assembly shall be factory tested to ensure proper operation and compliance with the specification requirements. A copy of the factory test report shall be available upon request.
O. The transfer switch shall be double throw, actuated by two (2) electric operators momentarily energized, and connected to the transfer mechanism by a simple over center type linkage. Minimum transfer time shall be 400 milliseconds.

P. The normal and emergency contacts shall be positively interlocked mechanically and electrically to prevent simultaneous closing. Main contacts shall be mechanically locked in both the normal and emergency positions without the use of hooks, latches, magnets, or springs, and shall be silver-tungston alloy. Separate arcing contacts with magnetic blowouts shall be provided on all transfer switches. Interlocked, molded case circuit breakers or contactors are not acceptable.
Q. The transfer switch shall be equipped with a safe manual operator, designed to prevent injury to operating personnel. The manual operator shall provide the same contact-to- contact transfer speed as the electrical operator to prevent a flashover from switching the main contacts slowly. The manual operator shall be safety operated from outside of the transfer switch enclosure while the enclosure door is closed.
R. The transfer switch shall be equipped with a microprocessor based control system, to provide all the operational functions of the automatic transfer switch. The controller shall have a real time clock with Nicad battery backup.
S. The CPU shall be equipped with self-diagnostics with a watchdog/power fail circuit.
   1. The controller shall have password protection required to limit access to qualified and authorized personnel.
   2. The controller shall include a 20 character, LCD display, with a keypad, which allows access to the system.
   3. The controller shall include 3 phase over/under voltage, over/under frequency, phase sequence detection and phase differential monitoring on both normal and emergency sources.
T. The controller shall be capable to storing the following records in memory for access either locally or remotely:
   1. Number of hours transfer switch is in the emergency position (total since record reset).
   2. Number of hours emergency power is available (total since record reset)
   3. Total transfer in either direction (total since record reset).
   4. Date, time, and description of the last four (4) source failures.
   5. Date of the last exercise period.
   6. Date of record reset.
U. Sequence of Operation:
   1. When the voltage on any phase of the normal source drops below 80% or increases to 120%, or frequency drops below 90%, or increases to 110%, or 20% voltage differential between phases occurs, after a programmable time delay period of 0-9999 seconds factory set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.
   2. The transfer switch shall transfer to emergency when the generating plant has reached specified voltage and frequency on all phases.
   3. After restoration of normal power on all phases to a preset value of at least 90% to 110% of rated voltage, and at least 95% to 105% of rated frequency, and voltage differential is below 20%, an adjustable time delay period of 0-9999 seconds (factory set at 300 seconds) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.
   4. After retransfer to normal, the engine generator shall be allowed to operate at no load for a programmable period of 0-9999 seconds, factory set at 300 seconds.
V. Automatic Transfer Switch Accessories:
   1. Programmable 3 phase sensing of the normal source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout at 110% of rated

voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.

2. Programmable 3 phase sensing of the emergency source set to pickup at 90% and dropout at 80% of rated voltage and overvoltage to pickup at 120% and dropout at 110% of rated voltage. Programmable frequency pickup at 95% and dropout at 90% and over frequency to pickup at 110% and dropout at 105% of rated frequency. Programmable voltage differential between phases, set at 20%, and phase sequence monitoring.
3. Time delay for override of momentary normal source power outages (delays engine start signal and transfer switch operation). Programmable 0-9999 seconds. Factory set at 3 seconds.
4. Time delay to control contact transition time on transfer to either source. Programmable 0-9999 seconds, factory set at 3 seconds.
5. A maintained type load test switch shall be included to simulate a normal power failure, keypad initiated.
6. A remote type load test switch shall be included to simulate a normal power failure, remote switch initiated.
7. A time delay bypass on retransfer to normal shall be included. Keypad initiated.
8. Contact, rated 10 amps 30 volts DC, to close on failure of normal source to initiate engine starting.
9. Contact, rated 10 amps 30 volts DC, to open on failure of normal source for customer functions.
10. A plant exerciser shall be provided within ten (10) 7-day events, programmable for any day of the week and 24 calendar events, programmable for any month/day, to automatically exercise generating plant programmable in 1 minute increments. Also, include selection of either “no load” (switch will <u>not</u> transfer) or “load” (switch will transfer) exercise period. Keypad initiated.
11. Two (2) auxiliary contacts rated 10 amp, 120 volts AC shall be mounted on the main shaft, one (1) closed on normal and the other closed on emergency. Both contacts will be wired to a terminal strip for each of customer connections.
12. A 3-phase digital LCD voltage readout, with 1% accuracy shall display all three separate phase to phase voltages simultaneously, for both the normal and emergency source.
13. A digital LCD frequency readout with 1% accuracy shall display frequency for both normal and emergency source.
14. An LCD readout shall display normal source and emergency source availability.

