SECTION 09260

GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.
2. Non-load-bearing steel framing.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

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

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

1. Steel Framing and Furring:
   a. Dale Industries, Inc. - Dale/Incor.
   b. Dietrich Industries, Inc.
   c. MarinoWare; Division of Ware Ind.
   d. National Gypsum Company.
   e. Unimast, Inc.

2. Gypsum Board and Related Products:

   a. American Gypsum Co.
   b. G-P Gypsum Corp.
   c. National Gypsum Company.
   d. United States Gypsum Co.

2.2 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: Provide material thickness to meet deflection criteria of stud length divided by 240.
2. Depth: As indicated in Partition tag descriptions in construction drawings.

C. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.

1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
b. Metal-Lite, Inc.; Slotted Track.

D. Proprietary Firestop Track: 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. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

a. Fire Trak Corp.; Fire Trak .
b. Metal-Lite, Inc.; The System.

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

2.3 INTERIOR GYPSUM WALLBOARD

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

B. Gypsum Wallboard: ASTM C 36.

1. Type X:

a. Thickness: 5/8 inch (15.9 mm).

b. Thickness: ¼" (2 layers) at vaulted ceiling in Conference 532.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

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

a. Cornerbead: Use at outside corners.
b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
c. Expansion (Control) Joint.
d. Drywall Molding End Closure: For use where partitions meet window mullions, Fry Reglet DMEC-4625.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, 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.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.

2.7 ACOUSTICAL SEALANT

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp.; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

2. Acoustical Sealant for Concealed Joints:

a. Ohio Sealants, Inc.; Pro-Series SC-170 Rubber Base Sound Sealant.
b. Pecora Corp.; BA-98.
c. Tremco, Inc.; Tremco Acoustical Sealant.

C. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

2.8 AUXILIARY MATERIALS

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

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

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

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

D. 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.

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

3.2 PREPARATION

A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.

3.3 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.
   a. Use proprietary deflection track where indicated.
   b. Use proprietary firestop track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.4 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief. Do not fasten studs to top track to allow independent movement of studs and track.
2. For fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: To meet deflection criteria.
2. Multilayer Construction: To meet deflection criteria.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. 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.

1. Install two studs at each jamb, unless otherwise indicated.

2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint.
3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. 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.

H. Curved Partitions:
1. Cut top and bottom track (runners) through leg and web at 2-inch (50-mm) intervals for arc length. In cutting lengths of track, allow for uncut straight lengths of not less than 12-inches (30-mm) at ends of arcs.
2. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
3. Support outside (cut) leg of track by clinching steel sheet strip, 1-inch-(25-mm) high-by-thickness of track metal, to inside of cut legs using metal lock fasteners.
4. Begin and end each arc with a stud, and space intermediate studs equally along arcs at stud spacing recommended in writing by gypsum board manufacturer for radii indicated. On straight lengths of not less than 2 studs at ends of arcs, place studs 6-inches (150-mm) o.c.

3.5 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

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

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Attach gypsum panels to framing provided at openings and cutouts.

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

I. Cover both faces of steel stud partition 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. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

3.6 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.7 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.8 FINISHING GYPSUM BOARD ASSEMBLIES

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, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

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

1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
2. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

END OF SECTION 09260

SECTION 09310

CERAMIC TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Floor tile.
   2. Metal edge strips installed as part of tile installations.

B. Related Sections include the following:
   1. Division 7 Section "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C 499) plus joint width indicated.

B. Facial Dimension: Actual tile size (minor facial dimension as measured per ASTM C 499).

C. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

   1. Level Surfaces: Minimum 0.6.
   2. Step Treads: Minimum 0.6.
   3. Ramp Surfaces: Minimum 0.8.

1.5 SUBMITTALS

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

B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required.
2. Metal edge strips in 6-inch (150-mm) lengths.

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

E. Product Certificates: For each type of product, signed by product manufacturer.

F. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all from one source or producer.

1. Obtain tile 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 a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
1. Metal edge strips.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

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 requirement in ANSI A137.1 for labeling sealed 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 avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT 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.

1.9 EXTRA MATERIALS

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

1. Tile Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Basis-of-Design Product: The design for each tile type is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting and Grouting Materials" Article.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Match Architect's samples.

D. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 TILE PRODUCTS

A. Unglazed Paver Tile: Provide flat tile complying with the following requirements:
1. Composition: Porcelain.
2. Facial Dimensions: 30 by 30 cms and 30 by 60 cms.
3. Thickness: 5/16 inch (12.7 mm).
4. Finish: Matte.
5. Face: Plain with square edges.
6. Static Coefficient of Friction: Level Surfaces, minimum 0.6.
7. Tile Type/Products: Available products include the following:
   a. Iris Ceramica, Fabbrica Marmi e Graniti, Color : Juparana Classic

2.4 SETTING AND GROUTING MATERIALS

A. Available Manufacturers:

1. Atlas Minerals & Chemicals, Inc.
2. Bonsal, W. R., Company.
3. Bostik.
4. Custom Building Products.
5. DAP, Inc.
6. LATICRETE International Inc.
7. MAPEI Corporation.
8. Southern Grouts & Mortars, Inc.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:

1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.

C. Standard Sanded Cement Grout: ANSI A118.6, color as indicated.
1. Polymer Type: Either ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients, or acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
   a. Sanded grout mixture for joints 1/8 inch (3.2 mm) and wider.

2.5 ELASTOMERIC SEALANTS

A. General: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer and characteristics indicated that comply with applicable requirements in Division 7 Section "Joint Sealants."

B. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

C. Multipart, Pourable Urethane Sealant for Use T: ASTM C 920; Type M; Grade P; Class 25; Uses T, M, A, and, as applicable to joint substrates indicated, O.

1. Available Products:

a. Bostik; Chem-Calk 550.
b. Mameco International, Inc.; Vulkem 245.
c. Pecora Corporation; NR-200 Urexpan.
d. Tremco, Inc.; THC-900.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications, stainless steel; ASTM A 666, 300 Series exposed-edge material.

C. 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.

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

1. Available Products:

a. Bonsal, W. R., Company; Grout Sealer.
b. Bostik; CeramaSeal Grout Sealer.
c. C-Cure; Penetrating Sealer 978.
d. Custom Building Products; Grout Sealer.
e. Jamo Inc.; Matte Finish Sealer.
f. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
i. TEC Specialty Products Inc.; TA-256 Penetrating Silicone Grout Sealer.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. 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. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Provide concrete substrates for tile floors installed with thin-set mortar that comply with flatness tolerances specified in referenced ANSI A108 Series of tile installation standards.

1. Fill cracks, holes, and depressions with trowelable leveling and patching compound according to tile-setting material manufacturer's written instructions. Use product specifically recommended by tile-setting material manufacturer.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, 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 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and 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.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

G. Grout tile to comply with requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement; dry-set, commercial portland cement; and latex-portland cement grouts), comply with ANSI A108.10.

3.4 FLOOR TILE INSTALLATION

A. General: Install tile to comply with requirements in the Floor Tile Installation Schedule, including those referencing TCA installation methods and ANSI A108 Series of tile installation standards.

1. For installations indicated below, follow procedures in ANSI A108 Series tile installation standards for providing 95 percent mortar coverage.
   a. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.

B. Joint Widths: Install tile on floors with the following joint widths:
1. Paver Tile: 1/4 inch (6.35 mm).

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

D. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement 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. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. When recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

3.6 FLOOR TILE INSTALLATION SCHEDULE

A. Tile Installation: Interior floor installation on concrete; thin-set mortar; TCA F113 and ANSI A108.5.

1. Tile Type: Porcelain tile.
2. Thin-Set Mortar: Latex-portland cement mortar.
3. Grout: Polymer-modified sanded grout.

END OF SECTION 09310

SECTION 09511

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

A. AC: Articulation Class.

B. CAC: Ceiling Attenuation Class.

C. LR: Light Reflectance coefficient.

D. NRC: Noise Reduction Coefficient.

1.4 SUBMITTALS

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

B. 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- (150-mm-) square Samples of each type, color, pattern, and texture.
2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch- (300-mm-) long Samples of each type, finish, and color.

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

1.5 QUALITY ASSURANCE

A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548. NVLAP-accredited laboratories must document

accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.

B. Source Limitations:

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

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Fire-Resistance Characteristics: Where indicated, provide acoustical panel ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

a. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
b. Identify materials with appropriate markings of applicable testing and inspecting agency.

2. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:

a. Smoke-Developed Index: 450 or less.

D. Seismic Standard: Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:

1. Standard for Ceiling Suspension Systems Requiring Seismic Restraint: Comply with ASTM E 580.

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 PROJECT 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.

1.8 COORDINATION

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

1.9 EXTRA MATERIALS

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

1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 ACOUSTICAL PANELS, GENERAL

A. 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 (400 mm) away from test surface per ASTM E 795.

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

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Coating-Based Antimicrobial Treatment: Provide acoustical panels with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273.

2.3 WATER-FELTED, MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – ACT 1

A. Products: Armstrong Dune.

B. Classification: Provide panels complying with ASTM E 1264 for Type III, mineral base with painted finish; Form 2, water felted; and pattern as follows:

1. Pattern: C (perforated, small holes)/E (lightly textured).

C. Color: White.

D. LR: 0.83.

E. NRC: Not less than 0.50.

F. CAC: Not less than 35.

G. Edge Detail: Angled tegular.

H. Thickness: 5/8 inch (15 mm).

I. Size: 24 by 24 inches (610 by 610 mm).

J. Antimicrobial Treatment: Coating based.

2.4 WATER-FELTED, MINERAL-BASE ACOUSTICAL PANELS FOR ACOUSTICAL PANEL CEILING – ACT 2

A. Products: Armstrong Fine Fissured (1728).

B. Classification: Provide panels complying with ASTM E 1264 for Type III, mineral base with painted finish; Form 2, water felted; and pattern as follows:
1. Pattern: C (perforated, small holes)/E (lightly textured).

C. Color: White.

D. LR: 0.85.

E. NRC: Not less than 33.

F. Edge Detail: Square.

G. Thickness: 5/8 inch (15 mm),

H. Size: 24 by 24 inches (610 by 610 mm).

I. Antimicrobial Treament: Coating based.

2.5 DECORATIVE METAL GRID SYSTEM

A. Open-Cell Ceiling: MagnaGrid by Interfinish or approved substitute.
1. Grid: Clear anodized aluminum, 24 by 24 inches (610 by 610 mm), 2 inch depth.
2. Panel Layout: 203/30; 8 by 8 inch (200 by 200 mm) open pattern.
3. Moldings: As required for system.

2.6 METAL SUSPENSION SYSTEMS, GENERAL

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

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

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, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- (2.69-mm-) diameter wire.
3. Provide universal hold down clips at rooms specified in Room Finish Schedule. Install per manufacturer's recommendations. Purpose is to resist force of fire suppression system release.

2.7 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING

A. Products:

1. Armstrong, Prelude XL.

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 (Z90) coating designation, with prefinished 15/16-inch- (24-mm-) wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Override (stepped) or butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Galvanized Steel cold-rolled sheet.
5. Cap Finish: Painted white.

2.8 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers:

1. Armstrong World Industries, Inc.

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

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

2.9 ACOUSTICAL SEALANT

A. Products:

1. Acoustical Sealant for Exposed and Concealed Joints:

a. Pecora Corp; AC-20 FTR Acoustical and Insulation Sealant.
b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.

B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 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. 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, GENERAL

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

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

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
4. 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved.

Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.

7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

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

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.66 m). Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

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

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

1. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
2. For reveal-edged panels on suspension system members with box-shaped flanges, install panels with reveal surfaces in firm contact with suspension system surfaces and panel faces flush with bottom face of runners.
3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

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 09511

SECTION 09651

RESILIENT FLOOR TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Vinyl composition tile (VCT).
   2. Resilient wall base and accessories.

1.3 SUBMITTALS

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

B. Samples for Initial Selection: For each type of product indicated.

C. Maintenance Data: For resilient products to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Provide products identical to those tested for fire-exposure behavior per test method indicated by a testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 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 (10 deg C) or more than 90 deg F (32 deg C). Store tiles on flat surfaces.

1.6 PROJECT CONDITIONS

A. Maintain temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), 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 postinstallation period, maintain temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Close spaces to traffic during floor covering installation.

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

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

1.7 EXTRA MATERIALS

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

1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.
2. Resilient Wall Base and Accessories: Furnish not less than 10 linear feet (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide the products listed in other Part 2 articles.

2.2 COLORS AND PATTERNS

A. Colors and Patterns: As selected by Architect from manufacturer's full range. Refer to AF drawing sheets for patterns and distribution of VCT types.

2.3 VINYL COMPOSITION TILE:

A. Vinyl Composition Tile (VCT): ASTM F 1066.
1. Armstrong Excelon, Color: As scheduled on Room Finish Schedule.

B. Class: 2 (through-pattern tile).

C. Wearing Surface: Smooth.

D. Thickness: 0.125 inch (3.2 mm).

E. Size: 12 by 12 inches (305 by 305 mm).

F. Fire-Test-Response Characteristics:

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm per ASTM E 648.

2.4 RESILIENT WALL BASE

A. Wall Base: ASTM F 1861.
1. Johnsonite; Vinyl Wall Base (ColorMatch).

B. Type (Material Requirement): TV (vinyl).

C. Group (Manufacturing Method): I (solid, homogeneous).

D. Style: Cove (with top-set toe) at VCT and straight at carpeted areas.

E. Minimum Thickness: 0.125 inch (3.2 mm).

F. Height: 4 inches (102 mm).

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

H. Outside Corners: Job formed.

I. Inside Corners: Job formed.

J. Surface: Smooth.

2.5 INSTALLATION MATERIALS

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

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances, moisture content, and other conditions affecting performance.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations 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. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
3. Moisture Testing:

a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
b. Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.

C. 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.

D. Use trowelable leveling and patching compound to fill cracks, holes, and depressions in substrates.

E. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

1. Do not install resilient products until they are same temperature as space where they are to be installed.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Lay out 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.

B. Match 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.

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

D. Extend tiles into toe spaces, door reveals, closets, and similar openings.

E. 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, nonstaining marking device.

F. Install tiles on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of tile installed on covers. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

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

3.4 RESILIENT WALL BASE INSTALLATION

A. Apply wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

B. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

C. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

D. Do not stretch wall base during installation.

E. On masonry surfaces or other similar irregular substrates, fill voids along top edge of wall base with manufacturer's recommended adhesive filler material.

F. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the wall base thickness.
2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.5 CLEANING AND PROTECTION

A. Perform the following operations immediately after completing resilient product installation:

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

a. Do not wash surfaces until after time period recommended by manufacturer.

B. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

1. Apply protective floor polish to horizontal surfaces that are free from soil, visible adhesive, and surface blemishes if recommended in writing by manufacturer.

a. Use commercially available product acceptable to manufacturer.
b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on horizontal surfaces with undyed, untreated building paper until Substantial Completion.
3. Do not move heavy and sharp objects directly over surfaces. Place hardboard or plywood panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09651

SECTION 09680

CARPET

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Tufted carpet.
2. Carpet cushion.

B. Related Sections include the following:
1. Division 9 Section "Resilient Wall Base and Accessories" for resilient wall base and accessories installed with carpet.
2. Division 9 Section "Carpet Tile."

1.3 SUBMITTALS

A. Product Data: For the following, including installation recommendations for each type of substrate:

1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Carpet Cushion: For each type indicated. Include manufacturer's written data on physical characteristics and durability.

B. 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: 12-inch- (300-mm-) square Sample.
2. Exposed Edge, Transition, and other Accessory Stripping: 12-inch- (300-mm-) long Samples of bound edge.
3. Carpet Cushion: 6-inch- (150-mm-) square Sample.

C. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, 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 and carpet cushion.

D. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

A. Comply with CRI 104, Section 7.2, "Site Conditions; Temperature and Humidity" and Section 7.12, "Ventilation."

B. Environmental Limitations: Do not install carpet and carpet cushion until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

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

1.7 WARRANTY

A. Special Warranty for Carpet: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.
3. Warranty Period: 15 years from date of Substantial Completion.

B. Special Warranty for Carpet Cushion: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet cushion installation that fail in materials or workmanship within specified warranty period.

1. Warranty includes consequent removal and replacement of carpet and accessories.
2. Warranty does not include deterioration or failure of carpet cushion due to unusual traffic, failure of substrate, vandalism, or abuse.
3. Failure includes, but is not limited to, permanent indentation or compression.
4. Warranty Period: 15 years from date of Substantial Completion.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 TUFTED CARPET

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Products: Subject to compliance with requirements, provide one of the following:

1. Mannington Roundtrip.

a. Color: Upgrade (UPGR).

C. Fiber Content: 100 percent nylon 6, 6.

D. Fiber Type: DuPont.

E. Pile Characteristic: Textured patterned loop pile.

F. Pile Thickness: .080 inches for finished carpet.

G. Stitches: 11 per inch.

H. Gage: 1/12.

I. Face Weight: 11oz./sq. yd.

J. Primary Backing: Manufacturer's standard material.

K. Secondary Backing: Manufacturer's standard material.

L. Width: 12 feet (3.7 m) with stair width and white selvage areas to be cut into several widths.

2.2 CARPET CUSHION

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Traffic Classification: CCC Class **II**, heavy (stair) traffic.

C. Fiber Cushion: Synthetic.
1. Thickness: 1/4" inches.
2. Density: 9-12 lb/cu. ft.

2.3 INSTALLATION ACCESSORIES

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

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet and carpet cushion manufacturers.

1. VOC Limits: Provide adhesives that comply with the following limits for VOC content when tested according to ASTM D 5116:

a. Total VOCs: 10.00 mg/sq. m x h.
b. Formaldehyde: 0.05 mg/sq. m x h.
c. 2-Ethyl-1-Hexanol: 3.00 mg/sq. m x h.

C. Tackless Carpet Stripping: Water-resistant plywood, in strips as required to match cushion thickness and that comply with CRI 104, Section 12.2.

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 performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness

characteristics by performing bond and moisture tests recommended by carpet cushion manufacturer.

2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

3.2 PREPARATION

A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet cushion manufacturer.

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

3.3 INSTALLATION

A. Comply with CRI 104 and carpet and carpet cushion manufacturers' written installation instructions for the following:

1. Stair Installation: Comply with CRI 104, Section 13, "Carpet on Stairs" for glue-down installation.

B. Do not bridge building expansion joints with carpet.

C. Cut and fit carpet 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 manufacturer.

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

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

F. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

G. Comply with carpet cushion manufacturer's written recommendations. Install carpet cushion seams at 90-degree angle with carpet seams.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."

C. Protect carpet 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 manufacturer and carpet cushion manufacturer.

END OF SECTION 09680

SECTION 09681

CARPET TILE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes carpet tile and installation.

B. Related Sections include the following:
1. Division 9 Section "Resilient Floor Tile" for resilient wall base and accessories installed with carpet tile.
2. Division 9 Section "Carpet" for broadloom carpet for stair.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.

B. 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.

C. Maintenance Data: For carpet tile to include in maintenance manuals specified in Division 1. 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.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

B. Fire-Test-Response Characteristics: Provide products with the critical radiant flux classification indicated in Part 2, as determined by testing identical products per ASTM E 648 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

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

1.6 PROJECT CONDITIONS

A. General: Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity."

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

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

1.7 WARRANTY

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

B. Special Carpet Tile Warranty: Written warranty, signed by carpet tile manufacturer agreeing to replace carpet tile that does not comply with requirements or that fails within specified warranty period. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, and delamination.

1. Warranty Period: 15 years from date of Substantial Completion against excessive surface wear.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2 - PRODUCTS

2.1 CARPET TILE CPT-1.

A. Product: Subject to compliance with requirements, provide the following:

1. Mannington: Roundtrip.

a. Colors: Upgrade (UPGR).

B. Fiber Content: 100% DuPont Type 6.6 Nylon.

C. Face Construction: Textured patterned loop.

D. Gauge: 1/12".

E. Stitches Per Inch: 11.

F. Pile Height: 0.083 in. avg. for finished carpet tile per ASTM D 418.

G. Surface Pile Weight: 11 oz./sq. yd.

H. Size: 18" x 18"".

I. Primary Backing: Non-woven, 100% synthetic.

J. Secondary Backing: Infinity™ Modular Cushion Back.

K. Performance Characteristics: As follows:

1. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm.
2. Colorfastness to Crocking: Not less than 4, wet and dry, per AATCC-165.
3. Colorfastness to Light: Not less than 4 after 40 AFU (AATCC fading units) per AATCC-16.
4. 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; no fungal growth; per AATCC-174.

2.2 INSTALLATION ACCESSORIES

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

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

3.2 PREPARATION

A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

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

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 13, "Carpet Modules (Tiles)."

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

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

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

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

F. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 15, "Protection of Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09681

SECTION 09922

INTERIOR PAINTING (PROFESSIONAL LINE PRODUCTS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and field painting of exposed interior items and surfaces.

1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color of finish is not indicated, Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Architectural woodwork.
b. Acoustical wall panels.
c. Metal lockers.
d. Elevator entrance doors and frames.
e. Elevator equipment.
f. Finished mechanical and electrical equipment.
g. Light fixtures.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
a. Furred areas.
b. Ceiling plenums.
c. Utility tunnels.

d. Pipe spaces.
e. Duct shafts.
f. Elevator shafts.

3. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel.
c. Chromium plate.
d. Copper and copper alloys.
e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:
1. Division 6 Section "Interior Architectural Woodwork" for shop finishing of interior architectural woodwork.
2. Division 8 Section "Steel Doors and Frames" for factory priming steel doors and frames.
3. Division 9 Section "Gypsum Board Assemblies" for surface preparation of gypsum board.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system indicated. Include block fillers and primers.

1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Initial Selection: For each type of finish-coat material indicated.

1. After color selection, Architect will furnish color chips for surfaces to be coated.

C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

1.5 QUALITY ASSURANCE

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

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

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample for each type of coating and substrate required. Comply with procedures specified in PDCA P5. Duplicate finish of approved sample Submittals.

1. Architect will select one room or surface to represent surfaces and conditions for application of each type of coating and substrate.

a. Wall Surfaces: Provide samples on at least 100 sq. ft. (9 sq. m).

2. Apply benchmark samples, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated. Provide required sheen, color, and texture on each surface.

a. After finishes are accepted, Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from benchmark samples.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1. Product name or title of material.
2. Product description (generic classification or binder type).
3. Manufacturer's stock number and date of manufacture.
4. Contents by volume, for pigment and vehicle constituents.
5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain storage containers in a clean condition, free of foreign materials and residue.

1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F (10 and 32 deg C).

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air are between 45 and 95 deg F (7 and 35 deg C).

C. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.

1. Quantity: Furnish Owner with an additional 3 percent, but not less than 1 gal. (3.8 L) or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles.

C. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Benjamin Moore & Co. (Benjamin Moore).
2. ICI Dulux Paint Centers (ICI Dulux Paints).
3. PPG Industries, Inc. (Pittsburgh Paints).
4. Sherwin-Williams Co. (Sherwin-Williams).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Match Architect's samples.

2.3 INTERIOR PRIMERS

A. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.

1. Benjamin Moore; Regal FirstCoat Interior Latex Primer & Underbody No. 216: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).
2. ICI Dulux Paints; 1030-1200 Ultra-Hide PVA Interior Primer Sealer General Purpose Wall Primer: Applied at a dry film thickness of not less than 1.9 mils (0.048 mm).
3. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil (0.025 mm).

4. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

B. Interior Ferrous-Metal Primer: Factory-formulated quick-drying rust-inhibitive alkyd-based metal primer.

1. Benjamin Moore; IronClad Alkyd Low Lustre Medal and Wood Enamel No. 163: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
2. ICI Dulux Paints; 4130-6130 Devshield Rust Penetrating Metal Primer: Applied at a dry film thickness of not less than 2.2 mils (0.056 mm).
3. Pittsburgh Paints; 7-858 Pittsburgh Paints Industrial Rust Inhibitive Steel Primer: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
4. Sherwin-Williams; Kem Kromik Universal Metal Primer B50NZ6/B50WZ1: Applied at a dry film thickness of not less than 3.0 mils (0.076 mm).

2.4 INTERIOR FINISH COATS

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

1. Benjamin Moore; Moore's Regal AquaVelvet No. 319: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
2. ICI Dulux Paints; 1402-XXXX Dulux Professional Acrylic Eggshell Interior Latex Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
3. Pittsburgh Paints; 89-Line Manor Hall Interior Eggshell Wall and Trim: Applied at a dry film thickness of not less than 1.4 mils (0.036 mm).
4. Sherwin-Williams; SuperPaint Interior Latex Satin Wall Paint A87 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

B. Interior Semigloss Acrylic Enamel: Factory-formulated semigloss acrylic-latex enamel for interior application.

1. Benjamin Moore; Regal AquaGlo No. 333 Premium Interior Finishes Latex Semi-Gloss: Applied at a dry film thickness of not less than 1.3 mils (0.033 mm).
2. ICI Dulux Paints; 1406-XXXX Dulux Professional Acrylic Semi-Gloss Interior Wall & Trim Enamel: Applied at a dry film thickness of not less than 1.5 mils (0.038 mm).
3. Pittsburgh Paints; 88-110 Satinhide Interior Enamel Wall & Trim Lo-Lustre Semi-Gloss Latex: Applied at a dry film thickness of not less than 1.1 mils (0.028 mm).
4. Sherwin-Williams; SuperPaint Interior Latex Semi-Gloss Enamel A88 Series: Applied at a dry film thickness of not less than 1.6 mils (0.041 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application.

1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.

2. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.

   a. Blast steel surfaces clean as recommended by paint system manufacturer and according to SSPC-SP 6/NACE No. 3.
   b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
   c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with same primer as the shop coat.

3. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:

1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
5. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
6. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

J. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.

1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 INTERIOR PAINT SCHEDULE

A. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:

1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.

a. Primer: Interior gypsum board primer.
b. Finish Coats: Interior low-luster acrylic enamel.

2. Semigloss Acrylic-Enamel Finish: Two finish coats finish coats over a primer.

a. Primer: Interior ferrous-metal primer.
b. Finish Coats: Interior semigloss acrylic enamel.

B. Ferrous Metal: Provide the following finish systems over ferrous metal:

1. Semigloss Acrylic-Enamel Finish: Two finish coats finish coats over a primer.

a. Primer: Interior ferrous-metal primer.
b. Finish Coats: Interior semigloss acrylic enamel.

END OF SECTION 09922

SECTION 11132

PROJECTION SCREENS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Front-projection screens.

B. Related Sections include the following:

1. Division 6 Section "Miscellaneous Carpentry" for wood blocking for recessed screen installation.
2. Electrical drawings for electrical service and connections including metal device boxes for switches.

1.3 DEFINITIONS

A. Gain of Front-Projection Screens: Ratio of light reflected from screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94.

B. Gain of Rear-Projection Screens: Ratio of light refracted by screen material to that reflected perpendicularly from a magnesium carbonate surface as determined per SMPTE RP 94, except that for measuring luminance of test screen, projection lamp shall be placed behind screen same distance as it was placed in front of magnesium carbonate surface for measuring luminance of reference standard.

C. Half-Gain Angle: The angle, measured from the axis of the screen surface, to the most central position on a perpendicular plane through the horizontal centerline of the screen where the gain is half of the peak gain.

1.4 SUBMITTALS

A. Product Data: For each type of screen indicated.

B. Shop Drawings: Show layouts and types of projection screens. Include the following:

1. Location of screen centerline relative to ends of screen case.
2. Location of wiring connections.
3. Location of seams in viewing surfaces.
4. Drop length.
5. Connections to supporting structure for pendant- and recess-mounted screens.
6. Anchorage details.
7. Details of juncture of exposed surfaces with adjacent finishes.
8. Frame details.
9. Accessories.
10. Wiring Diagrams: For electrically operated units.

C. Maintenance Data: For projection screens to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of projection screen through one source from a single manufacturer. Obtain each screen as a complete unit, including necessary mounting hardware and accessories.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver projection screens until building is enclosed and other construction within spaces where screens will be installed is substantially complete and ready for screen installation.

B. Store rear-projection screens in manufacturer's protective packaging and according to manufacturer's written instructions.

1.7 COORDINATION

A. Coordinate layout and installation of projection screens with adjacent construction, including ceiling framing, light fixtures, HVAC equipment, fire-suppression system, and partitions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Products: Subject to compliance with requirements, provide one of the products specified.

2.2 FRONT-PROJECTION SCREENS

A. Electrically Operated Screens, General: Manufacturer's standard units consisting of case, screen, motor, controls, mounting accessories, and other components necessary for a complete installation. Provide units that are listed and labeled as an assembly by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Line Voltage Control: Remote, 3-position control switch installed in recessed metal device box with flush cover plate matching other electrical device cover plates in room where switch is installed.

2. Motor in Roller: Instant-reversing motor of size and capacity recommended by screen manufacturer; with permanently lubricated ball bearings, automatic thermal-overload protection, preset limit switches to automatically stop screen in up and down positions, and positive-stop action to prevent coasting. Mount motor inside roller with vibration isolators to reduce noise transmission.

3. Screen Mounting: Top edge securely anchored to rigid metal roller and bottom edge formed into a pocket holding a 3/8-inch- (9.5-mm-) diameter metal rod with ends of rod protected by plastic caps.
   a. Roller for motor in roller supported by vibration- and noise-absorbing supports.

B. Recessed, Electrically Operated Screens with Automatic Ceiling Closure: In roller mounted motor units designed and fabricated for recessed installation in ceiling; with bottom of case composed of two panels fully enclosing screen, motor, and wiring, one panel hinged and designed to open and close automatically when screen is lowered and fully raised, the other removable or openable for access to interior of case.

1. Available Products:
   a. Da-Lite Screen Co., Inc.; Boardroom Electrol.
   b. Draper Inc.; Envoy.
2. Provide metal or metal-lined wiring compartment on units with motor in roller.
3. Screen Case: Made from metal, wood, wood products, and fire-retardant materials.
4. Provide screen case with trim flange to receive ceiling finish.

C. Screen Material and Viewing Surface:

1. Matte-White Viewing Surface: Peak gain of 0.9 to 1.0, and gain of not less than 0.8 at an angle of 50 degrees from the axis of the screen surface.

   a. Available Products:
      1) Da-Lite Screen Co., Inc.; Matte White.
      2) Draper Inc. Fiberglass Matte White.

2. Material: Vinyl-coated glass-fiber fabric.
3. Mildew Resistance: Rating of 0 or 1 when tested according to ASTM G 21.
4. Flame Resistance: Passes NFPA 701.
5. Flame-Spread Index: Not greater than 75 when tested according to ASTM E 84.

6. Seamless Construction: Provide screens, in sizes indicated, without seams.

7. Edge Treatment: Black masking borders.

8. Size of Viewing Surface: 84 by 84 inches (2133 by 2133 mm).

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install projection screens at locations indicated to comply with screen manufacturer's written instructions.

B. Install front-projection screens with screen cases in position and in relation to adjoining construction indicated. Securely anchor to supporting substrate in a manner that produces a smoothly operating screen with vertical edges plumb and viewing surface flat when screen is lowered.

1. Install low-voltage controls according to NFPA 70 and manufacturer's written instructions.

a. Wiring Method: Install wiring in raceway except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Use UL-listed plenum cable in environmental air spaces, including plenum ceilings. Conceal raceway and cables except in unfinished spaces.

2. Test electrically operated units to verify that screen controls, limit switches, closure, and other operating components are in optimum functioning condition.

3.2 PROTECTING AND CLEANING

A. After installation, protect projection screens from damage during construction. If damage occurs despite such protection, remove and replace damaged components or entire unit as required to provide units in their original, undamaged condition.

END OF SECTION 11132

SECTION 11451

RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Refrigerators.
   2. Microwaves.
   3. Toaster ovens.
   4. Cleaning appliances:
      a. Dishwashers.

B. Related Sections include the following:
   1. Division 6 Section "Interior Architectural Woodwork" for custom-made cabinets and plastic-laminate and granite tops that receive residential appliances.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include operating characteristics, dimensions of individual appliances, and finishes for each appliance.

B. Appliance Schedule: For appliances; use same designations indicated on Drawings.

C. Manufacturer Certificates: Signed by manufacturers certifying that products comply with requirements.

D. Maintenance Data: For each product to include in maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Regulatory Requirements: Comply with provisions of the following product certifications:

1. NFPA: Provide electrical appliances listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. UL and NEMA: Provide electrical components required as part of residential appliances that are listed and labeled by UL and that comply with applicable NEMA standards.
3. ANSI: Provide gas-burning appliances that comply with ANSI Z21 Series standards.
4. NAECA: Provide residential appliances that comply with NAECA standards.

1.5 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer of each appliance specified agrees to repair or replace residential appliances or components that fail in materials or workmanship within specified warranty period.
1. Dishwasher: 10-year warranty for in-home service against deterioration of tub and door liner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Products: Subject to compliance with requirements, provide the products specified.

B. Refrigerator:

1. Product:

a. Kitchenaid.

2. Type: 21.8 c.f. Architect Series with Freezer on the Bottom.
3. Features:

a. Finish: Stainless Steel.
b. Icemaker Kit.

C. Undercounter Refrigerator:

1. Product:

a. U-Line.

2. Type: Model 29R, Origins Series.
3. Features:

    a. Finish: Panel kit for millwork panel.
    b. ADA Height.

D. Toaster Oven:

1. Product:

    a. Cuisinart.

2. Type: Countertop, Stainless steel model, TOB-30BC.
3. Features:

    a. Oven/broiler combo.

E. Microwave:

1. Product:

    a. Kenmore, Sears item: #02063263000.

2. Type: Countertop, Stainless steel model.

2.2 CLEANING APPLIANCES

A. Dishwasher:

1. Product:
    a. Eurotech Model No. EDW194E (available at Clarke Appliances in Massachusetts – 1-800-842-5275.)

2. Type: Under the counter, 24 inches wide, height adjustable from 32-35" to accommodate ADA.
3. Tub and Door Liner: Stainless steel.

    a. Detergent Dispenser: Sealed detergent and automatic rinsing-aid dispensers in door liner.

4. Rack System: Nylon-coated sliding dish racks, with removable cutlery basket.
5. Operation: Six wash programs with hot-air and heat-off drying cycle options.
6. Front Panel: Stainless Steel.
7. Energy Star rated.

2.3 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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

C. Stainless-Steel Finish: Provide appliances with manufacturer's standard finish complying with manufacturer's written instructions for surface preparation including For exact finish, insert names of coating manufacturers and products.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

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

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written instructions.

B. Built-in Equipment: Securely anchor units to supporting cabinets or countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

C. Freestanding Equipment: Place units in final locations after finishes have been completed in each area. Verify that clearances are adequate to properly operate equipment.

D. Utilities: Refer to Construction Documents for plumbing and electrical requirements.

3.3 CLEANING AND PROTECTION

A. Test each item of residential appliances to verify proper operation. Make necessary adjustments.

B. Verify that accessories required have been furnished and installed.

C. Remove packing material from residential appliances and leave units in clean condition, ready for operation.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain residential appliances. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 11451

SECTION 13900

BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies the basic requirements for fire protection installations and includes requirements common to more than one section. It expands and supplements the requirements specified in sections of Division 1.
   1. Sleeves.
   2. Escutcheons.
   3. Grout.
   4. Equipment installation requirements.
   5. Painting and finishing.
   6. Supports and anchorages.
   7. Access panels and doors.
   8. Seismic Bracing.

B. Related Sections include the following:
   1. Division 7 Section, "Firestopping."
   2. Division 8 Section, "Access Panels."
   3. Division 16 Section, "Fire Alarm."
   4. Division 9 Section, "Painting."

1.3 DEFINITIONS

A. Complete and Operational System: A Fire Protection system that has been installed, tested, cleaned, signed-off by appropriate Authority and made operational. Completion of Owner training to be part of this requirement.

B. Fire Protection Contractor: The project Contractor responsible for the installation of the Fire Protection systems and equipment.

C. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

D. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

E. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

F. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

G. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

H. NFPA: National Fire Protection Association.

I. AHJ: Authority Having Jurisdiction, parties responsible for the approval of materials and installations.

1.4 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.
   1. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
      a. Copies of permits required to perform the work.
      b. Copies of certificates of registrations indicating compliance with the "Quality Assurance" paragraph that follows.
      c. Supports and hangers.
      d. Sleeves and sleeve seals.
      e. Escutcheons.
      f. Seismic bracing materials.
   2. Post-Construction Submittals: Submit the following items upon completion of the work.
      a. Copies of final system sign-off and acceptance by the AHJ.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: All work shall be performed by qualified journeymen of their respective trades who are employed by a firm that can demonstrate successful experience with work similar in type, quality and extent to the work required by this project.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

C. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

E. Listing and Approval: Unless otherwise required by the Owner's Insurance Underwriter, components intended for use in fire suppression systems shall be "listed" or "approved."
1. "Listed": UL Listed.
2. "Approved": FMC Approved.

1.6 BASIS OF FIRE PROTECTION DESIGNS

A. General: The following information is intended to provide an overview of the intent and operation of the project fire Protection systems. It is not intended that each and every project Fire Protection scope item be captured herein. The absence of a specific item or system in the descriptions below does not absolve the Fire Protection Contractor from providing the work identified by other Sections and the Drawings.
1. The Fire Protection Contractor shall provide complete and operational systems and installations.

B. Fire Protection Systems Description:
1. General:
a. Modify the base building shell sprinkler system to suit proposed fit-up.
b. Whereas simple addition of pendent sprinkler heads to base building tee provisions will not require hydraulic verification, some more extensively impacted areas may require system calculations to verify performance. The fire protection Contractor shall provide design as necessary in accordance with the Contract Documents as well as direction received from the Authorities Having Jurisdiction.
c. Obtain all permits and gain approvals from Authorities Having Jurisdiction for designs and installations, (at both facilities – see below).
d. Fire Protection installations shall be seismically braced per BOCA Building or NFPA 13 requirements.
2. Fire Sprinkler System Modifications:
a. Install pendent sprinkler heads in spaces being finished. Heads in suspended ceilings to be recessed pendent, white with white escutcheon. Heads in gypsum ceilings to be concealed, white cover plate. Modify upright head locations as necessary in newly partitioned spaces without ceilings.
b. Vaulted Ceilings: Provide recessed sidewall heads, centered at the ends of vaulted ceilings. Do not provide heads in the curved ceiling surface. Provide a head at one or both ends, utilizing extended coverage heads as required to achieve proper coverage.
c. New finished ceiling heads to be supplied via 1-inch arm-overs from base building provisions. Existing upright heads shall remain in-place.
d. New Equipment and Components: The Fire Protection Contractor shall provide the balance of the items required to complete the systems installation at 280 Fore Street – Floors 4 & 5.
e. Design: The Contractor shall provide full system design, calculations and shop drawings.

f. Extinguishers: Provide compatible clean agent fire extinguishers, including necessary surface mounting hardware. Extinguishers to be Ansul FE-36, 10 lb.

1.7 CODES, STANDARDS AND AUTHORITIES

A. General: The following listing is intended to identify the major Codes, Standards, and Authorities Having Jurisdiction, (AHJ's) for the project. This information is at least partially provided on the G-000 series Drawings as well. In the event that there is a discrepancy between the information contained herein and that on the G-000 Drawings, the information herein shall govern.
1. In the event that an item is included on the G-000 Drawings and is not listed herein, compliance with the requirements of said item is required.
2. The exclusion of an applicable Code, Standard, or AHJ in the list below does not absolve the Contractor from meeting the requirements of said Code, Standard or AHJ.

B. Codes and Standards: Work performed on the project must comply with the requirements of the following Codes and Standards:
1. BOCA Building Code – 1999.
2. NFPA 10 – 1998.
3. NFPA 13 – 1996.
4. NFPA 75 – 1995.
5. NFPA 101 – 2000.
6. NFPA 2001 – 2001.

C. Authorities Having Jurisdiction: Work performed on the project must comply with the requirements of the following AHJ's:
1. State Fire Marshal.
2. Local Fire Department.
3. Building Official.
4. Owner's Insurance Underwriter.

1.8 DRAWINGS AND SPEICIFICATIONS

A. General: The drawings and specifications are complimentary.
1. What is shown or noted on the drawings, but not mentioned in the specifications, automatically becomes a part of the specifications.
2. What is noted in the specifications, but not shown on the drawings, automatically becomes a part of the drawings.
3. Conflicts between the requirements of the drawings and the specifications must be brought to the immediate attention of the Architect/Engineer.
   a. The more stringent requirement will apply, unless ruled otherwise by the Architect/Engineer.
   b. When conflicts or discrepancies are noted, no work shall proceed until the conflict or discrepancy has been resolved by the Architect/Engineer.

B. Fire Protection Drawings and 13900 Series Specification Sections: The Fire Protection Contractor shall bear the responsibility of determining full extent of work required by Contract Documents. The Fire Protection Contractor shall refer to site, architectural, structural,

mechanical, electrical and other Drawings and Specification Sections that indicate types of construction with which work of this Section must be coordinated. The Fire Protection Contractor shall review the work with the General Contractor / Construction Manager to establish the extent of work for their trade, and to determine whether there will be any interference with the work of other trades. If the work is later found to include work required to complete and coordinate the work or another trade, or to interfere with the work of another trade then the changes required to complete the work or to eliminate the interference shall be made without additional cost to the Owner.

1. The Drawings schematically indicate the order of connection of the various system components. Each and every nuance and detail in not indicated. Whether specifically shown or not, all items shall be connected in accordance with Code, the details provided, accepted trade practices, and the intent of the Contract Documents. Coordinate with the other trades.

C. Exact locations of ceiling mounted items shall be as shown and detailed on the Architectural reflected ceiling plans.

D. System components are identified throughout the Drawings for proper system operation. If any component is inadvertently omitted from the drawings, provide that component as per a similar location.

1.9 SUBSTITUTIONS

A. General: See Division 1 for product substitution requirements.
1. No substitute materials or equipment shall be incorporated in the work without the written approval of the Architect/Engineer.

1.10 FIRE PROTECTION SUBMITTALS

A. General: Refer to Division 1 for submittal definitions, requirements and procedures.

B. Submittal of shop drawings. certified performance data, and samples will be accepted only when submitted per Division 1. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

C. When two or more items of the same material or equipment are required, they shall be products of the same manufacturer insofar as possible.
1. This does not apply to raw or bulk materials such as pipe and fittings, etc.

1.11 RECORD DOCUMENTS

A. General: Refer to Division 1 for requirements.

B. As work progresses, mark Drawings to indicate revisions to fire protection systems.

C. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

D. At completion of work and prior to final request for payment, the Fire Protection Subcontractor shall submit a complete set of reproducible record drawings showing all systems as actually installed. Drawings submitted shall be in the following format:
   1. Re-issuances of the project shop drawings.
   2. Re-issuance of the project hydraulic calculations, with revisions as necessary to account for modifications since the time of shop drawing submittal.

1.12 OPERATION AND MAINTENANCE, (O&M) MANUALS

A. General: Refer to Division 1 for procedures and requirements for preparation and submittal of O&M Manuals.

B. Systems Descriptions: Provide description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

C. Operating Procedures: Provide manufacturer's printed data, including start-up, break-in, routine and normal operating instructions; regulation control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

D. Maintenance Procedures: Provide for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

E. Servicing Instructions: Provide instructions, lubrication charts and schedules.

F. Product Data: Provide copies of all approved submittals.

1.13 OWNER TRAINING

A. General: Refer to Division 1 for general requirements.

1.14 WARRANTIES

A. Refer to Division 1 for project requirements for warranties. Individual warranties are required for each item of power driven or other fire protection equipment having moving parts, and wherever else specified in Division 15.
   1. Submit the warranties specified in Division 15 in a vinyl covered, three ring binder, tabulated and indexed for easy reference.

B. Provide complete warranty information for each item, to include date of commencement; duration; and the names, addresses, and telephone numbers and procedures for filing claims and obtaining warranty services.

C. Duration of warranties shall be not less than one year from the date of substantial completion of the facility unless prior approval has been granted in writing by the Architect/Engineer. If the manufacturer's warranty expires less than one year from the date of substantial completion, that

warranty service and replacement of parts shall be provided by the mechanical subcontractor at no cost to the Owner.

1.15 DELIVERY, STORAGE AND HANDLING

A. General: Refer to Division 1 for material procurement requirements.

B. 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.

C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

D. Coordinate deliveries of mechanical 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.

1.16 DIVISION OF FIRE PROTECTION, FIRE ALARM AND ELECTRICAL RESPONSIBILITY

A. General: Line voltage switches, fused switches, outlets, motor starters, power wiring and fuses necessary to connect and operate all electrically powered equipment specified herein will be furnished and installed as a part of the total project. Coordinate work with Division 16. The intent is to have a complete and operational system. The Fire Protection Contractor shall be responsible for furnishing and installing the equipment necessary to provide for the complete and operational system.

B. Power Wiring: Wiring for equipment shall be furnished and installed as specified under Division 16.

C. Alarm Wiring: Wiring for alarm devices shall be furnished and installed as specified under Division 16.

1.17 SEISMIC REQUIREMENTS

A. General: Performance requirements to be used in the design of seismic controls are as identified on Structural drawing SG001.

B. Applicability: Seismic controls are required on Fire Protection systems.
1. See Part 3 paragraph, "Seismic Restraint Installation" for exceptions.

1.18 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire protection installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire protection items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."
   1. The Fire Protection Contractor shall provide access panels per the requirements of Division 8 Sections. Installation of the panels to be as directed by the General Contractor / Construction Manager.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Mechanical Sleeve Seals:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.
   5. Thunderline/Link-Seal.

C. Pipe Identification Systems:
   1. Seaton Name Plate Co.
   2. Brady: Signmark Div.; W.H. Brady Co.
   3. Kolbi Industries, Inc.

D. Equipment and System Nameplates:
   1. Central Sprinkler Corp.
   2. Reliable Automatic Sprinkler Co., Inc.
   3. Viking Corp.

E. Supports and Anchors:
   1. B-Line Systems, Inc.
   2. Carpenter & Patterson, Inc.
   3. Grinnell Corp.
   4. Fee & Mason Mfg. Co.

F. Seismic Restraints:
   1. B-Line Systems, Inc.
   2. Loos & Co., Inc.; Cableware Technology Division.
   3. Mason Industries, Inc.
   4. TOLCO Incorporated.
   5. Grinnell Corp.

2.2 JOINING MATERIALS

A. Refer to individual 13900 series Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

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

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Plastic, include two for each sealing element.
3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
1. Underdeck Clamp: Clamping ring with set screws.

2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, and an OD that completely covers opening. Escutcheon finishes to be as follows:
   1. Finished area, exposed to view: Polished chrome-plated.
   2. Unfinished areas: Galvanized steel.

2.6 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and non-metallic, dry hydraulic-cement grout.

   1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

2.7 ACCESS PANELS AND DOORS

A. Panels and doors are to be furnished to provide access to items required in 13900 Series Sections and the Fire Protection Drawings. Panels and doors are to furnished per the requirements of Division 8 Section, "Access Doors."

2.8 PIPE IDENTIFICATION SYSTEMS

A. General: Provide Manufacturer's standard products.
   1. Lettering: Comply with ASME A13.1 for lettering size, colors, and viewing angles.