W. As a condition of approval, the manufacturer of the automatic transfer switches shall verify that their switches are listed by Underwriters Laboratories, Inc., Standard UL-1008 with 3-cycle short circuit closing and withstand as follows:
   1. 65k RMS Symmetrical Amperes 480 VAC.

X. The transfer switch manufacturer shall employ a nationwide factory-direct, field service organization, available on a 24-hour a day, 365 days a year, call basis.

Y. The manufacturer shall include an 800 telephone number, for field service contact, affixed to each enclosure.

Z. The manufacturer shall maintain records of each transfer switch, by serial number, for a minimum of 20 years.

PART 3 – EXECUTION

3.1 <u>BASIC REQUIREMENTS</u>

A. Adhere to best industry practice and the following:
   1. All work shall be concealed.
   2. Route circuitry runs embedded in concrete to coordinate with structural requirements.
   3. Equip each raceway intended for the future installation of wire or cable with a nylon pulling cord 3/16" in diameter and clearly identify both ends of the raceway.
   4. Provide all outlet boxes, junction boxes, and pull boxes for proper wire pulling and device installation. Include those omitted from the drawings due to symbolic methods of notation.
   5. Utilize lugs of the limited type to make connections at both ends of cables installed on the line side of main service overcurrent and switching devices. Provide cable limiters for each end of each service entrance cable.
   6. Beyond the termination of raceways, fireproof the following:
      a. All wires and cables within pad-mounted transformer enclosure.
      b. All service feeder cables ahead of main service overcurrent protection devices, and elsewhere where not in raceways.
   7. Fireproofing of wires and cables shall be by means of a half-lapped layer of arcproof or by means of sleeving of a type specifically manufactured for the purpose. Ends of tape or sleeving shall be severed with twine. Fireproofing shall be extended up into raceways. After conductors have been finally shaped into their permanent configuration, fireproofing tape or sleeving shall be coated with silicate of soda (water glass). Fireproofing shall be applied in an overall manner to raceway groupings of conductors.
   8. Provide all sleeves through fireproof and waterproof slabs, walls, etc., required for electric work.
   9. Provide waterproof sealing for the sleeves through waterproof slabs, walls, etc.
   10. Provide fireproof sealing for the sleeves through fireproof walls, slabs, etc.
   11. Provide fireproof sealing for the openings in fireproof walls, slabs, etc., resulting from removal of existing electrical sleeves, conduits, poke-thru's etc.
   12. No splicing of wires will be permitted in the Fire Alarm System.
   13. Bundle wiring passing through pull boxes and panelboards in a neat and orderly manner with plastic cable ties. Cable ties shall be by Ty-Raps as manufactured by Thomas & Betts, Holub Industries Inc., Quick Wrap, Bundy Unirap, or equal.
   14. Turn branch circuits and auxiliary system wiring out of wiring gutters at 90 degrees to circuit breakers and terminal lugs.

3.2 TESTING REQUIREMENTS & INSTRUCTIONS

A. Where any repairs, modifications, adjustments, tests or checks are to be made, the Contractor shall contact the Engineer to determine if the work should be performed by or with the Manufacturer's Representative.
B. Tests are to:
   1. Provide initial equipment/system acceptance.
   2. Provide recorded data for future routine maintenance and trouble-shooting.
   3. Provide assurance that each system component is installed satisfactorily and can be expected to perform, and continue to perform its specified function with reasonable reliability throughout the life of the facility.
C. At any stage of construction and when observed, any electrical equipment or system determined to be damaged, or faulty, is to be reported to the Engineer. Corrective action by the Contractor requires prior Engineer approval, retesting, and inspection.