B. Pipe Markers: Manufacturer's standard preprinted, semi-rigid snap-on, plastic color-coded pipe markers, ASME A13.1.

2.9 NAMEPLATES

A. General: Provide factory pre-printed porcelain enameled, 20 gauge minimum, steel nameplates.

B. Hydraulic Nameplates: Indicate the following:
   1. Area served.
   2. Design area, density, and occupancy classification.
   3. Flow and residual pressure required at the base of the riser.
   4. Inside hose stream demand.
   5. Outside hose stream demand.

C. Ancillary Nameplates: Provide for the following:
   1. Drain locations.
   2. Inspector's Test Stations.

3. Auxiliary Drains.
4. Concealed Floor Control and General Sprinkler Zone Valve Assemblies.

2.10 SUPPORTS AND ANCHORS

A. General: Provide Hangers, Supports and Anchors in accordance with NFPA 13, as specified herein, and as per the Manufacturer's Standardization Society Standard Practices, (MSS SP):
1. MSS SP-58, "Pipe Hanger and Supports – Materials, Design and Manufacture."
2. MSS SP-69, " Pipe Hanger and Supports – Selection and Application."
3. MSS SP-89, " Pipe Hanger and Supports – Fabrication and Installation Practices."

B. Material Compatibility: Provide hangers and supports which match the piping system material:
1. Copper Piping Systems: Provide copper plated or non-metallic coated hangers and supports.
2. CPVC Piping Systems: Provide non-metallic coated hangers and supports.

C. Miscellaneous Materials:
1. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Fasteners for fire protection systems include UL listing and FM approval.
5. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.

D. Retaining Straps: Install retaining straps on c-clamp style structure attachments.

2.11 SEISMIC CONTROLS

A. General: Restraint systems for these items shall consist of tension and compression, (strut) components, or tension only, (cable) components. In either case, provide necessary ancillary appurtenances as required to meet seismic restrain design criteria. Each and every component is not identified herein.
1. Systems and their components shall be provided by a single manufacturer.
2. Components shall be intended and listed for use with each other, (do not mix and match components not intended for use with each other).
3. Systems may include:
   a. Attachments to structure.
   b. Braces and other means of augmenting standard hanger and support assemblies.
4. Restraint devices constructed of aluminum or cast iron materials are not acceptable.

B. Strut Restraint Systems: Tension and Compression systems consisting of strut manufacturer's standard channel and attachments.

C. Restraining Cable Systems: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

A. Refer to Division 1 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Refer to Division 16 for requirements for cutting and patching electrical equipment, components, and materials.

C. Do not endanger or damage installed Work through procedures and processes of cutting and patching.

D. Arrange for repairs required to restore other work, because of damage caused as a result of fire protection installations.

E. No additional compensation will be authorized for cutting and patching work that is necessitated by ill-timed, defective, or non-conforming installations.

F. Perform cutting, fitting, and patching of fire protection equipment and materials 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. Upon written instructions from the Architect/Engineer, uncover and restore Work to provide for Architect/Engineer observation of concealed Work.

G. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.

H. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. General: Coordinate equipment and materials for installation with other building components.

B. Verify dimensions by field measurements.

C. Arrange for chases, slots, and openings in other building components to allow for fire protection installations.

D. Sequence, coordinate and integrate installations of fire protection materials and equipment for efficient flow of the work.

E. Coordinate the cutting and patching of building components to accommodate the installation of fire protection equipment and materials. Refer to Division 1.

F. Install mechanical 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.

G. Access Panels: Turn items over the the project General Contractor, (GC). The GC will install these items.

H. Coordinate the installation of mechanical materials and equipment above ceilings with suspension system, lighting fixtures, and other installations.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and other 13900 series Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following. Use One-piece escutcheons where ever possible in new construction. Split-casting units acceptable for installation on existing piping systems.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
      b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
      c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
         1) Seal space outside of sleeve fittings with grout.

   4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
   2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
   1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install fire protection equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.7 CLEAN CONSTRUCTION MEASURES

A. General: Take care during construction to maintain the integrity and cleanliness of pipe and equipment systems.

B. Exposed ends of piping systems and equipment connection ports shall be capped, plugged, or otherwise covered during construction.

3.8 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 9 Section "Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

C. Sprinkler Heads: Painting of sprinkler heads and their fusible link is prohibited.
1. Provide protective coverings on sprinkler heads where general area painting is taking place.
2. Remove coverings once painting is complete.
3. Replace heads which may have inadvertently been painted.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 5 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.11 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.12 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
1. Clean surfaces that will come into contact with grout.
2. Provide forms as required for placement of grout.
3. Avoid air entrapment during placement of grout.
4. Place grout, completely filling equipment bases.
5. Place grout on concrete bases and provide smooth bearing surface for equipment.
6. Place grout around anchors.
7. Cure placed grout.

3.13 SUPPORT AND ANCHORAGE INSTALLATION

A. General: Comply with NFPA 13, MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

C. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

D. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

F. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

G. Open Web Joist Attachments: Where systems are supported via attachments to open web steel joints, connections to the joists shall be made at joist panel points. Connections and loading shall also be made concentrically.

H. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

I. Support Spacing: Install piping supports at the following maximum spacing intervals using the minimum threaded rod sizes indicated;

Nominal Pipe Size (inches)	Max. Sch. 10, 30 & 40 Steel Pipe Span (feet)	Max. CPVC Pipe Span (feet)	Min. Rod Dia. (inches)
1	12	-	3/8
1-1/4	12	-	3/8
1-1/2	15	-	3/8
2	15	-	3/8
2-1/2	15	-	3/8
3	15	-	3/8
4	15	-	3/8
6	15	-	1/2
8	15	-	1/2

3.14 IDENTIFICATION SYSTEMS INSTALLATION

A. Nameplates: Install nameplates using corrosion resistant fasteners.
   1. Secure hydraulic nameplates directly to the riser valve which they apply.
   2. Install miscellaneous nameplates adjacent to the item being identified.
      a. For identification of items that are concealed, (i.e.; above a ceiling) install the nameplate in a clearly visible location.

B. Pipe Identification: Install pipe identification markers on fire protection system mains only, (not required on branch piping). Markers to be located as follows;
   1. At 50-foot intervals-max., 25-foot in congested areas.
   2. Adjacent to each system valve.

3. At either side of wall or floor penetration.
4. Behind access panels.

3.15 SEISMIC CONTROLS INSTALLATION

A. General: Install bracing in accordance with NFPA 13 or applicable building Code requirements.
   1. Cable Systems: Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
   2. Strut Systems: Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe hangers.

B. General Brace Location Requirements: Each straight run of piping or ductwork shall include a minimum of (2) transverse and (1) longitudinal brace.
   1. If the overall length of the run exceeds maximum brace spacing identified below, than additional bracing must be installed.
   2. Transverse brace locations shall include the ends of each straight run.
   3. A transverse brace within 2-feet of a 90° bend may meet the spacing requirements of a longitudinal brace in the adjacent 90° section to the order of half the maximum allowable longitudinal spacing minus 2 feet.
   4. Install a transverse brace within 2-feet of each pipe drop or rise to an equipment connection.
   5. Exceptions: Bracing is not required under the following circumstances.
      a. Piping suspended by individual hangers where the distance from top-of-pipe to the underside of supporting structure is 12-inches or less.
      b. Piping in mechanical equipment rooms which is smaller than 1-1/4-inch diameter.
      c. Piping in all other areas which is smaller than 2-1/2-inch diameter.
   6. Brace Spacing, (Steel Piping Systems; Welded, Grooved, or Threaded): Install bracing in accordance with the following maximum spacing:
      a. Transverse Brace Spacing: 50 feet.
      b. Longitudinal Braces: Install at 80 foot intervals, maximum.

3.16 START UP AND TESTING

A. General: The Fire Protection Contractor is responsible for startup of all equipment provided in 13900 Series Sections.

3.17 FINAL CLEANING

A. General: Refer to Division 1 for general requirements regarding final cleaning.

END OF SECTION

SECTION 13931

SPRINKLER SYSTEM MODIFICATIONS

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.

B. The requirements of Section 13900, "Basic Fire Protection Materials and Methods" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes the following fire-suppression systems inside the building:
   1. Sprinkler Systems.

B. Related Sections include the following:
   1. Division 16 Section "Fire Alarm" for alarm device wiring.
   2. Section 13960, "Clean Agent Extinguishing Systems" for Inergen Systems.

1.3 DEFINITIONS

A. AHJ: Authorities Having Jurisdiction.

1.4 SYSTEM DESCRIPTIONS

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

1.5 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig (1200 kPa).

B. Fire-suppression system designs and installations shall be approved by Authorities Having Jurisdiction.

C. Sprinkler Systems:
   1. Sprinkler Occupancy Hazard Classifications:

a. First Floor: Ordinary Hazard, Group 2 throughout.
b. Equipment and storage spaces on Floors Two through Five: Ordinary Hazard, Group 1.
c. Office and Common spaces on Floors Two through Five: Light Hazard.

2. Maximum Protection Area per Sprinkler:
a. Light-Hazard Occupancy: 225 sf per sprinkler.
b. Ordinary-Hazard Occupancy: 130 sf per sprinkler.

1.6 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
1. Product Data: For the following:
a. Piping materials, including sprinkler specialty fittings.
b. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
c. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
2. Shop Drawings: Sprinkler system layout drawings which include information as required by NFPA 13. Drawings shall be approved by the Authorities Having Jurisdiction prior to being submitted to the Architect. Drawings shall be generated at 1/8-inch per foot minimum scale. Information to be shown includes, but is not limited to the following;
a. Pipe size, location and elevation.
b. Sprinkler head locations and types.
c. Seismic brace details and locations, (where bracing is required by Section 13900).
d. Hanger details.
3. Hydraulic Calculations: For extensively modified portions of the base building system, as required by the AHJ's.

C. Post-Construction Submittals: Submit the following items upon completion of systems installations.
1. NFPA 13 "Contractor's Material and Test Certificate for Aboveground Piping"
2. Operation and Maintenance Data: Include approved product submittals and as-built shop drawings inO&M manuals, (see Section 13900).

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Installer's responsibilities include designing, fabricating, and installing fire-suppression systems.
1. Contractor to hold a sprinkler installer license in the project State.
2. Contractor's designer to be NICET Level IV Certified or a Registered Professional Fire Protection Engineer.
3. Contractor's designer to be a Responsible Managing Supervisor, (RMS).

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. Listing and Approval: Unless otherwise required by the Owner's Insurance Underwriter, components intended for use in fire suppression systems shall be "listed" or "approved."
   1. "Listed": UL Listed.
   2. "Approved": FM Approved.

1.8 COORDINATION

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

1.9 EXTRA MATERIALS

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

   1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Grooved-Joint Piping Systems:
   1. Anvil International, Inc.
   2. Central Sprinkler Corp.
   3. Star Pipe Products; Star Fittings Div.
   4. Victaulic Co. of America.

C. Sprinkler Heads:
   1. Central Sprinkler Corp.
   2. Globe Fire Sprinkler Corporation.
   3. Grinnell Fire Protection.
   4. Reliable Automatic Sprinkler Co., Inc.
   5. Star Sprinkler Inc.
   6. Viking Corp.

2.2 STEEL PIPE AND FITTINGS

A. Threaded-End, Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.

1. Cast-Iron Threaded Flanges: ASME B16.1.
2. Malleable-Iron Threaded Fittings: ASME B16.3.
3. Gray-Iron Threaded Fittings: ASME B16.4.
4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.

B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 (DN 125) and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 (DN 150 to DN 250); with factory- or field-formed, roll-grooved ends.
1. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
2. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, flexible and rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
   a. Where intended for dry-pipe service, coupling assembly shall be UL listed for such service.

2.3 SPRINKLERS

A. General: Sprinklers shall be UL listed or FMG approved, with 175-psig (1200-kPa) minimum pressure rating.
1. Sprinklers shall be quick response type, K=5.6, 155°F rated, nominal ½-inch orifice, unless otherwise stated.
   a. Option: Contractor may propose the use of sprinkler heads with alternate K factor and orifice sizes, pending available project flow and pressure requirements can satisfy their requirements.
2. Not Allowed: Sprinklers which employ O-ring seals and sprinklers recently involved in the recent Central Sprinkler recall.

B. Heat Responsive Elements shall comply with the following:
1. UL 199, for nonresidential applications.
2. UL 1626, for residential applications.
3. UL 1767, for early-suppression, fast-response applications.

C. Recessed pendent type with matching push-on escutcheon plate:
1. Finish: White enamel.
2. Escutcheon: White enamel.
3. Fusible Link: Glass bulb type, temperature rated for the specific hazard.

D. Concealed pendent type with matching push-on cover plate:
1. Finish: Rough bronze.
2. Cover: White enamel.
3. Fusible Link: Glass bulb type, temperature rated for the specific hazard.

E. Standard upright type.
1. Finish: Rough bronze.

2. Fusible Link: Glass bulb type, temperature rated for the specific hazard.

F. Recessed horizontal sidewall type with matching push-on escutcheon plate.
1. Finish: White enamel.
2. Escutcheon: White enamel.
3. Fusible Link: Glass bulb type, temperature rated for the specific hazard.

G. Fusible Link: Glass bulb type, temperature rated for the specific hazard

H. Dry Barrel Type, recessed pendent or horizontal type with matching push-on escutcheon plate. Dry barrel to be a minimum of 24-inches long. Coordinate exact length with construction requirements.
1. Finish: White enamel.
2. Escutcheon: White enamel.
3. Fusible Link: Solder type, temperature rated for the specific hazard.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

J. Sprinkler Cabinets: As furnished by the same manufacturer as the heads.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

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

3.2 PIPING APPLICATIONS, GENERAL

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Standard-Pressure, Wet-Pipe Systems, 175-psig (1200-kPa) Maximum Working Pressure:

1. NPS 2 and Smaller: Threaded-end, black, schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.

2. NPS 2-1/2 and Larger: Grooved-end, black, schedule 10 steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
   a. Threadable Light wall piping systems not allowed.
   b. NPS 8 and Larger Option: Grooved-end, black, schedule 30 steel pipe with roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.3 JOINT CONSTRUCTION

A. Refer to Section 13900, "Basic Fire Protection Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Do not thread pipe with wall thickness less than Schedule 40.

C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
   1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

D. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.

   1. NPS 2 (DN 50) and Smaller: Use dielectric unions, couplings, or nipples.
   2. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flanges.

3.4 PIPING INSTALLATION

A. Refer to Section 13900, "Basic Fire Protection Materials and Methods" for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install sprinkler piping with drains for complete system drainage.

E. Hangers and Supports: Comply with NFPA 13 for hanger materials.
   1. Install sprinkler system piping according to NFPA 13.

F. Seismic Restraints: Install piping according to NFPA 13 to protect from earthquake damage.

G. Fill wet-pipe systems with water.

3.5 SPRINKLER APPLICATIONS

A. General: As per Westbrook Ordinances, provide and install sprinkler protection at finished ceiling levels as well as above ceilings.

1. Rooms without Ceilings: Upright sprinklers.
   a. Install guards on heads located in Mechanical and storage rooms.
2. Rooms with Suspended Ceilings: Recessed pendent sprinklers at ceiling levels, upright heads above the ceiling.
3. Rooms with Hard Drywall, (or similar) Ceilings: Concealed sprinklers at ceiling levels, upright heads above the ceiling.
4. Wall Mounting: Sidewall sprinklers. Use recessed sidewalls in finished spaces.
   a. Application includes at the ends of vaulted ceilings.
5. Spaces Subject to Freezing: Dry-barrel type heads, (sidewall or pendent).

3.6 SPRINKLER INSTALLATION

A. General: Install sprinklers in obvious patterns with other ceiling mounted devices, (lights, diffusers, etc.). Do not "randomly" install sprinkler heads in hard ceilings.
1. Refer to the Drawings for other sprinkler placement requirements, (Fire Protection and/or Architectural reflected ceiling plans).
2. Install sprinklers centered in suspended ceiling tiles.

B. Upright Heads in Equipment and Storage Spaces: In base building spaces without ceilings that are not intended for future fit-up, install heads using a 1x1/2-inch reducer, 1-inch nipple and 1-inch tee. Do not use a branch size x ½-inch tee to supply heads.

C. Upright Heads in "Shell" Spaces: In spaces which will be fit-up at a future date, install upright sprinkler head coverage according to the following:
1. Install heads using a 1x1/2-inch reducer, 1-inch nipple and 1-inch tee. Do not use a branch size x ½-inch tee to supply heads.
2. Provide an additional in-line 1-inch tee on the nipple supplying the upright head. Plug the outlet of this tee. This will provide a connection port for future fit-up pendent sprinkler heads.

D. Pendent Heads: Install pendent heads using 1-inch arm overs, or return bends. Directly dropping off branch lines is unacceptable. Fabricate arm-overs to include an upright nipple, 1x1/2-inch reducer and above ceiling upright head.

E. Dry Heads: Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.
1. Dry pendent heads to be "tee'ed" directly into a drainable branch line such that a column of water is not stagnant on top of the dry barrel.
2. Provide dry sidewall, (extended coverage if necessary) coverage for the First Floor level loading dock area. If adequate coverage cannot be achieved using dry heads, provide a small anti-freeze system at no additional cost.
   a. System to include a local reduced pressure zone, (RPZ) backflow preventer, anti-freeze fill station, and listed expansion tank. Route RPZ relief waste to drain.
   b. Locate anti-freeze system components in the nearby Janitor's Closet.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.8 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
3. Coordinate with fire alarm tests. Operate as required.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.9 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

END OF SECTION

SECTION 15000

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies the basic requirements for mechanical installations and includes requirements common to more than one section. It expands and supplements the requirements specified in sections of Division 1.

1.3 DEFINITIONS

A. Complete and Operational System: A Mechanical system that has been installed, tested, cleaned, signed-off by appropriate Authority and made operational. Completion of Owner training to be part of this requirement.

B. Mechanical Contractor: The project Contractor responsible for the installation of the Mechanical systems and equipment. This designation refers to a Contractor who performs HVAC and/or Plumbing work.

1.4 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: All work shall be performed by qualified journeymen of their respective trades who are employed by a firm that can demonstrate successful experience with work similar in type, quality and extent to the work required by this project.

1.6 BASIS OF MECHANICAL DESIGNS

A. General: The following information is intended to provide an overview of the intent and operation of the project Mechanical systems. It is not intended that each and every project Mechanical scope item be captured herein. The absence of a specific item or system in the

descriptions below does not absolve the Mechanical Contractor(s) from providing the work identified by other Sections and the Drawings.

1. The Mechanical Contractor(s) shall provide complete and operational systems and installations.

B. Mechanical Design Criteria:

1. System type and capacity based on Tenant requirements.

2. HVAC system design to be based on 2001 ASHRAE Fundamentals Handbook, Climatic design conditions data for Portland, Maine.
   a. 99% Winter Frequency of Occurrence: -20 deg. F. db.
   b. 1% Summer Frequency of Occurrence: 98 deg. F. db / 76 deg. F. wb.

3. Indoor design conditions:
   a. Winter: 70 – 74 deg. F db, 25-30% relative humidity
   b. Summer: 72 – 74 deg. F db, 40-60% relative humidity

4. Cooling capacity and ventilation to be based on the following conditions:
   a. Occupancy Density: 170 sqft / person gross, 150 sqft / person in tenant usable areas.
   b. Office equipment internal load: 3 watts/sqft (assumes 1 laser printer/6 people and 1 computer/person).
   c. Lighting internal load: 2 watts/sqft.
   d. Maximum 300 sqft/ton cooling.
   e. Minimum 1.2 cfm supply air / usable sqft of floor area.

C. HVAC Systems Description:

1. General: Provide complete, tested and operational Mechanical and Plumbing systems to support the base building. Mechanical and Plumbing installations shall be seismically braced per BOCA Building Code requirements.

2. Air Handlers:
   a. Provided under Base Building Contract.

3. Heating System:
   a. Provided under Base Building Contract.
   b. Connection to the Base Building hydronic heating system to be in the ceiling cavity adjacent to the VAV boxes at each floor level. Extend piping to VAV terminal units.
   c. Piping to be sch. 40 steel or type L copper.

4. Tenant Fit-up Zoning:
   a. Zoning indicated on Tenant Fit-Up drawings.

5. Tenant Fit-up Air distribution:
   a. Connection to Base Building supply and return to be at each air handler duct stubs at each floor level.
   b. Provide VAV terminal units with hot water reheat coils for all zones.
   c. Provide ductwork between Base Building duct stubs and VAV terminal units.

d. Provide full size plenum supply duct downstream of each VAV terminal unit including branch ducts take-offs, volume dampers, flexible ductwork (5'max) to lay-in ceiling diffusers.
e. Provide ceiling transfer grilles with hard ducted elbow, penetrate full height walls to deck to ceiling plenum at each level.
f. Provide ceiling return grilles with hard ducted elbow to ceiling plenum. In spaces with full height walls to deck, penetrate wall with stub to ceiling plenum.
g. HVAC system ductwork to be galvanized sheet metal fabricated and installed in accordance with ASHRAE and SMACNA standards. HVAC system ductwork to be sized for main trunk maximum air velocity of 1500 ft/min. Branch ducts to be sized for maximum air velocity of 1000 ft/min.
h. Air distribution systems to be designed in accordance with ASHRAE and SMACNA standards to meet maximum NC40 noise levels in the occupied space.
i. Supply air ductwork shall be insulated in accordance with ASHRAE standards.

6. Fourth Floor Server Room:
   a. The Server Room environment shall be maintained by one (1) Computer Room Air Conditioner (CRAC) as scheduled on the drawings.

      1) Basis of Design:
         a) Environmental conditions: 72 deg. F db, 50% relative humidity.
         b) Cooling load: Load based on information provided by the Tenant.
         c) Redundancy: A VAV box will serve this space in case of CRAC failure.
         d) One (1) nominal 5-ton air-cooled unit, including factory installed condensate pump.
         e) System heat rejection equipment to include one (1) roof-mounted air-cooled condensing unit and associated piping.
         f) Unit to have dedicated microprocessor controls.

      2) Other acceptable computer room air handler manufacturers:
         a) Carrier Corp.
         b) Mitsubishi.

7. Automatic Temperature Controls:
   a. Direct Digital Control (DDC) system provided under Base Building contract.
   b. System and components to be manufactured, furnished and installed by same manufacturer of Base Building DDC system.
   c. Provide control devices, sub-panels, thermostats, sensors, and control wiring as required for Tenant spaces.
      1) All VAV zones to have temperature sensors with user adjustable setpoints and overrides.
      2) All open office areas and common areas to have temperature sensors, non-user adjustable.

D. Plumbing Systems Description:

1. General: Connection to plumbing systems to be at the utility risers provided under the Base Building contract. Each Base Building riser includes sanitary drain, vent, and domestic cold water valved and capped in several locations at each floor.

2. Sanitary and Vent
   a. Piping to be no-hub cast iron above grade and PVC below grade.

3. Storm Drain
   a. Provided under Base Building Contract.

   Natural gas
   b. Provided under Base Building Contract.

4. Water Service:
   a. Provided under Base Building Contract.
   b. Piping Tenant fixtures to be Type L copper and insulated per ASHRAE standards.

5. Plumbing Fixtures:

   a. Plumbing Fixtures:
      1) Main bathrooms: Provided under Base Building
      2) Break Room and Coffee Areas: Provided as part of Tenant Fit-up.

6. Domestic Hot Water:
      1) Provided as part of Tenant Fit-up.

   b. Piping to Tenant fixtures shall be Type L copper and insulated per ASHRAE standards.

7. Server Room:
   a. Provide drain to indirect waste from CRAC factory installed condensate pump.

1.7 CODES AND STANDARDS

A. General: The following listing is intended to identify the major Codes and Standards for the project. This information is at least partially provided on the G-000 series Drawings as well. In the event that there is a discrepancy between the information contained herein and that on the G-000 Drawings, the information herein shall govern.
   1. In the event that an item is included on the G-000 Drawings and is not listed herein, compliance with the requirements of said item is required.
   2. The exclusion of an applicable Code or Standard in the list below does not absolve the Contractor from meeting the requirements of said Code or Standard.

B. Codes: Work performed on the project must comply with the requirements of the following:
   1. BOCA National Building Code, 1999 edition.
   2. 1998 International Mechanical Code with 1999 Supplement
   3. State of Maine Internal Plumbing Rules, Latest Edition

C. Standards: Work performed on the project must comply with the requirements of the following Industry Standards:
   1. ASHRAE Standard 62-2001 Ventilation for Acceptable Indoor Air Quality
   2. ASHRAE Standard 90.1-1999 Energy Standard for Buildings Except Low-Rise Residential Buildings.
   3. NFPA 90A – Installation of Air-Conditioning and Ventilating Systems-1999

1.8 DRAWINGS AND SPEICIFICATIONS

A. General: The drawings and specifications are complimentary.
   1. What is shown or noted on the drawings, but not mentioned in the specifications, automatically becomes a part of the specifications.
   2. What is noted in the specifications, but not shown on the drawings, automatically becomes a part of the drawings.
   3. Conflicts between the requirements of the drawings and the specifications must be brought to the immediate attention of the Architect/Engineer.
      a. The more stringent requirement will apply, unless ruled otherwise by the Architect/Engineer.
      b. When conflicts or discrepancies are noted, no work shall proceed until the conflict or discrepancy has been resolved by the Architect/Engineer.

B. Mechanical Drawings and Division 15 Specification Sections: The Mechanical Contractor shall bear the responsibility of determining full extent of work required by Contract Documents. The Mechanical Contractor shall refer to site, architectural, structural, electrical and other Drawings and Specification Sections that indicate types of construction with which work of this Section must be coordinated. The Mechanical Contractor shall review the work with the General Contractor / Construction Manager to establish the extent of work for their trade, and to determine whether there will be any interference with the work of other trades. If the work is later found to include work required to complete and coordinate the work or another trade, or to interfere with the work of another trade then the changes required to complete the work or to eliminate the interference shall be made without additional cost to the Owner.
   1. The Drawings schematically indicate the order of connection of the various system components. Each and every nuance and detail in not indicated. Whether specifically shown or not, all items shall be connected in accordance with Code, the details provided, accepted trade practices, and the intent of the Contract Documents. Coordinate with the other trades.

C. Exact locations of ceiling mounted items shall be as shown and detailed on the Architectural reflected ceiling plans.

D. System components (thermostats, sensors, volume dampers, access doors, etc.) are identified throughout the Drawings for proper system operation. If any component is inadvertently omitted from the drawings, provide that component as per a similar location.

1.9 SUBSTITUTIONS

A. General: See Division 1 for product substitution requirements.

1. No substitute materials or equipment shall be incorporated in the work without the written approval of the Architect/Engineer.

B. Substitute materials and equipment submitted for approval must fit within the spaces available with neither substantial alteration nor increased pressure drops or friction losses.

C. Approval of substitute materials or equipment by the Architect/Engineer shall not relieve the contractor from his responsibility to provide a complete and operational mechanical system.

D. The Architect/Engineer's decision as to the equality or acceptability of proposed substitutions for the materials and equipment specified shall be final.
1. Any additional costs incurred by such substitutions, including additional costs to other trades, or engineering design costs, shall be borne by the Contractor. This includes costs associated with the design and installation of infrastructure and support systems to facilitate a proposed substitution. This cost will be borne by the Mechanical Contractor.

1.10 MECHANICAL SUBMITTALS

A. General: Refer to Division 1 for submittal definitions, requirements and procedures.

B. Submittal of shop drawings, certified performance data, and samples will be accepted only when submitted per Division 1. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.

C. Submittals for each mechanical trade shall be complete, including all items for which submission and approval is required, and each sheet containing performance data shall be clearly highlighted and marked for the appropriate model or type of equipment to be reviewed. Intended use shall be written on each submittal sheet for each different type of equipment or material to be reviewed (i.e. valves for domestic water or heating hot water, etc.). Incomplete or unmarked submittals WILL BE RETURNED to the Contractor without action.

D. Submittals shall be organized by specification Section and shall be clearly labeled. Submittals for HVAC and Plumbing items covered by a "shared" Mechanical specification Section, (i.e., hangers and supports, insulation) shall be separate and clearly labeled as to the trade intended.
1. Unclear and/or mixed submittals will not be processed.

E. When two or more items of the same material or equipment are required, (i.e., plumbing fixtures, pumps, valves, air handling units, fans, diffusers, registers and grilles.) they shall be products of the same manufacturer insofar as possible.
1. This does not apply to raw or bulk materials such as pipe and fittings, sheet metal, etc.

1.11 RECORD DOCUMENTS

A. General: Refer to Division 1 for requirements.

B. As work progresses, mark Drawings to indicate revisions to piping and ductwork, size and location including locations dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned for column

lines; mains and branches of piping systems, with valves and control devices located and numbered; Change Orders; concealed control system devices.

C. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.

D. At completion of work and prior to final request for payment, the Mechanical Subcontractor(s) shall submit a complete set of reproducible record drawings showing all systems as actually installed. Drawings submitted shall be in the following format:

1. CADD generated.

   a. SMRT design Drawing files may be available as a starting point for CADD generated drawings. A release form will need to be signed to facilitate this.
   b. CADD generated drawings shall be ultimately delivered in AutoCAD 2000 format on CD.

2. Valve Tags: Record drawings to include valve tag markers that correspond to the valve tag chart provided under the O&M Manual Section.

1.12 OPERATION AND MAINTENANCE, (O&M) MANUALS

A. General: Refer to Division 1 for procedures and requirements for preparation and submittal of O&M Manuals.

B. Systems Descriptions: Provide description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.

C. Operating Procedures: Provide manufacturer's printed data, including start-up, break-in, routine and normal operating instructions; regulation control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.

D. Maintenance Procedures: Provide for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

E. Servicing Instructions: Provide instructions, lubrication charts and schedules.

F. Product Data: Provide copies of all approved submittals.

1.13 OWNER TRAINING

A. General: Refer to Division 1 for general requirements.

1.14 WARRANTIES

A. Refer to Division 1 for project requirements for warranties. Individual warranties are required for each item of power driven or other mechanical equipment having moving parts, and wherever else specified in Division 15.
   1. Submit the warranties specified in Division 15 in a vinyl covered, three ring binder, tabulated and indexed for easy reference.

B. Provide complete warranty information for each item, to include date of commencement; duration; and the names, addresses, and telephone numbers and procedures for filing claims and obtaining warranty services.

C. Duration of warranties shall be not less than one year from the date of substantial completion of the facility unless prior approval has been granted in writing by the Architect/Engineer. If the manufacturer's warranty expires less than one year from the date of substantial completion, that warranty service and replacement of parts shall be provided by the mechanical subcontractor at no cost to the Owner.

1.15 DELIVERY, STORAGE AND HANDLING

A. General: Refer to Division 1 for material procurement requirements.

B. 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.

C. Store equipment and materials at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.

D. Coordinate deliveries of mechanical 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.

1.16 ENERGY EFFICIENCY

A. All equipment shall have minimum efficiency as described in ASHRAE Standard 90.1-1999, January 1, 1999 requirements. All equipment suppliers must be aware of the requirements and submitted equipment shall meet these minimum requirements.

1.17 REFRIGERANTS AND OTHER HAZARDOUS MATERIALS

A. The Mechanical Contractor shall be responsible for the capture, removal, and disposal of materials resulting from the Work.
   1. Comply with the requirements of applicable Codes, Standards and Authorities.

1.18 DIVISION OF MECHANICAL AND ELECTRICAL RESPONSIBILITY

A. General: Line voltage switches, fused switches, outlets, motor starters, power wiring and fuses necessary to connect and operate all electrically powered equipment specified herein will be furnished and installed as a part of the total project. Coordinate work with Division 16. The intent is to have a complete and operational system. The Mechanical Contractor shall be responsible for furnishing and installing the equipment necessary to provide for the complete and operational system.

B. Motor Starters: Where not specified in Division 15, shall be furnished and installed under Division 16.

C. Power Wiring: Wiring for equipment shall be furnished and installed as specified under Division 16.

D. Temperature Control Wiring: Wiring and interlocks shall be furnished and installed under Division 15.

E. Disconnect Switches: Where not specified in Division 15, shall be furnished and installed under Division 16.

1.19 TEMPORARY HEATING

A. Refer to Division 1 requirements regarding temporary facilities during construction.

B. The Mechanical Contractor shall provide necessary heating equipment, fuel sources, water treatment, and related items as necessary to meet the intent of the requirements.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 START UP AND TESTING

A. General: Contractor shall provide all fuel for startup and testing of all equipment provided in this section. Refer to Division 1 for responsibility of electrical power.

B. The Mechanical Contractor is responsible for startup of all equipment provided in Division 15 Sections.

C. The Mechanical Contractor shall verify that systems are complete and operational before commencing with balancing work.

D. Prior to balancing, ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.

4. Final filters are clean and in place.
5. Duct systems are clean of debris.
6. Fans and pumps are rotating correctly.
7. Air outlets are installed and connected.
8. Duct system leakage is minimized.
9. Hydronic systems are flushed, filled and vented.
10. Proper strainer baskets are cleaned and in place.
11. Service and balance valves are open.

E. Power Outage Test: Entire control system and all mechanical equipment shall be run through a simulated site power outage and shall regain standard operation sequences when normal power is restored.

F. Owner Witness of Test: The Owner shall witness final power outage test. Entire control system and all mechanical equipment shall pass power outage test prior to Owner witness.

3.2 FUNCTIONAL TESTING

A. General: The entirety of the Mechanical Equipment and Controls System shall be tested for functional performance for specified operation and control sequences.

3.3 FINAL CLEANING

A. General: Refer to Division 1 for general requirements regarding final cleaning.

B. Refer to Section 15950, "Testing, Adjusting and Balancing" for requirements of cleaning filters, strainers, and other mechanical systems prior to final acceptance.

END OF SECTION

SECTION 15081

DUCT INSULATION

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes fiberglass blanket duct insulation, field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include the following:

1. Section 15083, "Pipe Insulation" for insulation for piping systems.
2. Section 15815, "Metal Ducts".

1.3 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate clearance requirements with duct installer for insulation application.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Fiber Glass Insulation:

1. CertainTeed.
2. Knauf FiberGlass.
3. Owens-Corning Fiberglas Corp.
4. Schuller International, Inc. / Johns Manville Insulations

2.2 INSULATION MATERIALS

A. Fiberglass Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket (FSK) manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film. 'K' value: 0.29 Btu*in/(hr*sqft*degree F) at 75 degree F. Based on Johns Manville Microlite.

2.3 ACCESSORIES AND ATTACHMENTS

A. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.

1. Welded Pin Holding Capacity: 100 lb (45 kg) for direct pull perpendicular to the attached surface.

B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.

1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb (45 kg) for direct pull perpendicular to the adhered surface.

2.4 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

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

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply multiple layers of insulation with longitudinal and end seams staggered.

E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

F. Keep insulation materials dry during application and finishing.

G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

H. Apply insulation with the least number of joints practical.

I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

L. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.

M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.

N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.

1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.

O. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.

P. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.

3.4 FIBER GLASS INSULATION APPLICATION

A. Blanket Applications for Ducts: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions larger than 24 inches (450 mm). Space 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
   b. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   c. Do not overcompress insulation during installation.
2. Impale insulation over anchors and attach speed washers.
3. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches (50 mm) from one edge and one end of insulation segment. Secure laps to

adjacent insulation segment with 1/2-inch (13-mm) staples, 1 inch (25 mm) o.c., and cover with pressure-sensitive tape having same facing as insulation.

5. Overlap unfaced blankets a minimum of 2 inches (50 mm) on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches (450 mm) o.c.
6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- (150-mm-) wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches (150 mm) o.c.
8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
9. Terminate insulation around duct access doors and seal insulation edges.

3.5 DUCT SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.

C. Insulate the following duct systems:

1. Supply and return ductwork.
2. Exhaust ductwork within 10 feet of exterior opening.

D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Metal ducts with duct liner.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums, casings, terminal boxes, and sections.
4. Flexible connectors.
5. Vibration-control devices.
6. Testing agency labels and stamps.
7. Nameplates and data plates.
8. Access panels and doors in air-distribution systems.

3.6 INDOOR DUCT APPLICATION SCHEDULE

A. Service: Rectangular and round, supply and return-air ducts, above ceilings, concealed, in mechanical rooms, and in unconditioned space.

1. Material: Fiberglass blanket.
2. Thickness: 1 ½ inches.

3. Number of Layers: one.
4. Factory-Applied Jacket: FSK or vinyl-film. Vapor retarder required on ducts conveying air below ambient temperature.

B. Service: Exhaust ducts within 10' of exterior opening.

1. Material: Fiberglass blanket.
2. Thickness: 1 inch.
3. Number of Layers: one.
4. Factory-Applied Jacket: FSK or vinyl-film.

END OF SECTION

SECTION 15083

PIPE INSULATION

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

B. Related Sections include the following:

1. Section 15081 "Duct Insulation" for insulation for ducts and plenums.

1.3 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.

1. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in the appropriate piping section.

B. Coordinate clearance requirements with piping installer for insulation application.

1.7 SCHEDULING

A. Schedule insulation application after testing piping systems and, where required. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Fiber Glass Insulation:

1. CertainTeed Manson.
2. Knauf FiberGlass GmbH.
3. Owens-Corning Fiberglas Corp.
4. Schuller International, Inc. / Johns Manville Insulations

C. Flexible Elastomeric Thermal Insulation:

1. Armstrong World Industries, Inc.
2. Rubatex Corp.

2.2 INSULATION MATERIALS

A. Fiber Glass Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Thermal conductivity: 0.23 Btu*in/(hr*sq ft*degree F) at 75 degrees F.

2. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all-purpose, vapor-retarder jacket complying with ASTM C 1136. Based on Johns Manville Micro-Lok.

3. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.

4. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:

   a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.

   b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.

5. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.

B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Thermal conductivity: 0.27 Btu*in/(hr*sq ft*degree F) at 75 degrees F.
2. Adhesive: As recommended by insulation material manufacturer.
3. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.
4. Based on Armstrong AP Armaflex.

C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils (0.5 mm) thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White or gray.

D. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-(0.5-mm-) thick, high-impact, ultraviolet-resistant PVC.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

E. Aluminum Jacket: Aluminum roll stock, ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209 (ASTM B 209M), 3003 alloy, H-14 temper.

1. Finish and Thickness: Corrugated finish, 0.010 inch (0.25 mm) thick.
2. Moisture Barrier: 1-mil- (0.025-mm-) thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

2.4 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces. Remove materials that will adversely affect insulation application.

3.3 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.

H. Keep insulation materials dry during application and finishing.

I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

J. Apply insulation with the least number of joints practical.

K. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches (300 mm) from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. Install insert materials and apply insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.

M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

O. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches (100 mm) o.c.
3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches (40 mm). Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches (100 mm) o.c.

    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.

4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.

P. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Seal penetrations with vapor-retarder mastic.
2. Apply insulation for exterior applications tightly joined to interior insulation ends.
3. Extend metal jacket of exterior insulation outside roof flashing at least 2 inches (50 mm) below top of roof flashing.
4. Seal metal jacket to roof flashing with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section 07270 "Firestopping."

S. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.4 FIBER GLASS INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet (4.5 to 6 m) to form a vapor retarder between pipe insulation segments.
3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch (25 mm), and seal joints with vapor-retarder mastic.

C. Apply insulation to fittings and elbows as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
3. Cover fittings with standard PVC fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
3. Apply insulation to flanges as specified for flange insulation application.
4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
5. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

3.5 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.
5. surface.

3.6 FIELD-APPLIED JACKET APPLICATION

A. Apply metal jacket where indicated, with 2-inch (50-mm) overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches (300 mm) o.c. and at end joints.

3.7 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.8 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces, unless otherwise indicated.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
8. Flanges and unions at equipment on hot piping systems conveying fluids 140 degrees F or less. Bevel and seal ends of insulation.

3.9 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.10 INTERIOR INSULATION APPLICATION SCHEDULE

A. Service: Heating hot-water supply and return.

1. Operating Temperature: 100 to 200 deg F (38 to 93 deg C).
2. Insulation Material: Fiberglass with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:
   a. Piping up to 4": 1.0" thickness.
   b. Piping insulation is not required between the control valve and coil on run-outs when the control valve is located within 4 feet of the coil and the pipe size is 1 inch or less.
4. Vapor Retarder Required: No.
5. Finish: None.

B. Service: Domestic hot water.

1. Operating Temperature: 60 to 140 deg F (15 to 60 deg C).
2. Insulation Material: Fiber glass with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Piping up to 1 1/4": 0.5" thickness.
   b. Piping 1-1/4" and greater: 1" thickness.
4. Vapor Retarder Required: No.
5. Finish: None.

C. Service: Domestic cold water.

1. Operating Temperature: 35 to 60 deg F (2 to 15 deg C).
2. Insulation Material: Fiber glass with jacket.
3. Insulation Thickness: Apply the following insulation thicknesses:

   a. Piping up to 1 1/4": 0.5" thickness.
   b. Piping 1-1/4" and greater: 1" thickness.
4. Vapor Retarder Required: Yes.
5. Finish: None.

D. Service: Condensate drain piping from cooling coils.

1. Operating Temperature: 35 to 75 deg F (2 to 24 deg C).
2. Insulation Material: Fiberglass with jacket.
3. Insulation Thickness: ½".
4. Vapor Retarder Required: Yes.
5. Finish: none.

E. Service: Refrigerant suction and hot-gas piping.

1. Operating Temperature: 40 to 60 deg F (2 to 10 deg C).
2. Insulation Material: Flexible elastomeric.
3. Insulation Thickness: Apply the following insulation thicknesses:

    a. All piping: 1" thickness.
4. Finish:
    a. Indoors: none.
    b. Outdoors: weather-resistant protective finish equal to field applied, vinyl/acrylic water based, Rubatex Protective Coating.

END OF SECTION

SECTION 15181

HYDRONIC PIPING AND SPECIALTIES

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes piping, general-duty valves, special-duty valves, and hydronic specialties for heating water systems; and condensate drain piping.

1.3 SUBMITTALS

A. Product Data:

1. For pipe, tubing, and fittings. Include manufacturers technical data indicating pressure and temperature classifications; end connections; and dimensions. Indicate application for each type.

2. For each type of general-duty valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

3. For each type of special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing for diverting fittings, calibrated balancing valves, and automatic flow-control valves. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

B. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.

3. Failed test results and corrective action taken to achieve requirements.

C. Maintenance Data: For hydronic specialties and special-duty valves to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to the ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

C. ASME Compliance: ASME B31.9 for building services piping valves.

D. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.5 COORDINATION

A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate pipe fitting pressure classes with products specified in related Sections.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Calibrated Balancing Valves:

a. Armstrong Pumps, Inc.
b. Flow Design, Inc.
c. Gerand Engineering Company.
d. Griswold Controls.
e. ITT Bell & Gossett; ITT Fluid Technology Corp.
f. Taco, Inc.

2.2 PIPING MATERIALS

A. General: Refer to Part 3 "Piping Applications" Article for applications of pipe and fitting materials.

2.3 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B).

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.

2.4 STEEL PIPE AND FITTINGS

A. Steel Pipe, NPS 2 (DN 50) and Smaller: ASTM A 53, Type S (seamless) or Type F (furnace-butt welded), Grade B, Schedule 40, black steel, plain ends.

B. Steel Pipe, NPS 2-1/2 (DN 65): ASTM A 53, Type E (electric-resistance welded), Grade B, Schedule 40, black steel, plain ends.

1. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, Schedule 40, black steel; seamless for NPS 2 (DN 50) and smaller and electric-resistance welded for NPS 2-1/2 (DN 65) and larger.

C. Cast-Iron Threaded Fittings: ASME B16.4; Class 125.

D. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150.

E. Malleable-Iron Unions: ASME B16.39; Classes 150.

F. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

H. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.

I. Welding Materials: Comply with Section II, Part C, of the ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.5 SPECIAL-DUTY VALVES

A. Refer to Part 3 "Valve Applications" Article for applications of each valve.

B. Calibrated Balancing Valves, NPS 2 (DN 50) and Smaller: Bronze body, ball type, 125-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, and having threaded ends. Valves shall have calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, and be equipped with a memory stop to retain set position.

2.6 HYDRONIC SPECIALTIES

A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure; 225 deg F (107 deg C) operating temperature; manually operated with screwdriver or thumbscrew; with NPS 1/8 (DN 6) discharge connection and NPS 1/2 (DN 15) inlet connection.

B. Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for NPS 2-1/2 (DN 65) and larger, threaded connections for NPS 2 (DN 50) and smaller, bolted cover, perforated stainless-steel basket, and bottom drain connection.

C. Flexible Connectors: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket; 150-psig (1035-kPa) minimum working pressure and 250 deg F (121 deg C) maximum operating temperature. Connectors shall have flanged- or threaded-end connections to match equipment connected and shall be capable of 3/4-inch (20-mm) misalignment.

D. Spherical, Rubber, Flexible Connectors: Fiber-reinforced rubber body with steel flanges drilled to align with Classes 150 and 300 steel flanges; operating temperatures up to 250 deg F (121 deg C) and pressures up to 150 psig (1035 kPa).

2.7 VALVES, GENERAL

A. Refer to Part 3 "Valve Applications" Article for applications of valves.

B. Bronze Valves: NPS 2 (DN 50) and smaller with threaded ends, unless otherwise indicated.

C. Ferrous Valves: NPS 2-1/2 (DN 65) and larger with flanged ends, unless otherwise indicated.

D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

F. Valve Actuators:

1. Handwheel: For valves other than quarter-turn types.
2. Lever Handle: For quarter-turn valves NPS 6 (DN 150) and smaller, except plug valves.

2.8 COPPER-ALLOY BALL VALVES

A. MSS SP-110, Two-Piece, Copper-Alloy Ball Valves: Bronze body with large-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem. O-ring only stem seals shall not be acceptable.

1. Basis of Design: Hammond 8501/8511.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

A. Heating Water, NPS 2 (DN 50) and Smaller: Aboveground, use Type L (Type B) drawn-temper copper tubing with soldered joints or Schedule 40 steel pipe with threaded joints.

B. Heating Water System, NPS 2-1/2 (DN 65) and Larger: Schedule 40 steel pipe with welded and flanged joints or grooved mechanical-joint couplings.

C. Condensate Drain Lines: Type L (Type B) drawn-temper copper tubing with soldered joints.

3.2 VALVE APPLICATIONS

A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:

1. Shutoff Duty: Ball valves.

B. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

C. Install calibrated balancing valves in the return water line of each heating element and elsewhere as required to facilitate system balancing.

D. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

E. Heating Water System Piping: Use the following types of valves:

1. Ball Valves, NPS 2-1/2 and Smaller: Two-piece, 600-psig CWP rating, copper alloy.

F. Select valves, except wafer and flangeless types, with the following end connections:

1. For Copper Tubing, NPS 2-1/2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating water services.
2. For Steel Piping, NPS 2-1/2 and Smaller: Threaded ends.

3.3 PIPING INSTALLATIONS

A. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

B. Install drains, consisting of a tee fitting, NPS 3/4 (DN 20) ball valve, and short NPS 3/4 (DN 20) threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

C. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

D. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

E. Unless otherwise indicated, install branch connections to mains using tee fittings in main pipe, with the takeoff coming out the bottom of the main pipe. For up-feed risers, install the takeoff coming out the top of the main pipe.