D. When the electrical tests and inspections specified or required within Division 16 are completed and results reported, reviewed, and approved by the Engineer, the Contractor may consider that portion of the electrical equipment system or installation electrically complete. The Contractor will then affix appropriate, approved, and dated completion or calibration labels to the tested equipment and notify the Engineer of electrical completion. If the Engineer finds completed work unacceptable, he will notify the Contractor in writing of the unfinished or deficient work, with the reason for his rejection, to be corrected by the Contractor. The Contractor will notify the Engineer in writing when exceptions have been corrected. The Contractor will prepare a "Notification or Substantial Electrical Completion" for approval by the Engineer following Engineer's acceptance of electrical completion. If later in-service operation or further testing identified problems attributable to the Contractor, these will be corrected by the Contractor, at no additional cost to the Authority.

E. Grounding Systems:
   1. Test main building loops and major equipment grounds to remote earth, directly referenced to an extremely low resistance (approximately 1 ohm) reference ground benchmark. Perform a visual inspection of the systems, raceway and equipment grounds to determine the adequacy and integrity of the grounding. Ground testing results shall be recorded, witnesses, and submitted to the Engineer.
   2. Perform ground tests using a low resistance, null-balance type ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.
   3. Test each ground rod and measure ground resistance. If resistance is not 10 ohms or less, drive additional rods to obtain a resistance of 10 ohms or less. Submit tabulation of results to Engineer. Include identification of electrode, date of reading and ground resistance valve in the test reports.
   4. Test each building and major equipment grounding system for continuity of connections and for resistance. Ground resistance of conduits, equipment cases, and supporting frames, shall not exceed 5 ohms to ground. Submit all readings to the Engineer.
   5. Where ground test results identify the need for additional grounding conductors or rods that are not indicated or specified, design changes will be initiated to obtain the acceptable values. The Contractor is responsible for the proper installation of the grounding indicated and specified.
   6. Operating Instructions: Furnish operating instructions to Owner's designated representative with respect to operations, functions and maintenance procedures for equipment and systems installed. Cost of such instruction up to a full five (5) days of Electrical Subcontractor's time shall be included in contract. Cost of providing a Manufacturer's Representative at site for instructional purposes shall also be included.

3.3 BRANCH CIRCUITRY

A. For all lighting and appliance branch circuitry, raceway sizes shall conform to industry standard maximum permissible occupancy requirements except where these are exceeded by other requirements specified elsewhere.
B. Circuits shall be balanced on phases at their supply as evenly as possible.
C. Feeder connections shall be in the phase rotation which establishes proper operation for all equipment supplied.
D. Reduced size conductors indicated for any feeders shall be taken as their grounding conductors.

E. Feeders consisting of multiple cables and raceways shall be arranged such that each raceway of the feeder contains one (1) cable for each leg and one (1) neutral cable, if any.
F. For circuitry indicated as being protected at 20 Amps or less, abide by the following:
   1. All 20 amp, 120/208 volt, 3-phase, 4-wire combined branch circuit homeruns shall be provided with a #8 AWG neutral conductor.
   2. Minimum conductor size shall be No. 12 AWG cooper.
   3. Conductors operating at 120 volts extending in excess of 100 ft. or at 277 volts extending in excess of 200 ft., or the last outlet or fixture tap shall be No. 10 AWG cooper throughout.
   4. Lighting fixtures and receptacles shall not be connected to the same circuit.
G. Type MC Cable Installation:
   1. Where cable is permitted under the products section, the installation of same shall be done in accordance with code and the following:
      a. Cable shall be supported in accordance with code. Tie wire is not an acceptable means of support. Cable supports such as Caddy WMX-6, MX-3, and clamps such as Caddy 449 shall be used. Where cables are supported by the structure and only need securing in place, then ty-raps will be acceptable. Ty-raps are not acceptable as a means of support. All fittings, hangers, and clamps for support and termination of cables shall be of type specifically designed for use with cable, i.e., romex connectors not acceptable.
      b. Armor of cable shall be removed with rotary cutter device equal to roto-split by Seatek Co.; not with a hacksaw.
      c. Use split “Insuliner” sleeves at terminations.