F. Install strainers on supply side of each control valve and elsewhere as indicated. Match size of strainer blowoff connection for strainers smaller than NPS 2 (DN 50).

G. Anchor piping for proper direction of expansion and contraction.

3.4 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

3.5 HANGERS AND SUPPORTS

A. Comply with requirements below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 7 feet (2.1 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 9 feet (2.7 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 10 feet (3 m); minimum rod size, 3/8 inch (10 mm).
5. NPS 2-1/2 (DN 65): Maximum span, 11 feet (3.4 m); minimum rod size, 3/8 inch

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4 (DN 20): Maximum span, 5 feet (1.5 m); minimum rod size, 1/4 inch (6.4 mm).
2. NPS 1 (DN 25): Maximum span, 6 feet (1.8 m); minimum rod size, 1/4 inch (6.4 mm).
3. NPS 1-1/2 (DN 40): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).
4. NPS 2 (DN 50): Maximum span, 8 feet (2.4 m); minimum rod size, 3/8 inch (10 mm).

E. Support vertical runs at roof, at each floor, and at 10-foot (3-m) intervals between floors.

3.6 JOINT CONSTRUCTION

A. Valves & Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

3.8 TERMINAL EQUIPMENT CONNECTIONS

A. Size for supply and return piping connections shall be same as for equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure and temperature gages at coil inlet connections.

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush system with clean water. Clean strainers.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release trapped air. Use drains installed at low points for complete draining of liquid.
3. Check expansion tanks to determine that they are not air bound and that system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the design pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed either 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A of ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

3.10 ADJUSTING

A. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

B. Perform these adjustments before operating the system:

1. Open valves to fully open position. Close coil bypass valves.
2. Check pump for proper direction of rotation.
3. Set automatic fill valves for required system pressure.
4. Check air vents at high points of system and determine if all are installed and bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Check and set operating temperatures of boilers, chillers, and cooling towers to design requirements.
7. Lubricate motors and bearings.

3.11 CLEANING

A. Flush hydronic piping systems with clean water. Remove and clean or replace strainer screens. After cleaning and flushing hydronic piping systems, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.

END OF SECTION

SECTION 15410

PLUMBING FIXTURES

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes plumbing fixtures and related components.

B. Related Sections include the following:

1. Section 15430, "Plumbing Specialties" for water distribution piping specialties.

1.3 DEFINITIONS

A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

C. ADA: Americans with Disabilities Act.

1.4 SUBMITTALS

A. Pre-Construction Submittals: Submit the following items prior to commencing with the installations.

1. Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.

B. Post Construction Submittals: Submit the following items upon completion of system installations.

1. Maintenance Data: For plumbing fixtures to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; about plumbing fixtures for people with disabilities.

C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Stainless-Steel Fixtures Other Than Service Sinks: ASME A112.19.3M.

G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1M.
2. Supply and Drain Fittings: ASME A112.18.1M.

H. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Floor Drains: ASME A112.21.1M.
2. Hot-Water Dispensers: ASSE 1023 and UL 499.

1.6 COORDINATION

A. Coordinate roughing-in and final plumbing fixture locations, and verify that fixtures can be installed to comply with original design and referenced standards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Commercial Cast Brass Faucets:

1. Chicago Faucet Co.
2. Symmons Industries, Inc.
3. T&S Brass and Bronze Works.
4. Speakman Co.

C. Protective Shielding Guards, (Under counter Insulation Kits):

1. Truebro, Inc.
2. McGuire/Pro Wrap.
3. Plumberex Specialty Products, Inc.

D. Disposers and Hot Water Dispensers:

1. In-Sink Earator.
2. Eemax, Inc.
3. Hot Aqua, Inc.

E. Supply Stops:

1. Chicago Faucet Co.
2. McGuire Mfg. Co.

F. Stainless Steel Sinks:

1. Just Mfg. Co.
2. Elkay Mfg. Co.
3. Kindred.

2.2 FIXTURES, GENERAL

A. General fixture, faucet and related item requirements are listed below. Refer to the "Plumbing Fixture Schedule" on the Drawings for the basis of design for each item.

B. Accessibility: Fixtures and items that are required to be accessible are tagged as such in the Plumbing Fixture Schedule on the Drawings.

2.3 FAUCETS

A. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes and outlet with spout and fixture receptor.

1. Maximum Flow Rate, (unless otherwise indicated):
   a. Sinks: 2.5 gpm.
   b. Lavatories: 0.5 gpm
2. Body Material: Cast brass
3. Finish: Polished chrome plate
4. Vacuum Breaker: Required for service sinks, basins, science and laboratory sinks.
   a. Required at any sink faucet which has exposed hose thread end(s).
5. Operation Mechanism: Lever handles.

2.4 PROTECTIVE SHIELDING GUARDS

A. General: Manufactured insulation and plastic covering for water supplies, trap and drain piping and complying with ADA requirements.

2.5 HOT-WATER DISPENSERS

A. General: Household type with instant on-off control; insulated, corrosion-resistant-metal storage tank that is open to atmosphere; electric, 115-V ac, heating element; chrome-plated faucet or spout; removable strainer; thermostat control for water temperature up to 190 deg F (88 deg C); and thermal-overload protection.

1. Electrical Characteristics: As scheduled on the Drawings.

2.6 SUPPLY STOPS

A. General: Cast brass or copper, chrome plated angle style with chrome plated escutchon and loose key operator.

1. Lavatory Supplies: NPS 3/8.
2. Sink and Tank Style Water Closet Supplies: NPS ½.

2.7 GENERAL USE SINKS

A. General: Commercial, counter mount, self rimming, sound deadening fixture.

1. Material: 18 gauge, type 304 stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water soil and for waste piping systems and supports to verify actual locations and sizes of piping connections and that locations and types of supports match those indicated, before plumbing fixture installation. Use manufacturer's roughing-in data if roughing-in data are not indicated.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

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

3.2 FIXTURE INSTALLATION

A. Assemble fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install counter-mounting fixtures in and attached to casework.

C. Install fixtures level and plumb according to manufacturers' written instructions and roughing-in drawings.

D. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Use ball valve if stops are not specified with fixture.

E. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

F. Install protective shielding guards on exposed under counter supply and waste piping at fixtures identified as accessible and at other locations scheduled.

G. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

H. Install water supply, flow-control fittings with specified flow rates in fixture supplies at stop valves.

I. Install faucet, flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

J. Install traps on fixture outlets.

1. Exception: Omit trap on fixtures with integral traps.
2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

K. Install hot-water dispensers in back top surface of sink or in counter with spout over sink.

L. Install escutcheons at piping wall or ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings.

M. Seal joints between fixtures and counters using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Refer to Division 7 Section "Joint Sealants" for sealant and installation requirements.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect water supplies from water distribution piping to fixtures.

C. Connect drain piping from fixtures to drainage piping.

D. Supply and Waste Connections to Plumbing Fixtures: Connect fixtures with water supplies, stops, risers, traps, and waste piping. Use size fittings required to match fixtures. Connect to plumbing piping.

3.4 FIELD QUALITY CONTROL

A. Verify that installed fixtures are categories and types specified for locations where installed.

B. Check that fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust hot-water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets to produce proper flow and stream.

D. Replace washers and seals of leaking and dripping faucets and stops.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 15430

PLUMBING SPECIALTIES

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes the following plumbing specialties:

1. Outlet boxes.
2. Trap seal primer valves.
3. Miscellaneous piping specialties.
4. Cleanouts.
5. Floor drains.
6. Interceptors.

1.3 PERFORMANCE REQUIREMENTS

A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:

1. Water Supply Systems, Above Ground: 125 psig.
2. DWV, (Gravity) Systems: 10 foot of head of water.

1.4 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.

1. Product Data:

a. Water hammer arresters, air vents, and trap seal primer valves and systems.
b. Outlet boxes.
c. Floor drains.

1.5 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of plumbing specialties and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.

C. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.

D. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-dwv" on plastic drain, waste, and vent piping.
2. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Outlet Boxes:

1. Acorn Engineering Company.
2. Gray, Guy Manufacturing Co., Inc.
3. IPS Corporation.
4. Symmons Industries, Inc.

C. Trap Seal Primer Valves:

1. Precision Plumbing Products, Inc.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Industries, Inc.
5. Zurn Industries, Inc.

D. Water Hammer Arresters:

1. Josam Co.
2. Precision Plumbing Products, Inc.
3. Sioux Chief Manufacturing Co., Inc.
4. Watts Industries, Inc.
5. Smith, Jay R. Mfg. Co.

6. Zurn Industries, Inc.; Wilkins Div.

E. Floor Drains:

1. Watts Industries, Inc.
2. Smith, Jay R. Mfg. Co.
3. Zurn Industries, Inc.; Wilkins Div.
4. Josam Co.
5. Tyler Pipe; Wade Div.

2.2 OUTLET BOXES

A. General: Recessed-mounting outlet boxes with supply fittings complying with ASME A112.18.1M. Include box with faceplate, services indicated for equipment connections, and wood-blocking reinforcement.

B. Icemaker Outlet Boxes: With hose connection and the following:

1. Box and Faceplate: Plastic.
2. Shutoff Fitting: Hose bibb.
3. Supply Fitting: NPS 1/2 (DN 15) gate, globe, or ball valve and NPS 1/2 (DN 15) copper, water tubing.
4. Basis of Design: As scheduled on the Drawings.

2.3 WATER HAMMER ARRESTERS

A. General: ASSE 1010 or PDI-WH 201, piston type with pressurized metal-tube cushioning chamber. Sizes indicated are based on ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.4 FLOOR DRAINS

A. General: ASME A112.21.2M; Provide trap primer inlet connections on drain bodies unless otherwise scheduled.

1. Where drains do not require trap primers, install a threaded plug in the primer inlet port. Plug to be of a dielectrically compatible material.
2. Basis of Design: As scheduled on the Drawings.

B. Floor Drains:

1. Body Material: Cast Iron.
2. Seepage Flange and Clamping Device: Required for interior application.
3. Anchor Flange: Required for exterior application.
4. Exposed Surfaces and Interior Lining: As scheduled.
5. Outlet Style: Hub and Spigot for slab-on-grade applications. No-hub for above grade applications.

6. Sediment Bucket and Grate Variations: As scheduled.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install individual shutoff valve in each water supply to plumbing specialties. Use ball valve if specific valve is not indicated. Install shutoff valves in accessible locations. Refer to Division 15 Section "Valves" for general-duty ball valves.

B. Install air vents at piping high points. Include ball valve in inlet and drain piping from outlet to floor drain.

C. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

D. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 15485

ELECTRIC DOMESTIC WATER HEATERS

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes the following for domestic water systems:

1. Tankless, electric water heaters.
2. Residential, electric water heaters.
3. Accessories.

1.3 DEFINITIONS

A. Type I Lining: Spray-on and baked internal glass tank lining, (includes epoxy-phenolic and polymerized epoxy); and others deemed as equal by the Architect.

1. Anode rod(s) required and provided.

1.4 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.

1. Product Data: For each type and size of water heater. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.
2. Product Certificates: Signed by manufacturers of water heaters certifying that products furnished comply with requirements.
3. Warranty data.

C. Post Construction Submittals: Submit the following items upon completion of system installations.

1. Maintenance Data: For water heaters to include in maintenance manuals specified in Division 1.
2. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on specific units indicated. Other manufacturers' products complying with requirements may be considered. Refer to Division 1 Section "Substitutions."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance: Fabricate and label water heater, hot-water storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:

1. ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings," for commercial water heaters.

1.6 WARRANTY

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

B. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of water heaters that fail in materials or workmanship within specified warranty period.

C. Heating Elements: Include a 5 year warranty from date of Substantial Completion.

D. Tank and Lining: Include a 5 year warranty from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

B. Residential Storage Electric Water Heaters, Type I Lining:

1. Lochinvar Corp.
2. Rheem Manufacturing Co.; Ruud Water Heater Div.
3. Smith: A. O. Smith Water Products Co.
4. State Industries.

C. Point-of-Use, Tankless, Electric Water Heaters:

1. Hubbell; The Electric Heater Co.
2. Eemax, Inc.
3. Hot Aqua, Inc.
4. In-Sink Erator; Division of Emerson Electric Company.
5. ARISTON, Inc.

2.2 RESIDENTIAL STORAGE ELECTRIC WATER HEATERS

A. Description: Comply with UL 174.

B. Storage Tank Construction: Steel with 150-psig (1035-kPa) working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank for piping connections, relief valve, drain, anode rod, and controls as required. Attach tappings to tank before testing and labeling. Include ASME B1.20.1, pipe thread.
2. Interior Finish: Materials and thicknesses complying with NSF 61, barrier materials for potable-water tank linings. Extend finish into and through tank fittings and outlets.
   a. Type I.
3. Insulation: Comply with ASHRAE 90.2. Surround entire storage tank except connections and controls.
4. Jacket: Steel, with enameled finish.

C. Heating Elements: Electric, screw-in, immersion type.

1. Temperature Control: Adjustable thermostat for each element with wiring arrangement for non-simultaneous operation.

D. Anode Rod: Factory installed, magnesium.

E. Dip Tube: Factory installed. Not required if cold-water inlet is near bottom of storage tank.

F. Drain Valve: ASSE 1005, factory installed.

G. Basis of Design: As scheduled on the Drawings.

2.3 POINT-OF-USE, TANKLESS, ELECTRIC WATER HEATERS

A. Description: Comply with UL 499.

B. Construction: Without hot-water storage.

1. Working-Pressure Rating: 150 psig (1035 kPa).
2. Tappings: ASME B1.20.1, pipe thread.
3. Interior Finish: Materials complying with NSF 61, barrier materials for potable-water tank linings.
4. Jacket: Aluminum or steel, with enameled finish, or plastic.

C. Heating System: Electric-resistance type.

1. Temperature Control: Adjustable thermostat.
2. Safety Control: Automatic, high-temperature-limit cutoff device or system.

D. Mounting: Bracket or device for wall mounting.

E. Basis of Design: As scheduled on the Drawings.

2.4 WATER HEATER ACCESSORIES

A. Combination Temperature and Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include relieving capacity at least as great as heat input and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into tank.

1. Option: Separate temperature and pressure relief valves are acceptable instead of combination relief valve.
2. Exception: Omit combination temperature and pressure relief valve for tankless water heater, and furnish pressure relief valve for installation in piping.

B. Pressure Relief Valves: ASME rated and stamped and complying with ASME PTC 25.3. Include pressure setting less than heat-exchanger working-pressure rating.

C. Vacuum Relief Valves: Comply with ASME PTC 25.3. Furnish for installation in piping.

D. Water Heater Stand and Drain Pan Units: High-density-polyethylene-plastic, 18-inch- (457-mm-) high, enclosed-base stand complying with IAPMO PS 103 and IAS No. 2. Include integral or separate drain pan with raised edge and NPS 1-1/4 drain outlet with ASME B1.20.1, pipe thread.

E. Water Heater Stands: Water heater manufacturer's factory-fabricated, steel stand for floor mounting and capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches (457 mm) above the floor.

F. Water Heater Mounting Brackets: Water heater manufacturer's factory-fabricated, steel bracket for wall mounting and capable of supporting water heater and water.

G. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of water heater and include drain outlet not less than NPS 1-1/4.

H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE 90.1 or ASHRAE 90.2.

1. Application: Required at connections to heaters in non-circulated systems.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install water heaters, level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Anchor water heaters to substrate.

C. Install temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

D. Install pressure relief valves in water piping for water heaters without storage. Extend relief valve outlet with water piping in continuous downward pitch and discharge onto closest floor drain.

E. Install vacuum relief valves in cold-water-inlet piping.

F. Install water heater drain piping as indirect waste to spill into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "Plumbing Specialties" for drain valves.

G. Install thermometers on water heater inlet and outlet piping. Refer to Division 15 Section "Meters and Gages" for thermometers.

1. Exception: Omit thermometers for the following:
   a. Residential, water heater inlet and outlet piping.

H. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

1. Exception: Not required for heaters installed in piping systems that are circulated.

I. Fill water heaters with water.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect hot- and cold-water piping with shutoff valves and unions.

D. Make connections with dielectric fittings where piping is made of dissimilar metal.

E. Electrical Connections: Power wiring and disconnect switches are specified in Division 16 Sections. Arrange wiring to allow unit service.

F. Ground equipment.

1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. In addition to manufacturer's written installation and startup checks, perform the following:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify that piping system tests are complete.
3. Check for piping connection leaks.
4. Check for clear relief valve inlets, outlets, and drain piping.
5. Test operation of safety controls, relief valves, and devices.
6. Energize electric circuits.
7. Adjust operating controls.
8. Adjust hot-water-outlet temperature settings. Do not set above 110 deg F (44 deg C) unless piping system application requires higher temperature.

END OF SECTION

SECTION 15738

SPLIT-SYSTEM AIR-CONDITIONING UNITS

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed mounting.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.

B. Shop Drawings: Diagram power, signal, and control wiring.

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

D. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 COORDINATION

A. Coordinate size, location, and connection details with roof curbs, equipment supports, and roof penetrations specified in Division 7 Section "Roof Accessories."

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carrier Air Conditioning; Div. of Carrier Corporation.
2. Mitsubishi Electronics America, Inc.; HVAC Division.
3. Mitsubishi Heavy Industries America, Inc.; Air-Conditioning & Refrigeration Division, Inc.
4. Sanyo Fisher (U.S.A.) Corp..

2.2 CONCEALED EVAPORATOR-FAN COMPONENTS

A. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.

1. Insulation: Faced, glass-fiber duct liner.
2. Drain Pans: Galvanized steel, with connection for drain; insulated.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.

D. Disposable Filters: 1 inch (25 mm) thick, in fiberboard frames.

E. Wiring Terminations: Connect motor to chassis wiring with plug connection.

2.3 WALL-MOUNTING, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain pump and condensate connection.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve.

C. Fan: Direct drive, centrifugal fan.

D. Filters: Permanent, cleanable.

2.4 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

1. Compressor Type: Scroll.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.

D. Fan: Aluminum-propeller type, directly connected to motor.

E. Motor: Permanently lubricated, with integral thermal-overload protection.

F. Low Ambient Kit: Permits operation down to -20 deg F (-29 deg C).

G. Mounting Base: Polyethylene.

2.5 ACCESSORIES

A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

B. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:

1. Compressor time delay.
2. 24-hour time control of system stop and start.
3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
4. Fan-speed selection, including auto setting.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

E. Condensate Pump: Motor driven pump to raise condensate from the evaporator coil to a level above the evaporator for drainage to an indirect waste.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounting compressor-condenser components on equipment supports specified in Division 7 Section "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to unit to allow service and maintenance.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Electrical Connections: Comply with requirements in Division 16 Sections for power wiring, switches, and motor controls.

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 15815

METAL DUCTS

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 2-inch wg. Metal ducts include the following:

1. Rectangular ducts and fittings.
2. Single-wall, round spiral-seam ducts and formed fittings.
3. Duct liner.

B. Related Sections include the following:

1. Section 15820 "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 DEFINITIONS

A. SMACNA – Sheet Metal and Air Conditioning Contractors' National Association, Inc. – latest edition.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Engineer must specifically approve changes to layout or configuration of duct system in writing. Accompany requests for layout modifications with calculations showing that proposed layout would provide original design results without increasing system total pressure.

1.5 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

B. Pre-construction Shop Drawings: Show fabrication and installation details for metal ducts as follows prior to commencing with fabrication and installation:

1. Metal gages.
2. Fittings.
3. Reinforcement and spacing.
4. Seam and joint construction.
5. Equipment installation based on equipment being used on Project.
6. Duct accessories, including access doors and panels.
7. Hangers and supports, including methods for duct and building attachment.

C. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Duct liner
   a. CertainTeed Corp.; Insulation Group.
   b. Johns Manville International, Inc.
   c. Knauf Fiber Glass GmbH.
   d. Owens Corning

2. Transverse joints
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

3. Round duct and fittings
   a. McGill AirFlow Corporation.
   b. SEMCO Incorporated.
   c. Monroe Metal Mfg. Co.

4. Duct joints – round ducts
   a. Ductmate Industries, Inc.
   b. Lindab Inc

2.2 SHEET METAL MATERIALS

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

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

2.3 DUCT LINER

A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.

B. Materials:

1. Flexible Duct Liner: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers. Based on Johns Manville Permacote Linacoustic.
   a. Thickness: 1 inch
   b. Thermal Conductivity (k-Value): 0.25 at 75 deg F (0.037 at 24 deg C) mean temperature.
   c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
      1) Tensile Strength: Indefinitely sustain a 50-lb- (23-kg-) tensile, dead-load test perpendicular to duct wall.
      2) Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch (3 mm) into airstream.
      3) Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

2.4 SEALANT MATERIALS

A. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

B. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

C. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.5 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.6 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible"

2.7 APPLICATION OF LINER IN RECTANGULAR DUCTS

A. Duct liner of the specified material and thickness shall be furnished and installed where shown on the drawings. The duct dimensions indicated on the drawings are the net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

B. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

C. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

D. Butt transverse joints without gaps and coat joint with adhesive.

E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

F. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and standard liner product dimensions make longitudinal joints necessary.

G. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

H. Secure transversely oriented liner edges facing the airstream with metal nosing that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharges.
2. Intervals of lined duct preceding unlined duct.
3. Upstream edges of transverse joints in ducts where air velocities are greater than 2500 fpm or where indicated.

I. Terminate inner ducts with buildout attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildout (metal hat sections) or other buildout means are optional; when used, secure buildout to duct walls with bolts, screws, rivets, or welds.

2.8 ROUND DUCT AND FITTING FABRICATION

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards and as indicated. Provide duct material, gauges, reinforcement, and sealing for operating pressures indicated.

B. All duct and fittings shall be manufactured by a company whose primary business is the manufacture of spiral duct and fittings and who has been in business for at least 10 years. All spiral duct and fittings shall be manufactured by the same firm and shall be as shown on the contract drawings.

C. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.

E. Branch connections shall be made with 90-degree conical and 45-degree lateral taps. All branch connections shall be made as separate fittings. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Round Elbows 12 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
2. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
3. Round Elbows Larger Than 14 Inches in Diameter: Fabricate gored elbows unless space restrictions require mitered elbows.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts (upstream of Air Terminal Units): 2-inch wg.
2. Supply Ducts (downstream Air Terminal Units): 1-inch wg.
3. Return Ducts (Negative Pressure): 2-inch wg.
4. Exhaust Ducts (Negative Pressure): 1-inch wg.
5. Return and Transfer Grille Plenums: 1/2 –inch wg.

B. All ducts shall be galvanized steel.

3.2 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

I. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

J. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

K. Electrical Equipment Spaces: Route ducts to avoid passing through electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

M. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories." Firestopping materials and

installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."

N. Protect duct interiors from the elements and foreign materials until building is enclosed. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

O. Paint interiors of metal ducts that do not have duct liner, for 24 inches upstream of registers and grilles. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.

3.3 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated, as required to meet requirements of the applicable energy code, and as outlined below.

1. Supply Ducts – pressure classes equal to or lower than 2-inch wg:
   a. For ducts located in conditioned spaces: seal transverse joints.
   b. For ducts located in unconditioned spaces: seal all transverse joints and longitudinal seams.
   c. For ducts located outdoors: seal all transverse joints, longitudinal seams and duct wall penetrations.

2. Return/Transfer Ducts, all pressure classes:
   a. For ducts located in conditioned spaces: seal transverse joints.
   b. For ducts located in unconditioned spaces: seal all transverse joints and longitudinal seams.
   c. For ducts located outdoors: seal all transverse joints, longitudinal seams and duct wall penetrations.

3. Exhaust ducts:
   a. For ducts located in conditioned spaces: seal all transverse joints and longitudinal seams.
   b. For ducts located in unconditioned spaces: seal all transverse joints only.

B. Seal ducts before external insulation is applied.

3.4 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.

1. Create other openings to comply with duct standards.
2. Disconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.

D. Clean the following metal duct systems by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Coils and related components.
4. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
5. Supply-air ducts, dampers, actuators, and turning vanes.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION

SECTION 15820

DUCT ACCESSORIES

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Volume dampers.
2. Turning vanes.
3. Duct-mounting access doors.
4. Flexible ducts.
5. Duct accessory hardware.

B. Related Sections include the following:

1. Section 15815 "Metal Ducts."

1.3 SUBMITTALS

A. General: See Division 1 for general submittal and product substitution requirements.

B. Pre-construction Shop Drawings: Provide the following before fabrication and installation:

1. Product Data: For the following:
   a. Volume dampers.
   b. Turning vanes.
   c. Duct-mounting access doors.
   d. Flexible ducts.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Volume dampers
   a. Air Balance, Inc.
   b. American Warming and Ventilating.
   c. Flexmaster U.S.A., Inc.
   d. McGill AirFlow Corporation.
   e. METALAIRE, Inc.
   f. Nailor Industries Inc.
   g. Ruskin Company.

2. Manufactured turning vanes
   a. Ductmate Industries, Inc.
   b. Duro Dyne Corp.
   c. METALAIRE, Inc.
   d. Ward Industries, Inc.

3. Duct-mounting access doors – rectangular
   a. American Warming and Ventilating.
   b. CESCO Products.
   c. Ductmate Industries, Inc.
   d. Flexmaster U.S.A., Inc.
   e. Greenheck.
   f. McGill AirFlow Corporation.
   g. Nailor Industries Inc.
   h. Ward Industries, Inc.

4. Duct-mounting access doors – round
   a. Ductmate Industries, Inc.
   b. Flexmaster U.S.A., Inc.

5. Flexible ducts
   a. ATCO Rubber Products, Inc.
   b. Flexmaster U.S.A., Inc.
   c. Hart & Cooley, Inc.
   d. McGill AirFlow Corporation.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

2.3 VOLUME DAMPERS

A. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Pressure Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

B. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized, or stainless where indicated on drawings, sheet steel channels, minimum of 0.064 inch (1.62 mm) thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- (1.62-mm-) thick, galvanized, or stainless where indicated on drawings, sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch- (2.5-mm-) thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch- (2.5-mm-) thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch- (1.2-mm-) thick extruded aluminum.
6. Blade Axles: Galvanized steel or Stainless steel.
7. Bearings: Synthetic

C. Jackshaft: 1-inch- (25-mm-) diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- (2.4-mm-) thick zinc-plated steel, and a 3/4-inch (19-mm) hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- (38-mm-) wide, single vane, curved blades of galvanized sheet steel set 3/4 inch (19 mm) o.c.; support with bars perpendicular to blades set 2 inches (50 mm) o.c.; and set into vane runners suitable for duct mounting.

2.5 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch (25-by-25-mm) butt or piano hinge and cam latches.

1. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
2. Provide number of hinges and locks as follows:

a. Less Than 12 Inches (300 mm) Square: Secure with two sash locks.
b. Up to 18 Inches (450 mm) Square: Two hinges and two sash locks.
c. Up to 24 by 48 Inches (600 by 1200 mm): Three hinges and two compression latches, with outside and inside handles.

C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch (25-mm) thickness. Include cam latches.

1. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch- (25-mm-) thick, fibrous-glass or polystyrene-foam board.

2.6 FLEXIBLE DUCTS

A. Insulated-Duct Connectors: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor barrier film.

1. Pressure Rating: 10-inch wg (2500 Pa) positive and 1.0-inch wg (250 Pa) negative.
2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
3. Temperature Range: Minus 10 to plus 160 deg F (Minus 23 to plus 71 deg C).

B. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches (75 to 450 mm) to suit duct size.

2.7 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.

C. Install volume dampers in ducts with liner; avoid damage to and erosion of duct liner.

D. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.

E. Provide test holes at fan inlets and outlets and elsewhere as indicated.

F. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories and terminal units as follows:

1. Before and after duct coils.
2. On sides of ducts where adequate clearance is available.

G. Install the following minimum sizes for duct-mounting, rectangular access doors:

1. One-Hand or Inspection Access: 8 by 5 inches (200 by 125 mm).
2. Two-Hand Access: 12 by 6 inches (300 by 150 mm).

H. Install the following sizes for duct-mounting, round access doors:

1. One-Hand or Inspection Access: 8 inches (200 mm) in diameter.
2. Two-Hand Access: 10 inches (250 mm) in diameter.

I. Connect terminal units to supply ducts directly. Do not use flexible ducts.

J. Connect diffusers to low pressure ducts directly or with maximum 60-inch (1500-mm) lengths of flexible duct clamped or strapped in place.

K. Connect flexible ducts to metal ducts with draw bands.

L. Install duct test holes where indicated and required for testing and balancing purposes.

3.2 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Final positioning of manual-volume dampers is specified in Section 15950 "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 15855

DIFFUSERS, REGISTERS, AND GRILLES

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes:

1. Ceiling- and wall-mounted diffusers, registers, and grilles.

B. Related Sections include the following:

1. Section 15815 "Metal Ducts"
2. Section 15820 "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. General: See Division 1 for general Submittal and product substitution requirements.

B. Pre-construction Shop Drawings: Provide the following before fabrication and installation:

1. Product Data: For each product indicated, include the following:
   a. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
   b. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Grilles, registers, and diffusers

    a. Anemostat; a Mestek Company.
    b. Krueger.
    c. Price Industries.
    d. Titus.
    e. Metalaire

2. Linear slot diffuser

    a. Anemostat; a Mestek Company.
    b. Krueger.
    c. METALAIRE, Inc.; Metal Industries Inc.
    d. Price Industries.
    e. Titus.
    f. Tuttle & Bailey.

2.2 SQUARE CEILING DIFFUSERS

A. Basis of Design: Krueger model PLQ

1. Type: Square multi-louvered diffuser to discharge air in a 360-degree pattern, round neck as scheduled.
2. Frame: Inverted T-bar type or surface mount as scheduled.
3. Fabrication: Steel with factory white baked enamel white finish.

2.3 RETURN GRILLES

A. Basis of Design: Krueger model EGC-10

1. Type: Eggcrate, 1 x 1 x 1 " aluminum grid core with minimum 90% free area.
2. Fabrication: Extruded aluminum with factory white baked enamel finish.
3. Surface mount 1-1/4 inch margin with countersunk screw mounting. Coordinate frame type with mounting conditions. Frame type as scheduled.
4. Provide panel for lay-in installation as scheduled.

2.4 LINEAR SLOT OUTLETS

A. Basis of design: Anemostat SLAD-150

1. Material - Shell: Aluminum, insulated.
2. Material - Pattern Controller and Tees: Aluminum.
3. Finish - Face and Shell: Baked enamel, white.
4. Finish - Pattern Controller: Baked enamel, black.
5. Finish - Tees: Baked enamel, white.
6. Slot Width: 1-1/2 inches (38 mm).
7. Number of Slots: Four.
8. Length: 24 inches (600 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 15900

HVAC INSTRUMENTATION AND CONTROLS

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes:

1. Control system components for Tenant Fit-up HVAC systems and equipment are included under the base building contract. The Fit-up Contractor will ensure that the controls are installed per the plans [Thermostat locations] and that the sequences called for in the base building do indeed operate as intended.

1.3 SYSTEM DESCRIPTION

A. Control system consists of sensors, indicators, actuators, control elements, interface equipment, other apparatus, and accessories as required providing control of mechanical systems and equipment as indicated in Sequence of Operation detail on the drawings and Base-Building Mechanical Contractor's drawing "HVAC_CONTROLS", C-1.

1.4 COORDINATION

A. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment with Division 13 to achieve compatibility with equipment that interfaces with that system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer:

1. Control components to serve Tenant Fit-up equipment and systems shall be provided under the Base Building DDC System.

PART 3 - EXECUTION

NOT USED – See base building specifications.

END OF SECTION

SECTION 15950

TESTING, ADJUSTING, AND BALANCING

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.

B. The requirements of Section 15000, "Basic Mechanical Requirements" apply to work defined by this Section.

1.2 SUMMARY

A. This Section includes TAB for Tenant Mechanical Systems including the following:

1. Air Systems.
   a. Server Room HVAC Equipment.
   b. VAV Terminal Units.
   c. Diffusers, Registers, and Grilles.

2. Hydronic Systems.
   a. Reheat Coils, VAV Terminal Units.
   b. Server Room Ductless-Split System.

3. Verifying that automatic control devices are functioning properly.
4. Reporting results of activities and procedures specified in this Section.

1.3 SUBMITTALS

A. Refer to Division 1 for Submittal Procedures.

B. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

C. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of the Contract Documents review report as specified in Part 3.

D. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

E. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

F. Sample Report Forms: Submit two sets of sample TAB report forms.

1.4 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

D. TAB Report Forms: Use standard forms from one of the following:

1. AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
2. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
3. SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing."

E. Instrumentation Type, Quantity, and Accuracy: As described in either of the following:

1. AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
2. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.5 COORDINATION

A. Obtain a copy of the Base Building Balancing report of Base Building mechanical systems and equipment for review, reference, and coordination of Tenant Fit-up TAB.

B. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

C. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 DOCUMENT EXAMINATION

A. Pre-Construction Plan Check and Review: Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems that may preclude proper TAB of systems and equipment.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls. Refer to Section 15000, "Basic Mechanical Requirements."

E. Examine equipment performance data including fan and pump curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Examine system and equipment test reports.

F. Submit report of review.

3.2 FIELD EXAMINATION

A. Job Site Inspections: During construction, the TAB Firm shall inspect the installation of HVAC systems

B. Examine system and equipment installations to verify that they are complete and that testing, cleaning and adjusting specified in individual Sections have been performed.

C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and

fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

E. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

F. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

G. Examine plenum ceilings used for return air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

H. Examine strainers for clean screens and proper perforations.

I. Examine valves for proper installation for their intended function.

J. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

K. Examine system pumps to ensure absence of entrained air in the suction piping.

L. Examine equipment for installation and for properly operating safety interlocks and controls.

M. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves are properly connected.
5. Thermostats and are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.

N. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in one of the following:

1. AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems".
2. NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems".
3. SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing".

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling unit components.

L. Check for proper sealing of air duct system.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
6. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR HEAT-TRANSFER COILS

A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.10 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure outside-air, wet- and dry-bulb temperatures.

3.11 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.12 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.

3.13 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.14 REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in a binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers' test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect's name and address.
6. Engineer's name and address.
7. Contractor's name and address.
8. Report date.
9. Signature of TAB firm who certifies the report.
10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
11. Summary of contents including the following:

    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.

12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer, type size, and fittings.
14. Notes to explain why certain final data in the body of reports varies from indicated values.
15. Test conditions for fans and pump performance forms including the following:

    a. Settings for outside-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Fan drive settings including settings and percentage of maximum pitch diameter.

e. Settings for supply-air, static-pressure controller.
f. Other system operating conditions that affect performance.

E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Terminal units.
6. Balancing stations.
7. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units testing is performed under the Base Building Contract.

G. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:

a. Make and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

3. Test Data (Indicated and Actual Values):

a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

H. Round and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. System and air-handling unit number.
    b. Location and zone.
    c. Traverse air temperature in deg F.
    d. Duct static pressure in inches wg.
    e. Duct size in inches.
    f. Duct area in sq. ft.
    g. Indicated airflow rate in cfm.
    h. Indicated velocity in fpm.
    i. Actual airflow rate in cfm.
    j. Actual average velocity in fpm.
    k. Barometric pressure in psig.

I. Air-Terminal-Device Reports:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Test apparatus used.
    d. Area served.
    e. Air-terminal-device make.
    f. Air-terminal-device number from system diagram.
    g. Air-terminal-device type and model number.
    h. Air-terminal-device size.
    i. Air-terminal-device effective area in sq. ft.

2. Test Data (Indicated and Actual Values):

    a. Airflow rate in cfm.
    b. Air velocity in fpm.
    c. Preliminary airflow rate as needed in cfm.
    d. Preliminary velocity as needed in fpm.
    e. Final airflow rate in cfm.
    f. Final velocity in fpm.
    g. Space temperature in deg F.

J. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:

1. Unit Data:

    a. System and air-handling unit identification.
    b. Location and zone.
    c. Coil make and size.

2. Test Data (Indicated and Actual Values):

a. Airflow rate in cfm.
b. Entering-water temperature in deg F.
c. Leaving-water temperature in deg F.
d. Water pressure drop in feet of head or psig.
e. Entering-air temperature in deg F.
f. Leaving-air temperature in deg F.

K. Compressor and Condenser Reports: For refrigerant side of unitary systems, include the following:

1. Unit Data:

a. Unit identification.
b. Location.
c. Unit make and model number.
d. Compressor make.
e. Compressor model and serial numbers.
f. Refrigerant weight in lb.
g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):
a. Entering-air, dry-bulb temperature in deg F.
b. Leaving-air, dry-bulb temperature in deg F.
c. Control settings.
d. Unloader set points.
e. Low-pressure-cutout set point in psig.
f. High-pressure-cutout set point in psig.
g. Suction pressure in psig.
h. Suction temperature in deg F.
i. Condenser refrigerant pressure in psig.
j. Condenser refrigerant temperature in deg F.
k. Oil pressure in psig.
l. Oil temperature in deg F.
m. Voltage at each connection.
n. Amperage for each phase.
o. Kilowatt input.
p. Crankcase heater kilowatt.
q. Number of fans.
r. Condenser fan rpm.
s. Condenser fan airflow rate in cfm.
t. Condenser fan motor make, frame size, rpm, and horsepower.
u. Condenser fan motor voltage at each connection.
v. Condenser fan motor amperage for each phase.

L. Pump Test Reports: Include the following:

1. Unit Data:

a. Unit identification.
b. Location.

c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):

a. Static head in feet of head or psig.
b. Pump shutoff pressure in feet of head or psig.
c. Actual impeller size in inches.
d. Full-open flow rate in gpm.
e. Full-open pressure in feet of head or psig.
f. Final discharge pressure in feet of head or psig.
g. Final suction pressure in feet of head or psig.
h. Final total pressure in feet of head or psig.
i. Final water flow rate in gpm.
j. Voltage at each connection.
k. Amperage for each phase.
l. Amperage for each phase.

M. Instrument Calibration Reports:

1. Report Data:

a. Instrument type and make.
b. Serial number.
c. Application.
d. Dates of use.
e. Dates of calibration.

END OF SECTION

SECTION 16010

GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 REFERENCES

A. Conditions of the Contract, Specifications, Change Orders, Addenda, Drawings and Division 1 General Requirements, apply to work of this section. Where paragraphs of this section conflict with similar paragraphs of Division 1, requirements of this section shall prevail.

B. As used in this section, "provide" means "furnish and install", "furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support and to store in a secure area in accordance with manufacturers instructions", and "install" means "to unload at the delivery point at the site or retrieve from storage, move to point of installation and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project".

1.2 EXAMINATION OF SITE

A. Before submitting a bid, the Contractor shall visit and carefully examine site to identify existing conditions and difficulties that may affect the work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions.

B. Before starting work in a particular area of the project, the Contractor shall examine the conditions under which work must be performed including preparatory work performed under other Sections of the Contract, or by the Owner and report conditions, which might adversely affect the work in writing to the Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.3 SCOPE

A. The work to be accomplished under these specifications includes providing all labor, materials, equipment, consumable items, supervision, administrative tasks, tests and documentation required to install complete and fully operational electrical systems as described herein and shown on the Drawings. The Contractor shall completely coordinate the work of this section with the work of other trades.

B. The Contractor shall file plans, obtain permits and licenses, pay fees and obtain necessary inspections and approvals from authorities that have jurisdiction, as required to perform work in accordance with all legal requirements. The Contractor shall pay utility back charges and excess costs and perform work in accordance with local utility company requirements.

C. The Work shall be complete from point of service to each outlet or device with all accessory construction and materials required to make each item of equipment or system complete and ready for operation. The work shall include but not be limited to the following. The Contractor shall provide:

1. Addition to base building power and lighting distribution systems including panelboards, transformers, overcurrent devices raceway, cable and wire.

2. Branch circuits and devices for modular furniture, power and convenience receptacles.

3. All motor wiring, safety disconnects, and motor starters unless integral with equipment.

4. Complete interior lighting system including normal and emergency fixtures, exit signs, lamps, controls, trim and accessories.

5. Addition to base building fire alarm and detection system including pull stations, area smoke detectors, indicating appliances, auxiliary contacts for equipment interlocking, (magnetic door holders) and other devices shown on the Drawings.

6. Empty raceways, junction boxes and cable tray for voice/data and other Division 17 equipment and wiring.

7. Conduit and outlet boxes for CATV.

8. Control wiring not provided by Division 15000.

9. Grounding of raised floor, equipment racks and cable tray as indicated on drawings. Ground bars in all Tele/Data rooms.

10. All support material and hardware for raceway, cable tray and electrical equipment.

11. Branch circuits to control panels and devices furnished under other sections.

12. Empty conduits and outlet boxes for card access and security system.

13. Local control and pilot devices.

14. Termination of all cable and wire unless otherwise noted.

15. Building wall, floor and roof penetrations for raceway.

D. Install the following items furnished by others:

1. Motors

2. Control Panels

3. Wiring to magnetic door holders.

1.4 RELATED WORK IN OTHER SECTIONS

A. The following work is not included in this Section and shall be performed under other sections:

1. Excavation and backfill.

2. Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment.

3. Cutting and patching of masonry, concrete, tile, and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal decks.

4. Installation of access panels in ceilings and wall construction.

5. Painting, except as specified herein.

6. Temporary water, heat, gas and sanitary facilities for use during construction and testing.

7. Outdoor air intake or exhaust louvers.

8. Cathodic anti-corrosion protection for buried piping and tanks.

9. Control wiring specifically indicated as part of Division 15.

10. Concrete pads for new pad mount switch and pad mount transformer and light pole bases to be by site contractor

B. The Contractor shall identify locations of penetrations, excavations, structural supports, etc. required for the completion of the Work of this Section to the General Contractor in a timely manner.

1.5 CODES, STANDARDS, AND AUTHORITIES

A. All work shall be performed strictly as required by rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have lawful jurisdiction. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of publications, standards, rulings, and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire and health department and public safety codes agencies.

2. National Fire Protection Association (NFPA)

3. Occupational Safety and Health Act (OSHA)

4. Factory Mutual Association (FM)

5. National Electrical Code (NEC)

6. National Electrical Safety Code (NESC).

7. The BOCA National Building Code.

B. All materials and equipment shall be listed by Underwriters Laboratories (UL), and approved for intended service.

C. When requirements cited in this Paragraph conflict with each other or with Contract Documents, the most stringent requirements shall govern conduct of work. The Architect may relax this requirement when such relaxation does not violate the ruling of authorities that have jurisdiction. Approval for such relaxation shall be obtained in writing.

1.6 WARRANTY

A. Refer to Division 1 General Requirements for Warranty Requirements.

1.7 CONTRACT DRAWINGS

A. Work to be performed under this section is shown on the electrical drawings listed in Division 1 General Requirements.

B. The listing of electrical drawings does not limit responsibility of determining full extent of work required by contract documents. The Contractor shall refer to architectural, plumbing, HVAC, structural, and other drawings and other sections that indicate types of construction with which work of this section must be coordinated. The Contractor shall check with the General Contractor and other subcontractors to determine whether there will be any interference by such trades with the electrical work. If the Contractor fails to check with the General Contractor and subcontractors and the electrical work is later found to interfere with their work, then he shall make necessary changes, without additional cost to the Owner, to eliminate such interference.

C. Drawings are diagrammatic and indicate general arrangement of systems and work included in contract. Information and components shown on riser diagrams or called for in the specifications but not shown on plans, and vice versa, shall apply and shall be provided as though required expressly by both. It is not intended to specify or to show every offset, fitting, or component; however, contract documents require components and materials whether or not indicated or specified as necessary to make electrical installation complete and operational.

1.8 DISCREPANCIES IN DOCUMENTS

A. It shall be the responsibility of each bidder to examine the drawings and specifications carefully before submitting his bid, with particular attention to errors, omissions, conflicts with provisions of laws and codes imposed by authorities having jurisdiction, conflicts between portions of drawings, or between drawings and specifications, and ambiguous definition of the extent of coverage in the contract. Any such discrepancy discovered shall be brought to the immediate attention of the Architect for correction. Should any of the aforementioned errors, omissions, conflicts or ambiguities exist in either or both the drawings and specifications, the Contractor shall have the same explained and adjusted in writing before signing the contract or proceeding with work. Failure to notify the Architect in writing of such irregularities will cause the Architect's interpretation of the Contract Documents to be final. No additional compensation will be approved because of discrepancies thus resolved.

B. The drawings and these specifications are intended to comply with all the above-mentioned rules and regulations. If discrepancies occur, the Contractor shall immediately notify the Architect in writing of said discrepancies and apply for an interpretation and, unless and interpretation is offered in writing by the Architect prior to the execution of the contract, the applicable rules and regulations shall be complied with as a part of the contract.

C. In case of difference between building codes, specifications, state laws, industry standards and the contract documents, the most stringent shall govern. Should the Contractor perform any work that does not comply with the requirements of the applicable building codes, state laws, and industry standards, he shall bear all costs arising in correcting these deficiencies.

1.9 EQUIPMENT AND MATERIALS

A. All equipment and materials shall be new and of the quality specified. All materials shall be free from defects at the time of installation. Materials or equipment damaged in shipment or otherwise damaged during construction shall not be repaired at the jobsite, but shall be replaced with new materials.

B. All equipment installed on this project shall have local representation, local factory authorized service and a local stock of repair parts.

C. No equipment or material shall be installed in such a manner as to void a manufacturers warranty. The Contractor shall notify the Architect of any discrepancies between the Contract Documents and manufacturer's recommendations prior to execution of the work.

1.10 RECORD DRAWINGS

A. As work progresses, and for duration of the Contract, the Contractor shall maintain a complete and separate set of prints of Contract Drawings at job site at all times and record work completed and all changes from original Contract. Drawings shall clearly and accurately include work installed as a modification or added to the original design.

B. At completion of work and prior to final request for payment, the Contractor shall submit a complete set of reproducible record drawings showing all systems as actually installed.

1.11 SHOP DRAWINGS

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain complete shop drawings, product data and samples from manufacturers, suppliers, vendors, and Subcontractors for all materials and equipment specified herein, and submit data and details of such materials and equipment for review by the Architect and Engineer. Prior to submission of the shop drawings, product data and samples to the Architect, the Contractor shall review and certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Further, the Contractor shall check all materials and equipment after their arrival on the jobsite and verify their compliance with the Contract Documents. A minimum period of ten working days, exclusive of transmittal time will be required in the Architect's office each time shop drawings, product data and/or samples are submitted or resubmitted for review. The Contractor when scheduling his Work shall consider this time period.

B. The Contractor shall submit to the Architect four (4) copies of shop drawings. All copies shall be neatly bound in folders. Additional copies required for distribution shall be the responsibility of the Contractor after reviewed copies are returned to him with the Architect's review comments and notes.

C. Each shop drawing shall indicate in the lower right hand corner, and each product data brochure shall indicate on the front cover the following: Title of the sheet or brochure; name and location of the building; names of the Architect and Engineer, Contractor, Subcontractor, manufacturer, supplier, vendor; the date of submittal; and the date of each correction and revision. So far as is practical, each shop drawing, product data and/or samples shall bear a cross-reference note to the page or sheet number of the Drawings and/or Specifications showing the Work. Unless the above information is included, the submittal will be returned for resubmittal without review.