3.4 REQUIREMENTS GOVERNING ELECTRICAL WORK IN DAMP OR WET LOCATIONS

A. Outlets and outlet size boxes shall be of galvanized cast ferrous metal only.
B. The finish of threaded steel conduit shall be galvanized only.
C. Wires for pulling into raceways for lighting and appliance branch circuitry shall be limited to “THWN”.
D. Wires for pulling into raceways for feeders shall be limited to “THWN”.
E. Plates for toggle switches and receptacles shall have gasketed snap shut covers suitable for wet locations while in use.
F. Final connections of flexible conduit shall be neoprene sheathed.
G. Apply one (1) layer of half looped plastic electric insulating tape over wire nuts used for joining the conductors of wires.
H. Enclosures, junction boxes, pull boxes, cabinets, cabinet trims, wiring troughs and the like, shall be fabricated of galvanized sheet metal, shall conform to the following:
   1. They shall be constructed with continuously welded joints and seams.
   2. Their edges and weld spots shall be factory treated with cold galvanizing compound.
   3. Their connection to circuitry shall be by means of watertight hub connectors with sealing rings.
I. Enclosures for individually mounted switching and overcurrent devices shall be NEMA Class IV weatherproof construction.
J. The covers, doors and plates and trims used in conjunction with all enclosures, pull boxes, outlet boxes, junction boxes, cabinets and the like shall be equipped with gaskets.
K. Panels shall be equipped with doors without exception.
L. The following shall be interpreted as damp or wet locations within building confines:
   1. Spaces where any designations indicating weatherproof (WP) or vapor proof appear on the drawings.

2. Below waterproofing in slabs applied directly on grade.
3. Spaces defined as wet or damp locations by Article 100 of the National Electric Code.
4. Parking garage.

3.5 REQUIREMENTS GOVERNING ELECTRIC WORK IN AIR HANDLING SPACES

A. Within air handling ductwork or plenums (other than spaces within suspended ceilings used for air handling purposes), Area “B” and the media shall comply with requirements for return air plenums.
B. Abide by the requirements specified for electric work in damp locations within building confines.
C. Where circuitry passes through duct walls, include, in accordance with instructions issued in the field, airtight sealing provisions which allow for a relative movement between the circuitry and the duct walls.
D. Exclude the installation of type NM or NMC cable.
E. In spaces within suspended ceilings used for air handling purposes, abide by the requirements specified for normal electric work conditions except:
F. Lighting fixtures recessed into the ceilings shall be certified as being suitable for this purpose.

3.6 UNDERGROUND CONDUIT DUCT BANKS

A. The electrical work required in conjunction with underground conduit banks shall include providing all conduits.
B. Conduits for underground banks shall be:
   1. Trade diameter size as indicated but in no case less than one inch.
   2. Polyvinyl chloride Schedule 40 (approved for encased burial) duct, rigid steel conduit for vertical elbows and straight sections used to penetrate equipment pads, building foundation walls and concrete slabs.
C. All conduits indicated as being incorporated into conduit banks unless specifically noted as rigid steel conduits shall be encased in a concrete envelope which accommodates the indicated configuration of conduits and which encompasses dimensions as follows:
   1. Outside surfaces of conduits to outside surface of envelope where reinforcement of encasement is required – 6” minimum.
   2. Outside surfaces of conduits to outside surface of envelope where no reinforcement of encasement is required – 3” minimum.
   3. Spacing between centerlines of conduits assigned to different categories of use primary feeders, secondary feeders, communications and signaling – 10-1/2” minimum.
   4. Spacing between centerlines of conduits assigned to the same category of use – 7-1/2” minimum.
D. Reinforcement of the concrete encasement for conduit banks where required shall consist of No. 4 longitudinal reinforcing bars located 3” from the outside surface of the envelope and spaced 6” on centers all around. No. 8 wire reinforcing hoops set 8” apart shall be used to tie the longitudinal bars together.
E. Install conduit in such a manner as to provide a minimum cover of 30 inches after final grading except the cover may be reduced to a minimum of 18 inches to:
   1. Tie into existing work.
   2. Pass over other underground utilities.
   3. Pass over underground obstructions.
   4. Assist in the avoidance of low points.