D. The shop drawing submittal shall include all data necessary for interpretation as well as manufacturer's name and catalog number. Sizes, capacities, colors, etc., specified on the drawings shall be specifically noted or marked on the shop drawings.

E. Submittals shall contain only information specific to systems, equipment and materials required by Contract Documents for this Project. Do not submit catalogs that describe products, models, options or accessories, other than those required, unless irrelevant information is marked out or unless relevant information is highlighted clearly. Marks on submittals, whether by Contractor, Subcontractor, manufacturer, etc., shall not be made in red ink. Red is reserved for review process.

F. All specification sheets, drawings and diagrams shall be submitted within 30 days from the date of Contractor signs the Contract. The Architect's review of such drawings shall not relieve the Contractor of responsibility for deviations from the Contract, Drawings or Specifications, unless he has in writing called the attention of the Architect to such deviations at the time of the submission. The Architect's review shall not relieve the Contractor from responsibility for errors or omissions in such drawings.

G. If the Contractor proposes an item of equipment other than that specified or detailed on the drawings which requires any redesign of the wiring or any other part of the mechanical, electrical or architectural layout, the required changes shall be made at the expense of the trade furnishing the changed equipment at no cost to the Owner.

H. Manufacturer's names are listed herein and on the drawings to establish a standard for quality and design. Where one manufacturer's name is mentioned, products of other manufacturers will be acceptable if, in the opinion of the Architect the substitute material is of quality equal to or better than that of the material specified. Where two or more manufacturer's names are specified, material shall be by one of the named manufacturers only.

1.12 BULLETINS, MANUALS, AND INSTRUCTIONS

A. The Contractor shall obtain at time of purchase of equipment, three copies of operation, lubrication and maintenance manuals for all items and assemble literature in coordinated manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manuals shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into two sections or books as follows:

1. Directions for and sequence of operation of each item of electrical systems, e.g. emergency generator, sound system, fire alarm system, etc.

2. Detailed maintenance and trouble shooting manuals containing data furnished by manufacturer for complete maintenance.

B. Furnish three copies of manuals to the Architect for review and distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.

C. Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct the Owner's operating personnel in any and all parts of various systems. Such instructions shall cover period of control such as will take mechanical equipment through complete cycle. Make adjustments under actual operating conditions.

1.13 SPACE, EQUIPMENT ARRANGEMENT AND ACCESS

A. The size of equipment shown on the drawings is based on the dimensions of a particular manufacturer. Where other manufacturers are acceptable, it is the responsibility of the Contractor to determine if the equipment he proposed to furnish will fit the space available. Shop drawings shall be prepared by the Contractor when required by the Architect or Owner to indicate a suitable arrangement.

B. Locate all equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the drawings may be made to allow for better accessibility at no additional cost to the Owner, but changes shall not be made without review by the Architect.

C. Minimum clearances in front of or around equipment shall conform to the latest applicable code requirements.

1.14 MARKING AND LABELING

A. All panelboards, indoor transformers, cabinets and other specified equipment shall be labeled with engraved laminated plastic plates, minimum 3/4" high with 3/8" engraved letters. Punch tapes with mastic backings are not acceptable.

B. All starters, disconnect switches and other specified equipment shall be marked with engraved laminated plastic plates, minimum 1/2" high with 1/4" engraved letters. Where individual switches or circuit breakers in power or distribution panelboards do not have cardholders, they shall be marked with 1/2" high labels.

C. All empty conduits shall have labels tied to the pull string at each end of each empty conduit, marked as to identification of each end. Junction boxes with circuits provided for future use shall be labeled with appropriate circuit designation.

D. Cardholders for panelboards shall be filled out with typewritten identification of each circuit, except that the word "spare" shall be written in soft pencil to identify all circuit breakers installed that are not used.

1.18 WIRING METHODS

A. Unless otherwise noted all wiring shall be installed in raceway.

Wiring shall be installed as follows:

1. All conduit installed outdoors, all risers between floors and conduit exposed to physical damage shall be rigid steel, rigid aluminum or intermediate metal conduit.

2. Unless otherwise noted, all other power distribution wiring including feeders and branch circuits shall be installed in electrical metallic tubing (EMT). Type MC cable shall be permitted for branch circuit wiring within wall cavities and above ceilings.

3. All fire alarm system wiring shall be installed in EMT. Fire Alarm type MC cable shall be permitted for wiring within wall cavities and above ceilings. Cable shall have a continuous red stripe along outer jacket to indicate fire alarm conductors.

4. All control wiring including automatic temperature control wiring provided by Division 15000 shall be installed in EMT when exposed to physical damage. Wiring concealed in walls and above ceilings shall be plenum rated cable supported by J-hooks.

5. Voice/data wiring stub-ups, and wiring run exposed to be run in EMT. Wiring above ceilings to be exposed plenum rated cable supported by J-hooks.

6. CATV wiring stub-ups, and wiring run exposed to be run in EMT. Wiring above ceilings to be exposed plenum rated cable supported by J-hooks.

7. All conduit in corrosive areas shall be PVC coated rigid steel.

8. Conduit installed in and below floor slabs shall be rigid nonmetallic conduit with rigid steel stubups.

END OF SECTION 16010

SECTION 16030

ELECTRICAL ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 GENERAL

A. Provisions of Section 16010, General Requirements for Electrical Work apply to the work of this Section.

B. This Specification Section covers the field inspection, mechanical completeness, and electrical acceptance tests required for electrical apparatus, wire, cable and other miscellaneous equipment and material installed and wired by Contractor.

C. The Contractor shall prepare written procedures for the performance of all testing. The procedures shall include an itemization of all equipment, devices, cable and material requiring field testing, setting, adjustment or calibration and shall describe the required set points. The procedures shall be submitted to the Engineer for review prior to the commencement of any testing.

D. The Contractor shall maintain records for all tests and inspections, with complete data on all readings taken. Test results shall be recorded on standard test forms. All reports shall be dated and shall include the name of the person performing the test.

PART 2 - PRODUCTS

2.1 GENERAL

A. The equipment to be tested under this Section is generally provided under other Specification Sections.

PART 3 - EXECUTION

3.1 EXECUTION

A. Upon completion of the installation, the Contractor shall perform field tests on all equipment, materials and systems to insure that the entire installation is sound and that all circuits, including power, control, relaying, instrumentation and metering will function properly and as intended.

B. The Contractor shall furnish and maintain all tools, instruments, materials, test equipment, test connections and personnel, including supervision and labor required for testing, setting and adjusting of all electrical equipment.

C. All tests shall be performed with proper regard for the protection of equipment and the Contractor shall be responsible for adequate protection of all personnel during such tests.

D. No equipment shall be installed, operated or tested in such a manner as to void the manufacturer's

warranty or guarantee. Should any test values or procedures as indicated in this Specification exceed the values or overrule the procedures recommended by the manufacturer for the equipment involved, the manufacturer's recommendation, shall take precedence.

E. Prior to energizing or placing in service any electrical equipment, testing and checking shall be completed.

F. The witnessing or waiving of witnessing of any test shall not relieve the Contractor of its guarantees for material, equipment and workmanship.

G. The Contractor shall promptly advise the Engineer in writing concerning the failure of any equipment or material to pass the tests performed, or to properly function as intended, or to meet calibration accuracy required. After the defects have been corrected, the test(s) shall be repeated.

3.4 DRY TYPE TRANSFORMERS (GENERAL PURPOSE POWER AND LIGHTING)

A. Check primary and secondary connections for correctness.

B. Check secondary neutral for proper bonding to ground.

C. Perform one minute megger tests of the primary windings to ground with the secondary grounded and secondary windings to ground with the primary grounded.

D. After transformers are energized check secondary voltage and adjust taps as necessary.

3.5 ROTATING EQUIPMENT

A. All motors shall be subjected to a one minute megger test, resistance measured to ground with all phase leads tied together. Minimum insulation resistance values are as follows:

Equipment Rating (volts)	600 or less
Megger Rating (volts)	1000
Min Resistance (megohms)	10

If minimum resistance values are not obtained, the equipment shall be dried out as required, and the above test repeated.

B. The following visual inspection shall be made on all motors:

1. Check bearings for free rotation.

2. Check all ventilation openings for blockages.

3. Check bearing lubrication and correct as necessary.

4. Check that frame is grounded.

5. Check motor leads for proper connection and color coding.

C. The Contractor shall check all motors for proper rotation by bumping motors. Coupled motors shall not be bumped. The Contractor shall correct motor connections as necessary.

3.6 WIRE AND CABLE

A. Control and Instrument Wiring - Control and instrument field wiring shall be visually inspected and tested for continuity to insure that all field wiring is installed in accordance with Contract Drawings and/or equipment manufacturers drawings. Verify all field conductors are properly identified with wire numbers.

B. Low Voltage Power Wiring - All 480V and 208V power wiring shall be subjected to one minute 1000V megger test. Minimum insulation resistance shall be 50 megohms. Megger tests shall be performed between each phase (A-B, B-C, and C-A) and three phases tie together to ground.

3.7 CALIBRATION

A. The Contractor shall check, calibrate and operate all protective relays, timers, meters, instruments and devices furnished under this Division, in accordance with manufacturers recommendations. Equipment furnished under other Divisions will be calibrated by others.

B. Ratios of current and potential instrument transformers shall be verified by test.

3.8 FUNCTIONAL TESTING

A. Unless otherwise noted, the Contractor shall energize and operate all alarm and control circuits under simulated or actual system conditions to verify the correctness of wiring. All control circuits shall be checked in their entirety.

B. Control wiring, circuits and devices furnished and installed by Division 15 will be tested by Division 15.

3.9 GROUNDING

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

2. Perform tests, by the fall-of-potential method according to IEEE 81.

3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 16030

SECTION 16050

INSTALLATION OF ELECTRICAL EQUIPMENT

PART 1 - GENERAL

1.1 GENERAL

A. The provisions of Section 16010 General Requirements for Electrical Work apply to the work of this section.

B. Included in the work of this section is the assembly, installation and wiring of all parts, subassemblies and shipping sections of the electrical panels, motors, disconnect switches, and similar equipment.

C. Testing shall be performed in accordance with Section 16030 Electrical Acceptance Testing.

PART 2 - PRODUCTS

2.1 GENERAL

A. Equipment to be installed under this section is generally furnished under other specification sections.

PART 3 - EXECUTION

3.1 GENERAL

A. All equipment shall be completely assembled, installed and connected and shall be fully prepared and made ready for operation. The Contractor may employ the use of any special tools furnished with the equipment specifically for installation purposes, but shall not use tools furnished with the equipment for maintenance purposes. The Contractor shall acquaint himself with and follow special instructions of the Manufacturer for the care, handling and installation of the equipment.

B. After installation, all operating parts shall be inspected to insure correct mechanical operation.

C. Internal wiring within any equipment which as been disconnected for shipping purposes shall be reconnected. Any wiring not installed by reason of shipping requirements shall also be installed. The Contractor may disconnect internal wiring as necessary for installation purposes, and shall reconnect all wiring so disconnected.

D. After installation, all equipment shall be left in clean conditions. In particular, all insulators, bushings, insulating materials, and other parts which are depended upon for their insulating qualities shall be thoroughly cleaned.

E. No overall painting of equipment will be required, but housing surfaces which have been soiled or marred shall be touched up or refinished with primer and color coat.

F. Drilling, tapping, cutting, or welding of equipment required for mounting or for conduit and cable entrances to suit particular conditions of installation shall be considered as part of electrical equipment installation.

G. All equipment shall be provided with engraved nameplates in accordance with Section 16010 and the drawings.

3.2 SUPPORTS

A. The Contractor shall size and provide all supports necessary for the installation of the electrical equipment.

B. Supports shall be designed for seismic forces in accordance with the latest edition of BOCA National Building Code, Section 1610.

C. Channel framing shall be manufactured by Unistrut, Kindorf, B-Line or approved equal.

D. In dry, non corrosive areas, channel framing shall be galvanized steel or aluminum and all nuts, bolts and hardware shall be carbon steel, cadmium plated or hot dipped galvanized.

E. In outdoor, wet or damp areas channel framing shall be aluminum or 304 stainless steel and nuts, bolts and hardware shall be 304 stainless steel.

F. In corrosive areas, channel framing shall be 316 stainless steel, PVC coated steel or PVC coated aluminum. Nuts, bolts and hardware shall be 316 stainless steel.

G. Supports shall be sized with a minimum safety factor of four or 200 lbs. whichever is greater.

H. Fastening to steel may be welded or bolted. Fastening to solid masonry or concrete shall be machine bolts with expansion shields. Fastening to hollow masonry shall be by toggle bolts.

3.3 WIRING

A. All external connections to electrical equipment shall be completed by the Contractor. Wiring shall be neatly formed, trained and tied with nylon cable ties in all equipment.

B. All power conductors shall be color coded. All control wiring shall be identified with sleeve type wire markers with wire numbers matching those on the manufacturers schematic and connection diagrams.

C. All bus work shall be properly phased "A", "B", "C" left to right, front to back or top to bottom.

3.4 PANELBOARDS

A. The Contractor shall mount equipment at locations shown on the drawings, install all interiors, branch circuit protective devices, complete all external connections and install exterior trim.

B. The panelboard circuit directory card shall be completed in accordance with Section 16010.

C. Mount panelboards so that top of trim is at 6'-2" above finished floor. If panelboard is taller than the highest circuit breaker shall not exceed 6'-6" above finished floor.

D. Mount panelboards plumb and rigid without distortion of box. Mount recessed panels uniformly flush with wall finish. Install panels securely mounted to building structure or to steel channel framing fastened to building structure.

E. For all recessed panelboards stub four one inch conduits from panelboard to an accessible ceiling space for future access to panelboards.

F. Wiring in panel gutters to betrained neatly into groups, bundled and wrapped with wire ties.

G. Install electrical equipment to resist seismic forces determined in accordance with the latest edition of BOCA Building Code and based on applicable seismic zone for project geographical location.

3.5 MOTOR SAFETY SWITCHES

A. Equipment shall be installed at locations shown on the drawings. Deviations shall be permitted to allow better access or may be required to move due to inadequate clearances. The Contractor shall provide all support material and framing required for proper support.

B. Mount equipment so that top of equipment is no higher than 6'-6" above finished floor unless directed otherwise by the authority having jurisdiction. If other construction interferes with this requiement inform the Architect in writing for approval of proposed location prior to relocation.

C. Install equipment plumb, level and true to finished floor lines and locations. Rigidly support and secure equipment in place.

D. Tighten all electrical connections as directed by manufacturers written instruction's and inspect equipment for any damage during shipping or installation.

E. Enclosures installed on concrete surfaces or surfaces where condensation is likely to occur shall clear the mounting surface by at least 1/4 inch.

F. Conduit shall be bottom entry to all enclosures installed outdoors or in wet or damp areas.

3.6 TRANSFORMERS

A. Transformers shall be floor mounted at locations shown on the drawings. The Contractor shall provide all brackets, mounting accessories, support material and hardware.

B. Transformers shall be installed with adequate cooling space in accordance with the manufacturers recommendations, a minimum of 6" from wall.

C. Tighten all electrical connectors and terminals in accordance with manufacturer's published tourque-tightening values. When not specified by manufacturer, use those published in UL 486A and 486B.

D. Transformer neutral shall be grounded in accordance with NEC Article 250.

E. Provide flexible conduit, minimum 2-feet length, for final connections to transformer case.

F. Provide seismic restraints as required by latest edition of the BOCA Building Code.

3.7 MOTORS

A. Motors shall be set plumb and aligned with shafts or pulleys.

B. Motor connections shall be made with compression lugs installed on the motor leads and the motor branch circuit conductors, bolted together.

C. Motor connections shall be wrapped with varnished cambric tape, then insulated with Super 33 Scotch Vinyl electric tape or insulated with motor connection kits as manufactured by Raychem or 3M.

END OF SECTION 16050

SECTION 16060

INSTALLATION OF WIRE AND CABLE

PART 1 - GENERAL

1.1 GENERAL

A. The Provisions of Section 16010 General Requirements for Electrical Work apply to the Work of this Section.

1.2 CODES AND STANDARDS:

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled where applicable.

IEEE 48	Standard Test Procedures and Requirements for High Voltage Alternating Current Cable Terminations.
IEEE 404	Standard for Cable Joints for use with Extruded Dielectric Cable Rated 5000V through 46000V.
UL 486A	Wire Connectors and Soldering Lugs for use with Copper Conductors.
UL 510	Electrical Insulating Tape

1.3 SUBMITTALS

A. Manufacturers product data sheets

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. Wire and cable are specified in other Sections of Division 16000.

2.2 TERMINATIONS AND SPLICES

A. Power Wiring:

1. Terminal lugs, connectors and splices shall be tin plated, high conductivity copper compression type. They shall have chamfered barrels and be permanently identified with conductor sizes.

2. Terminal lugs for conductors No. 3/0 AWG and larger shall be long barrel NEMA two hole type.

3. Splices shall be long barrel butt type with a center stop in the splice barrel.

4. Hydraulic crimping tools with proper die sizes which require full closure before reopening shall be used.

B. Lighting and branch circuits

1. Splices and taps in lighting and branch circuit wiring shall be 3M Hyflex connectors or equal.

C. Metal clad cable connectors.

1. For non-jacketed metal clad cable in dry locations, cable terminations shall be O.Z. Gedney Type PK for use with galvanized steel armor or Type PK-A for use with aluminum armor. Cable terminations shall be provided with locknuts and bushings.

2. For jacketed metal clad cable, cable terminators shall be Thomas & Betts "SPIN-ON" [in non-hazardous areas and "SPIN-ON X" in Class 1 Division 2 areas.]

PART 3 - EXECUTION

3.1 GENERAL

A. Conductors shall be carefully handled during installation to avoid damage of any kind. They shall be unreeled or uncoiled slowly in order to prevent damage to the insulation or sheath due to sudden bending. Repeated bending shall be avoided. Sharp kinks shall be avoided in unreeling, uncoiling and pulling.

B. Suitable precautions shall be made to protect all installed wiring against damage due to construction activities.

3.02 PREPARATION OF RACEWAYS

A. Raceways shall be substantially completed before any wiring is installed in them. Before any wiring is pulled into a conduit, the conduit shall be cleaned and tested for obstructions and cleared of foreign material that may be found.

3.3 PULLING INTO RACEWAYS

A. All possible care shall be taken in pulling of wiring into conduits or other raceways. The cable reels or coils shall be set up in such a way that the conductor may be trained into the raceway as directly as possible with a minimum number of changes of direction or amount of bending. Where several cables are contained in one conduit, all such cables shall be pulled in together.

B. The use of pulling lubricants shall be restricted to non hardening type, approved by UL and the cable manufacturer.

C. Maximum allowable pull tension as specified by the cable manufacturer shall not be exceeded. Cables shall not be bent or pulled around sheaves less than the minimum radius recommended by the manufacturer.

D. Cable in manholes shall be neatly formed, tied and installed on cable racks. Preferred and backup circuits shall not be installed on the same racks.

3.4 TRAY CABLE

A. Cable installed in cable tray shall be placed in a neat and orderly manner.

B. Cables shall be installed using pulleys, sheaves, rollers and other approved tools. Cable shall not be bent or pulled around sheaves less than the minimum radius recommended by the manufacturer.

C. Where spacing is to be maintained between cables they shall be fastened with nylon bands at intervals not exceeding 8 feet in horizontal runs.

D. All cable in vertical runs shall be supported at intervals not to exceed 5 feet.

3.5 SPLICES AND TERMINATIONS

A. All power and control wiring shall be continuous and shall not be spliced unless otherwise indicated on the Drawings.

B. Bolts, nuts and hardware used for terminations shall be silicone bronze. All terminations shall be properly torqued and provided with Belleville washers.

C. Where terminations are made on insulated buses, the terminations shall be insulated using the proper tape(s) and fillers for the voltage level of the cable.

D. Shielded medium voltage cable shall be provided with stress relieved terminations in accordance with IEEE 48, Class 1. Terminations shall be made from kits containing all necessary materials as manufactured by Raychem or equal and installed in accordance with the manufacturer's instructions.

E. Splices in shielded medium voltage cable shall comply with IEEE 404 and be made from kits containing all necessary materials as manufactured by Raychem or equal and installed in accordance with the manufacturer's instructions.

F. Connections in motor terminal boxes shall be made by installing compression type lugs on the motor branch circuit conductors and the motor leads and bolting the lugs together then insulating with motor lead connection kits, Raychem, 3M or equal.

G. Control wiring terminated on terminal blocks provided with saddle clamps does not require terminal lugs. Where screw or stud type terminal blocks are provided, control wiring shall be terminated with insulated, crimp type locking forks, Thomas & Betts STA-KON or approved equal.

3.6 FIREPROOFING

A. In all manholes, pull boxes and equipment enclosures, where two or more medium voltage circuits are installed together, cable shall be wrapped with fire and arc proofing tape, 3M Scotch 77 installed in accordance with the manufacturers instructions including any binding tape as required.

3.7 IDENTIFICATION

A. All power wiring conductors shall be color coded as follows:

Phase	208Y/120V	480Y/277V
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green

B. Each cable shall be permanently identified with cable numbers as indicated on the Drawings. Tags shall be provided at each end, in manholes, pull and splice boxes.

C. Each control conductor shall be identified with a preprinted, sleeve type wire marker. The wire numbers shall match those shown on the Drawings or on manufacturer's schematic and connection diagrams.

3.8 TESTING

A. Wire and cable shall be tested in accordance with Section 16030 "Electrical Acceptance Testing".

END OF SECTION 16060

SECTION 16110

RACEWAY AND FITTINGS

PART 1 - GENERAL

1.1 GENERAL

A. Provisions of Section 16010 General Requirements for Electrical Work apply to the work of this Section.

B. This section includes requirements for racewayssystems, including conduit, boxes, cabinets, and all materials required to install, support and secure a complete system for support and protection of electrical conductors..

1.2 CODES AND STANDARDS

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

ANSI C80.1	Standard for Rigid Steel Conduit
NEMA RN-1	Polyvinyl-chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
NEMA TC-2	Electrical Plastic Tubing and Conduit
NEMA TC-3	PVC Fittings for use with Rigid PVC Conduit and Tubing
UL 1	Flexible Metal Conduit
UL 6	Rigid Metal Conduit
UL 360	Liquid Tight Flexible Steel Conduit
UL 514B	Fittings for Conduit and Outlet Boxes
UL651	Schedule 40 and 80 Rigid PVC Conduit
UL797	Electrical Metallic Tubing
UL870	Wireways, Auxilliary Gutters and Associated Fittings
UL1242	Intermediate Metal Conduit

1.3 SUBMITTALS

A. Submit manufacturers illustrated product literature and technical specifications for each type of raceway provided on this project.

1.4 MANUFACTURERS

A. Rigid steel conduit, electrical metallic tubing, and intermediate metal conduit: Allied Tube and conduit, Triangle, Wheatland or approved equal.

B. Non-metallic conduit: Carlon, Universal, Electriflex, or approved equal.

C. Flexible metal conduit, including liquidtight: AFC, Electriflex, Universal or approved equal.

D. Coupling and fittings: Appleton, crouse Hinds, Killark, O-Z Gedney, Steel City, Thomas & Betts or approved equal.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid steel conduit shall be of mild steel piping with a uniform protective coating of hot dipped galvanizing inside and outside, including all threads. The conduit shall be furnished in nominal 10-foot lengths, with both ends threaded and one coupling (galvanized inside and out) applied to each length. The threads opposite the coupling end shall be protected by a plastic cap.