F. Increase the minimum cover where required by field conditions.
G. Lay conduit to avoid low points during run. Pitch at a minimum of 3 inches per 100 feet away from building.
H. Provide reinforcement for the concrete encasement of a conduit bank where:
   1. It passes under or over underground utilities.
   2. It passes under or over underground obstructions.
   3. Its cover is reduced to less than 30 inches.
   4. It runs through foundation walls and other building construction.
I. Concrete encasement reinforcing shall extend in each case 5 feet beyond the points at which the determining conditions terminate.
J. Bends in conduit shall have minimum radii as follows:
   1. For primary feeder 15’-0” except where specifically indicated otherwise or where turning up at termination point.
   2. For primary feeder turning up at termination point – 4’-0”.
K. Install conduit so that adjacent joints are staggered at least 6 inches from one another.
L. Offsets to accommodate field conditions shall be accomplished with two (2) bends of not more than ten (10) degrees each.
M. Plug both ends of all conduit stubs.
N. Seal the end of each conduit run terminating inside a building utilizing a water and gas-tight sealant manufactured specifically for the purpose.
O. After conduit has been installed with concrete encasement completed, clear each conduit of all obstructions and foreign matter by pulling a flexible mandrel (12” minimum length and a diameter 1/4" less than that of the conduit) and brush through it. In the event that obstructions are encountered in any conduit which will not permit the mandrel to pass, remove and replace the blocked section. Include in the electric work all excavation, backfilling, repair of concrete encasement and restoration of surface at grade involved in the conduit replacement.
P. Provide a nylon cord for the pulling of cable in each conduit in which no cable is to be installed as part of the electric work.
Q. The Electrical Sub-Contractor shall provide all insulated racks as required for proper support of all cables and wires.
R. Provide a continuous nylon warning tape above each full length of duct bank 12 inches below grade.

3.7 LIMITING NOISE PRODUCED BY ELECTRICAL INSTALLATION

A. Perform the following work, in accordance with field instructions issued by the Architect to assure that minimal noise is produced by electrical installations due to equipment furnished as part of the electrical work.
B. Check and tighten the fastenings of sheet metal plates, covers, doors and trims used in the enclosures of electrical equipment.
C. Remove and replace any individual device containing one or more magnetic flux path metallic cores (e.g., discharge lamp ballast, transformer, reactor, dimmer, and solenoid) which is found to have a noise output exceeding that of other identical devices installed at the project.

3.8 SUPPORTS AND FASTENINGS

A. Support work in accordance with best industry standards, and Local Electric Code.
B. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free standing position.

C. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braces to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.
D. No work intended for exposed installation shall be mounted directly on any building surface. In such locations, flat bar members or spaces shall be used to create a minimum of ¼" air space between the building surfaces and the work. Provide ¾" thick exterior grade plywood painted with two (2) coats of fire-retardant gray paint for mounting of panelboards.
E. Nothing (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways or cables for support.
F. Nothing shall rest on, or depend for support on, suspended ceiling media.
G. Support less than 2" trade size, vertically run, conduits at intervals no greater than 8'. Support such conduits, 2-1/2" trade size or larger, at intervals no greater than they story height, or 15', whichever is smaller.
H. Where they are not embedded in concrete, support less than 1" trade size, horizontally run, conduits at intervals no greater than 7'. Support such conduits, 1" trade size or larger, at intervals no greater than 10'.
I. Support all lighting fixtures directly from structural slab, deck or framing member.
J. Where fixtures and ceilings are such as to require fixture support from ceiling openings frames, include in the electric work the members necessary to tie back the ceiling opening frames to ceiling suspension members or slabs so as to provide actual support for the fixtures noted above.
K. As a minimum procedure, in suspended ceilings support smalls runs of circuitry (e.g., conduit not in excess of 1" trade size) from ceiling suspension members as defined above. Support larger runs of circuitry directly from structural slabs, decks or framing members.
L. Fasten electric work to building structure in accordance with the best industry practice.
M. Floor mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastenings in all cases.
N. For items which are shown as being ceiling mounted at locations where fastenings to the building construction element above is not possible, provide suitably auxiliary channel or angle iron bridging tying to building structural elements.
O. As a minimum procedure, where weight applied to the attachment points is 100 lbs. or less, fasten to concrete and solid masonry with bolts and expansion shields.
P. As a minimum procedure, where weight applied to building attachment points exceed 100 lbs., but is 300 lbs. or less, conform to the following:
   1. At field poured concrete slabs, utilize inserts with 20' minimum length slip-through steel rods, set transverse to reinforcing steel.

3.9 SPLICING AND TERMINATING WIRES AND CABLES

A. Maintain all splices and joints in removable cover boxes or cabinets where they may be easily inspected.
B. Locate each completed conductor splice or joint in the outlet box, junction box, or pull box containing it, so that it is accessible from the removal cover side of the box.
C. Join solid conductors No. 8 AWG and smaller by securely twisting them together and soldering, or by using insulated coiled steel spring "wire nut" type connectors. Exclude "wire nuts" employing non-expandable springs. Terminate conductors No. 8 AWG and smaller by means of a neat and fast holding application of the conductors directly to the binding screws or terminals of the equipment or devices to be connected.

D. Join, tap and terminate standard conductors No. 6 AWG and larger by means of solder sleeves, taps, and lugs with applied solder or by means of bolted saddle type or pressure indent type connectors, taps and lugs. Exclude connectors and lugs of the types which apply set screws directly to conductors. Where equipment or devices are equipped with set screw type terminals which are impossible to change, replace the factory supplied set screws with a type having a ball bearing tip. Apply pressure indent type connectors, taps and lugs utilizing tools manufactured specifically for the purpose and having features preventing their release until the full pressure has been exerted on the lug or connector.
E. Except where wire nuts are used, build up insulation over conductor joints to a value, equal both in thickness and dielectric strength, to that of the factory applied conductor insulation. Insulation of conductor taps and joints shall be by means of half-lapped layers of rubber tape, with an outer layer of friction tape; by means of half-lapped layers of approved plastic electric insulating tape; or by a means of split insulating casings manufactured specifically to insulate the particular connector and conductor, and fastened with stainless steel or non-metallic snaps or clips.

3.10 PULLING WIRES INTO CONDUITS AND RACEWAYS

A. Delay pulling wires or cables in until the project has progressed to a point when general construction procedures are not liable to injure wires and cables, and when moisture is excluded from raceways.
B. Utilize nylon snakes or metallic fish tapes with ball type heads to set up for pulling. In raceways 2” trade size and larger, utilize a pulling assembly ahead of wires consisting of a suitable brush followed by a 3-1/2” diameter ball mandrel.
C. Leave sufficient slack on all runs of wire and cable to permit the secure connection of devices and equipment.
D. Include circular wedge-type cable supports for wires and cables at the top of any vertical raceway longer than 20 feet. Also include additional supports spaced at intervals which are no greater than 10’. Supports shall be located in accessible pull boxes. Supports shall be of a non-deteriorating insulating material manufactured specifically for the purpose.
E. Pulling lubricants shall be used. They shall be products manufactured specifically for the purpose.

3.11 REQUIREMENTS FOR THE INSTALLATION OF JUNCTION BOXES, OUTLET BOXES AND PULL BOXES

A. Flush wall-mounted outlet boxes shall not be set back to back but shall be offset at least 12” horizontally regardless of any indication on the drawings.
B. Locate all boxes so that their removable covers are accessible without necessitating the removal of parts of permanent building structure, including piping, ductwork, and other permanent mechanical elements.
C. In conjunction with concealed circuitry, abide by one of the following instructions (as may be applicable to the conditions) in order to assure the aforementioned accessibility. (Not required for circuitry concealed by removable suspended ceiling tiles.)
D. For a small (outlet size) box on circuitry concealed in a partition or wall, locate box or fitting so that its removable cover side, (or the face of any applied raised cover) penetrates through to within 1/8” of the exposed surface of the building materials concealing the circuitry and apply a blank or device plate to suit the functional requirements.

E. For a large box on circuitry concealed in a partition, suspended ceiling, or wall, locate box totally hidden but with its removable cover directly behind an architectural access door or panel (included for the purpose, separate from the electric work) in the building construction which conceals the circuitry.
F. Include all required junction and pull boxes regardless of indications on the drawings (which, due to symbolic methods of notation, may omit to show some of them).
G. Unless noted below or otherwise specifically indicated, include a separate outlet box for each individual wiring device, lighting fixture and signal or communication system outlet component. Outlet boxes supplied attached to lighting fixtures shall not be used as replacements for the boxes specified herein.
H. Utilize an outlet box no smaller than 5” square by 2-1/2” deep.
I. Allow no fixture to be supplied from an outlet box in another room.
J. Multiple local switches indicated at a single location shall be gang-mounted in a single outlet box.
K. Install junction boxes, pull boxes and outlet boxes in conjunction with concealed circuitry.
L. Close up all unused circuitry openings in outlet boxes. Unused openings in cast boxes shall be closed with approved cast metal threaded plugs. Unused openings in sheet metal boxes shall be closed with sheet metal knock-out plugs.
M. Outlet boxes for switches shall be located at the strike side of doors. Indicate door swings are subject to field change. Outlet boxes shall be located on the basis of final door swing arrangements.
N. Boxes and plaster covers for duplex receptacles shall be arranged for vertical mounting of the receptacle.
O. Equip outlet boxes used for devices which are connected to wires of systems supplied by more than one set of voltage characteristics with barriers to separate the different systems.
P. Barriers in junction and pull boxes of outlet size shall be of the same metal as the box.
Q. Barriers in junction and pull boxes which are larger than outlet size shall be of the polyester resin fiberglass of adequate thickness for mechanical strength, but in no case less than 1/4" thick. Each barrier shall be mounted, without fastenings, between angle iron guides so that they may be readily removed.

3.12 LOCATING AND ROUTING OF CIRCUITRY

A. In general, all circuitry shall be run concealed except that it shall be run exposed where the following conditions occur:
   1. Horizontally at the ceiling of permanently unfinished spaces which are not assigned to mechanical or electrical equipment.
   2. Horizontally and vertically in mechanical equipment spaces.
   3. Horizontally and vertically in electric equipment rooms.
B. Concealed circuitry shall be so located that building construction materials can be applied over its thickest elements without being subject to spalling or cracking.
C. All circuitry and raceways shall not be run within slabs. If field conditions requires raceways to be embedded in field-poured structural building construction concrete fill or slab shall conform to the following:
   1. Where turned up or down into a wall or partition they shall, before entering same, be routed parallel for a long enough distance to assure that no relocation of the wall or partition will be necessary to conceal the required bend.
   2. They shall be routed in such a manner as to coordinate with the structural requirements of the building.

3. They shall be routed in accordance with field instructions issued by the Architect where such instructions differ from specifications set forth herein.

D. Circuitry run exposed shall be routed parallel to building walls and column lines.

E. Circuitry shall be routed so as to prevent electric conductors from being subject to high ambient temperature. Minimum clearances from heated lines or surfaces shall be maintained as follows:
   1. Crossing where uninsulated: 3”.
   2. Crossing where insulated: 1”
   3. Running parallel where uninsulated: 36”.
   4. Running parallel where insulated: 6”.

F. Circuitry shall not be run in elevator shafts, hoistways, and the like. Where outlets for trail cables, pit lights, run be level lights, and the like, are involved, only the “final connection” outlet boxes themselves shall be located within or open into, the confines of the shaft.

3.13 INSTALLING CIRCUITRY

A. The outside surface of circuitry, which is to be embedded in cinder concrete, shall be coated with asphaltum paint.

B. In runs of conduit or raceway including flexible limit the number of bends between cable access points to a total which does not exceed the maximum specified for the particular system. Where no such maximum is specified, limit the number to four (4) right angle bends or the equivalent thereof.

C. In each conduit or raceway assigned for the future pulling in of wires, include a nylon drag cord. In raceways 2” trade size and larger, the cord shall be pulled in utilizing a suitable brush, followed by an 85% diameter ball mandrel ahead of the cord in the pulling assembly. In the event that obstructions are encountered, which will not permit the drag cord to be installed, the blocked section of raceway shall be replaced and any cutting and patching of the structure involved in such replacement shall be included as part of the electric work.

D. Circuitry shall be arranged such that conductors of one feeder or circuitry carrying “going” current are not separated from conductors of the same feeder or circuitry carrying “return” current by any ferrous or other metal. Where not within raceways, all “going” and “return” current conductors of one feeder or circuit shall be laced together so as to minimize induction heating of adjacent metal components.

E. Sleeves used where circuitry is to penetrate waterproof slabs, decks and walls, shall be of a type selected to suit the water condition encountered in the field.

END OF SECTION