B. Rigid aluminum conduit, couplings and elbows shall be manufactured of a suitable copper-free aluminum alloy. Conduit lengths shall be seamless throughout and shall have hard, smooth and gum-free interior coatings to facilitate the pulling-in of conductors. It shall be furnished in nominal 10-foot lengths, with both ends threaded and a coupling applied to one end of each length. Threads on the coupling end shall be coated with a special lubricant so that the coupling may be removed without difficulty. Threads on the end opposite the coupling shall be protected from damaged by a plastic cap.

C. Intermediate metal conduit shall be of steel piping with a uniform protective coating of hot dipped galvanizing inside and outside, including all threads. The conduit shall be furnished in nominal 10-foot lengths, both ends threaded and one coupling (galvanized inside and out) applied to each length. The threads opposite the coupling end shall be protected by a plastic cap.

D. Plastic coated rigid steel conduit shall have a 40 mil polyvinyl chloride coating fused to the exterior of the conduit and a urethane coating on the interior and over the threads. The conduit shall be hot dipped galvanized inside and out before the PVC coating is applied. All couplings and fittings shall be similarly coated and shall have overlapping sleeves for the sealing of all joints

Plastic coated conduit and fittings shall be "Plasti-Bond Red" as manufactured by Robroy Industries, or approved equal.

E. Rigid nonmetallic conduit shall be heavy wall Schedule 40 polyvinyl chloride 90 deg. C rated furnished in 10-20-, or 30-foot lengths.

F. Electrical metallic tubing shall be of zinc coated steel with an interior coating of lacquer or enamel.

G. Liquid tight flexible conduit shall be constructed with a flexible core of galvanized steel and an oil resistant PVC jacket to form a liquid tight raceway. The overall jacket shall be wrinklefree and suitable for use in temperatures from -40 deg. C to + 100 deg. C.
Flexible conduit shall be Anaconda "Sealtite" type UA or approved equal.

H. Flexible metal conduit shall be hot dipped galvanized interlocked strip steel.

2.2 CONDUIT FITTINGS

A. Bushings.

1. Insulated bushings for conduit sizes 1-1/4 inches and larger shall have metal bodies and threads, with molded-on high impact phenolic thermosetting insulation to prevent conductor insulation damage. Bushings shall be Type IBC insulated bushings as manufactured by O.Z./Gedney or an approved equal. Insulated bushings for conduit sizes 1 inch and smaller may be of plastic, O.Z./Gedney Type "A", or an approved equal.

2. Insulated grounding bushings shall be similar to the insulated bushings described above, except they shall have set screws to lock the bushings on the conduits and shall have mechanical type lugs attached. The lugs shall be sized to accept the ground wire sizes as set forth in the latest edition of the National Electrical Code, but in no case smaller than No. 8 AWG wire. Grounding bushings shall be Type BLG as manufactured by O.Z./ Gedney or an approved equal.

3. Male bushings shall be Thomas and Betts Corporation insulated throat chase nipples, or a product of equal construction. Bushings used only to pass conductors through metal partitions, etc. shall be O.Z./Gedney, Type "ABB".

4. Bushings for use with EMT shall be O.Z./Gedney type SBT or approved equals.

B. Conduit bodies for use with aluminum conduit shall be of copper free aluminum alloy. Those for use with steel conduit may be of galvanized, or cadmium plated cast iron, or of copper free aluminum alloy. All conduit fittings shall be provided with neoprene gaskets and sheet metal covers, except that cast covers shall be used for sized 1-1/2 inches and larger. Conduit connections shall be threaded and EMT connections shall be set screw. Cover screws shall be captive. All conduit fittings shall be Crouse Hinds, Appleton, Killark or approved equal.

C. Hubs. Water-tight conduit connections are required on all NEMA 3R, 4, and 4X enclosures and all electrical equipment located outdoors or in damp or wet areas. Where hubs or water-tight threaded connections are not provided as part of the enclosure, water-tight hubs shall be Myers "Scru-tite", or approved equal. All other terminations shall be double locknut and bushing.

D. Fittings for use with liquid-tight flexible conduit shall be zinc plated malleable iron O.Z./Gedney type 4Q or approved equal.

E. Locknuts. Locknuts shall be hot dipped galvanized steel or malleable iron. Standard locknuts shall be used for connections to NEMA 1 enclosures. Sealing locknuts with integral gasket shall be used for connections to NEMA 12 enclosures.

2.3 JUNCTION BOXES

A. Pull and junction boxes shall be of code gauge metal with continuously welded joints or of cast metal if called for on the Drawings. All junction boxes shall have gasketed screw covers. Boxes for use with aluminum conduits shall be of aluminum. Sheet steel boxes shall be galvanized after

fabrications. Screws for galvanized steel box covers shall be made of brass. Screws for aluminum box cover shall be stainless steel.

Boxes installed in concrete shall be cast iron alloy or copper free aluminum.

Unless otherwise shown on drawings, all boxes installed indoors shall be rated NEMA 1and all boxes installed outdoors shall be rated NEMA 3R.

2.4 OUTLET BOXES

A. Outlet boxes for concealed work shall be pressed steel boxes, galvanized and not less than #12 gauge. Each ceiling outlet designated for a lighting fixture shall have a fixture support secured in place with bolts and nuts. Ceiling boxes shall be octagonal with lugs and screws for back plates.

B. Outlet boxes installed outdoors, in concrete or exposed, shall be cast iron alloy or copper free aluminum with gasketed covers.

C. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used and to fulfill installation requirements for individual wiring situations.

2.5 WIREWAY

A. Wireway shall be lay-in type, code gauge steel with dark gray enamel finish inside and out.

B. Covers shall be hinged with captive screw fasteners for NEMA 1 & NEMA 3R wireway and gasketed quick release latch covers for NEMA 12 wireway.

2.6 SURFACE RACEWAY

2.7 SUPPORTS

A. The Electrical Subcontractor shall size and provide all supports necessary for the installation of all raceway.

B. Supports shall be designed for seismic forces in accordance with The BOCA National Building Code, Section 1612.

C. Channel framing shall be manufactured by Unistrut, Kindort, B-Line or approved equal.

D. In dry, non corrosive areas, channel framing and angle shall be galvanized steel or aluminum and all nuts, bolts and hardware shall be carbon steel, cadmium plated or hot dipped galvanized. Ream clamps shall be galvanized steel or malleable iron.

E. In outdoor, wet or damp areas channel framing and angle shall be aluminum or 304 stainless steel and nuts, bolts and hardware shall be 304 stainless steel. Beam clamps shall be hot dipped galvanized steel or malleable iron.

F. In corrosive areas, channel framing shall be 316 stainless steel, PVC coated steel or PVC coated aluminum. Nuts, bolts and hardware shall be 316 stainless steel. Beam clamps shall be PVC coated.

G. Supports shall be sized with a minimum safety factor of four or 200 lbs. whichever is greater.

PART 3 - EXECUTION

3.1 GENERAL

A. Wiring methods are specified in Section 16010 General Requirements for Electrical Work.

3.2 INSTALLATION

A. Conduit, EMT, boxes & enclosures shall be installed so that they are mechanically secure, electrically continuous and neat in appearance.

B. Exposed runs shall be installed to conform to the shape of the surface over which they are run. Where they are run over a plane surface, they shall be straight and true. All exposed conduits shall be run parallel and perpendicular to building column lines and walls. Diagonal run will not be permitted. Conduit runs in groups shall be supported by means of common members made of channel framing. Group mounting is not required where the group consists of only two conduits. Fastening to solid masonry or concrete shall be machine bolts with expansion shields. Fastening to hollow masonry shall be with toggle bolts.

Unless otherwise approved, spacing between conduit supports shall not exceed ten feet. Conduits shall not be supported from structural members marked Removable on the structural drawings. Conduit hangers and supports shall be fastened to buildings and structural members only and not to any equipment or piping. Separate conduits a minimum 6 inches from flues, steam and hot water lines. Install conduit above mechanical piping wherever possible.

C. All conduit supports other than structural members shall be galvanized. The use of perforated strap or plumber straps will not be permitted.

D. Conduit up to 1-1/2 inches may shall be supported by one hole malleable iron straps with clamp backs. Conduit 2 inches and larger shall be supported by two hole straps.

E. Conduit runs shall not exceed 100 feet between boxes, fittings or devices.

F. All conduit crossing building or structure expansion joints shall be provided with approved expansion fittings.

3.3 BENDS

A. Field bends shall be made with approved bending tools. All field-formed bends shall be of maximum radius permitted by the design and construction conditions.

B. Where a group of exposed conduits change direction, the bends shall have a common center in order to maintain the uniformity and neat appearance of the group, having regard for the minimum bending radius of the largest conduit in the group.

C. Bends shall be uniform radius and free from cracks, crimps or other damage to the conduit or its coating and shall not unduly flatten the conduit section.

3.4 JOINTS AND TERMINATIONS

A. All joints in rigid conduit shall be threaded, using standard couplings. The use of running threads, threadless or split couplings is prohibited. When reaming out of conduit ends to remove burrs and rough edges, care shall be exercised to avoid excessive reaming which results in the weakening of the conduit wall at the end.

B. All joints shall be made up wrench tight and with a minimum of wrench work in order to avoid wrench cuts.

C. All cut threads shall be thoroughly painted with a coating of a rust inhibiting primer.

D. EMT couplings and fittings shall be compression type up to 1 –1/4 inch and double set screw type 1-1/2 inch and larger.

G. All conduit terminations in panels, enclosures, outlet boxes and equipment shall be provided with bushings.

3.5 FLEXIBLE CONDUIT

A. Flexible conduit shall be use to terminate all, lighting, motors, unit lanterns, transformers, pilot devices and vibrating equipment.

B. All flexible conduit shall be liquid-tight except connections to lighting fixtures and equipment installed in ceiling spaces.

C. Connections to lighting fixtures shall be maximum length of 6 feet. All other flexible connections shall be maximum 18 inches.

3.6 PENETRATIONS

A. All penetrations through concrete slabs, masonry walls or roofs shall be provided with sleeves.

B. All sleeves shall be sealed to maintain the integrity of the structure. Fire resistant walls and floors shall be sealed with approved material, and shall maintain the original fire rating. All seals below grade shall be watertight, O.Z./Gedney type WSK or approved equal.

3.7 CONCRETE SLABS

A. Conduit shall be installed below concrete floor slabs at all locations possible.

B. If required to be run within slab conduit shall be separated by not less than twice the nominal diameter of the largest conduit and diameter shall not exceed 1/3 of the slab thickness.

END OF SECTION 16110

SECTION 16200

600 VOLT WIRE

PART 1 - GENERAL

1.1 GENERAL

A. The provisions of Section 16010, General Requirements for Electrical Work apply to the Work of this Section.

1.2 CODES AND STANDARDS

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

ASTM B-3	Soft or Annealed Copper Wire
ASTM B-8	Concentric Lay Stranded Copper Conductors
NEMA WC-5	Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
UL 44	Rubber Insulated Wires and Cables
UL 83	Thermoplastic Insulated Wires and Cables

1.3 SUBMITTALS

A. Manufacturer's product data sheets.

PART 2 - PRODUCTS

2.1 GENERAL

A. All conductors shall be annealed copper in accordance with ASTM B-3.

B. The jacket of all wire shall be printed with the following information:

1. Manufacturer
2. Size
3. Insulation type
4. Maximum voltage
5. UL label

C. All insulation shall be rated 600 volt.

2.2 POWER WIRING

A. Feeders and motor branch circuits shall be type THHN/THWN.

B. All power wiring shall be stranded, Class B strand in accordance with ASTM B-8, minimum size #12 AWG.

2.3 BRANCH CIRCUITS

A. All lighting and convenience receptacle branch circuit wiring shall be type THHN/THWN.

B. Branch circuit wiring shall be solid or stranded conductor, minimum size #12 AWG.

2.4 CONTROL WIRING

A. Wiring for control circuits shall be THHN/THWN.

B. Control wiring shall be stranded, Class B strand in accordance with ASTM B-8, minimum size #14 AWG.

2.5 FIXTURE WIRE

A. Where high temperature fixture wire is required it shall be silicone rubber type SF-2.

PART 3 - EXECUTION

3.1 GENERAL

A. All wire shall be installed in accordance with Section 16060, Installation of Wire and Cable.

B. All wire shall be tested in accordance with Section 16030, Electrical Acceptance Testing.

END OF SECTION 16200

SECTION 16470

PANELBOARDS

PART 1 - GENERAL

1.1 GENERAL

A. The provisions of Section 16010, General Requirements for Electrical Work apply to the Work of this Section.

B. This Section includes lighting, power and power distribution panelboards and associated auxiliary equipment rated 600 V or less.

1.2 CODES AND STANDARDS

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

NEMA AB-1	Molded Case Circuit Breakers
NEMA PB-1	Panelboards
UL 50	Enclosures for Electrical Equipment
UL 67	Panelboards
UL 489	Molded Case Circuit Breakers and Circuit Breaker Enclosures
UL 943	Ground Fault Circuit Interrupters
UL 250	Enclosures for Electrical Equipment

1.3 SUBMITTALS

A. Manufacturer's product data sheets for each type of panelboard, overcurrant device, transient voltage suppression devices, accessories and components indicated on panel schedules.

B. Panelboard Schedules indicating layout of all breakers (consistant with layout on drawings).

C. Dimensioned plans, elevations, sections and details. Include enclosure types, bus configuration, current and voltage ratings, short circuit current ratings, features, characteristics and wiring diagrams.

1.4 MANUFACTURERS

A. Subject to compliance with the Specification requirements:

Eaton Corporation; Cutler-Hammer Products
General Electric Co.;Electrical Distribution & Controls
Siemens Energy & Automation, Inc.
Square D Co.

1.5 EXTRA MATERIALS

A. Touch-Up Paint: 1 half-pint container.

PART 2 - PRODUCTS

2.1 GENERAL

A. Panelboards shall be dead-front type assembled into a single interior unit mounted in a sheet-steel enclosure, consisting of a box and front, and designed to be mounted in or against wall.

B. Panelboards, including lighting and power panelboards and power distribution panelboards, shall be of the sizes, ratings and arrangement shown on the Drawings.

C. Panelboards shall be provided complete with all overcurrent devices, accessories and trim.

D. All panelboards shall be provided with safety barriers for dead front construction.

E. The required short circuit ratings of assembled panelboards are shown on the Drawings. The short circuit rating of every overcurrent device in the panel shall meet or exceed the panel rating. Unless otherwise noted on the Drawings, series rated combinations will not be permitted.

F. Provide feed through or sub-feed lugs as indicated on panel schedules. Feed through lugs to be located at opposite end of bus from incoming lugs or main device.

2.2 CABINETS

A. Boxes shall be code gauge galvanized sheet steel flush or surface mounted as indicated. NEMA Type 1 enclosure unless otherwise noted on drawings. Surface mounted panelboards shall be provided without pre-punched knockouts.

B. Trim shall be code gauge steel, ANSI-61 gray finish with stainless steel flush type lock/latch handle. All locks shall be keyed alike.

C. Entire front trim to be hinged to box so that panelboard gutter space can be accessed without removing trim.

D. Directory frames shall be metal frame with plastic covers.

2.3 BUS

A. All bus work shall be 1000 amp/sq.in. hard drawn copper with 98% conductivity.

B. Unless otherwise noted on the Drawings, neutral busses shall be 100% rated with adequate connections for all outgoing neutral conductors.

C. Panelboards shall be provided with copper equipment ground bus bonded to box and sized adequate for branch circuit equipment ground conductors.

D. Panelboards indicated as having Isolated Ground Bus shall have a copper bus insulated from box and having adequate capacity for branch circuit equipment ground conductors.

E. Bus shall be designed for sequence phase connection to allow the installation of one, two or three pole branch circuit breakers in any position.

F. Provide mounting brackets, bus connections and necessary appurtenances required for future installation of devices.

2.4 OVERCURRENT DEVICES

A. Overcurrent devices shall be trip-free molded case, bolt-on, thermal magnetic circuit breakers.

B. Main circuit breakers shall be individually mounted and bolted to bus assembly. Back-fed branch mounted circuit breakers are prohibited.

C. Front faces of all circuit breakers shall be flush. Trip indication shall be clearly shown by the handle position between the ON and OFF positions.

D. Ground fault circuit breakers shall require no more panel space than standard breakers.

E. Where circuit breakers are used for switching of lighting, circuits type "SWD" circuit breakers shall be provided.

F. All connections shall be rated for 75 degree C copper conductors.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Panelboards shall be installed in accordance with Section 16050, Installation of Electrical Equipment & NEMA PB 1.1.

3.2 IDENTIFICATION

A. Label panelboards in accordance with Section 16010, General Requirements For Electrical Work.

3.3 FIELD QUALITY INSPECTION

A. Make visual inspection for defects and physical damage, labeling and nameplate compliance with record drawings. Check panelboard mounting, area clearances, alignment and fit of components.

B. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual. Check tightness of all bolted electrical connections with calibrated tourque wrench. Refer to manufacturer's instructions for proper tourque values.

3.4 TESTING

A. Test insulation resistance for each panelboard bus, component, connecting supply, feeder and control circuit.

B. Test continuity of each circuit.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner. Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.4 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16470

SECTION 16490

SAFETY SWITCHES

PART 1 - GENERAL

1.1 GENERAL

A. The provisions of Section 16010 General Requirements for Electrical Work apply to the Work of this Section.

B. This section includes disconnect switches and the installation of these devices. Furnish quantities and sizes as indicated on drawings.

1.2 CODES AND STANDARDS

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

NEMA KS-1	Enclosed Switches
UL 98	Enclosed and Deadfront Switches
UL 198	Power Fuses

1.3 SUBMITTALS

A. Manufacturers Product Data Sheets for each type of motor starter specified in this section. Data Sheets to include short-circuit current rating, electrical characteristics, ratings and finishes.

B. Dimensioned Outline Drawings including elevations, sections, and details including required clearances and service space around equipment .

C. Control wiring diagrams specific for this project. Generic manufacturers control drawings shall not be acceptable unless they pertain to specific project

1.4 MANUFACTURERS

A. Subject to compliance with the Specification requirements:

Eaton Corporation; Cutler-Hammer Products
General Electric Co.;Electrical Distribution & Controls
Siemens Energy & Automation, Inc.
Square D Co.

1.5 EXTRA MATERIALS

A. Furnish one spare fuse for every five installed, but no less than three for each type and size installed.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

A. Safety switches shall be 600 VAC (or 240 VAC) NEMA heavy duty, single throw, horsepower rated visible blade type. Switches shall be non-fused or fused as indicated on the Drawings.

B. The switch operating mechanism shall be spring activated quick make - quick break.

C. The external operating handle shall indicate the switch position, ON in the up position, OFF in the down position and shall be padlockable in the OFF position. A defeatable interlock shall be provided to prevent opening the cover when the switch is ON and prevent closing the switch contacts when the cover is opened.

D. Switches shall be provided with arc suppressors and line terminal shields.

E. Single speed motors shall be provided with three pole switches. Two speed motors shall be provided with six pole switches.

F. Switches shall be provided with a factory supplied ground kit.

G. Fused switches shall be provided with class R fuses.

H. Safety switches installed indoors shall be provided with NEMA 1enclosures. Safety switches installed outdoors or in wet areas shall be provided with NEMA 3R enclosures.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Safety switches shall be installed in accordance with Section 16050 Installation of Electrical Equipment.

3.2 TESTING

A. Test mechanical and electrical operation of each safety switch.

3.3 CLEANING

A. Clean and dry thoroughly all motor starters before energizing. Vacuum enclosures inside and out, then wipe down equipment.

END OF SECTION 16490

SECTION 16500

INTERIOR LIGHTING FIXTURES

PART 1 - GENERAL

1.1 GENERAL

A. Provisions of Section 16010 General Requirements for Electrical Work, Section 16060 Installation of Wire and Cable, and Section 16110 Raceway and Fittings apply to the work of this section.

1.2 CODES AND STANDARDS

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

CBM Labels	Certified Ballast Manufacturers Assoc.
NEC Art. 410	National Electrical Code
FCC, Part 18	RFI and EMI
ANSI C62.41	Line Transient Protection
UL 1570	Fluorescent Lighting Fixtures
UL 1572	HID Lighting Fixtures
UL 1571	Incandescent Lighting Fixtures
UL 924	Emergency Lighting and Power Equipment
UL 1088	Temporary Lighting

1.3 SUBMITTALS

A. Submit manufacturer's product data, photometrics, and installation instructions for each type of light fixture specified. Fixture submittals will be in booklet form with separate sheet for each fixture assembled in "luminaire type" alphabetical order, with proposed fixture and accessories clearly indicated on each sheet.

B. Submit on a separate sheet for each HID and fluorescent fixture type specified, the ballast manufacturer, type and technical data for that ballast.

C. Submit on a separate sheet for each light fixture specified, the proposed lamp and manufacturers data for that lamp.

1.4 MANUFACTURERS

A. Provide products of the manufacturers specified on the contract drawings and as listed under Part 2 of this section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Light fixtures shall be provided with housings, trims, ballasts, lamp holders, sockets, reflectors, wiring and other components required, as a factory-assembled unit for a complete installation.

B. Provide electrical wiring within light fixtures suitable for connecting to branch circuit wiring in accordance with N.E.C. Article 410, Paragraph 25.

C. Deliver interior lighting fixtures in factory fabricated containers and wrapping, which properly protect fixtures from damage.

D. Store interior lighting fixtures in original packaging. Store inside well-ventilated area protected from weather, moisture, soiling, humidity, extreme temperatures, laid flat and on skids to keep off floors and ground.

E. Fixtures installed in ceilings, suspended from ceilings or on walls shall have a plastic film covering protecting lens, louver and lamps from dust, dirt and debris. Plastic film shall not be removed until construction is completed.

2.2 FLUORESCENT FIXTURES

A. General Provide fluorescent fixtures of sizes, types and ratings indicated and specified in the Lighting Fixture Schedule on the Contract Drawings.

B. Fluorescent-Lamp Ballasts: provide low-energy solid state fluorescent lamp ballasts, capable of operating lamp types indicated; with high power factor, rapid-start, and low-noise features. Ballasts shall have lamp current crest factor of 1.5 or less and total harmonic distortion less than 10%.

1. Manufacturers: Subject to compliance with the requirements, provide ballasts by one of the following:
   a. Motorola Lighting, Inc.
   b. ETTA Industries, Inc.

C. Fluorescent Dimming Ballasts: Provide solid state electronic dimming ballasts, capable of operating lamp types specified, with high power factor rapid start, and low noise features. Ballast shall have a lamp crest factor of 1.6 and below and a total harmonic distortion not to exceed 15%. Dimming range of 100 to 5%.

1. Manufacturers: Subject to compliance with requirements provide dimming ballasts by one of the following:

   a. Lutron Electronics Co., Inc.

D. Compact Fluorescent Ballast: Provide 90% minimum power factor electronic ballast capable of operating lamp types specified. Ballasts to have flicker of less than 5%, lamp crest factor less than 1.7 and lamp end-of-life detection and shutdown circuit.

E. Compact Fluorescent Dimming Ballasts: Provide solid state electronic dimming ballasts, capable of operating lamp types specified, with high power factor rapid start, and low noise features. Ballast shall have a lamp crest factor of 1.6 and below and a total harmonic distortion not to exceed 15%. Dimming range of 100 to 5%.

2.3 INCANDESCENT FIXTURES

A. Provide incandescent fixtures of sizes, types and ratings indicated and specified in the fixture schedule. Fixtures shall have diecast aluminum lampholder housing with medium base porcelain socket. The fixtures frame shall have galvanized steel junction box with hinged covers and 1/2"-3/4" knockouts. Thermal protection shall be as required. Specular Alzak reflector cones shall be provided with color as specified.

2.4 HIGH INTENSITY DISCHARGE FIXTURES

A. Provide HID lamp ballasts, of ratings, types and makes as recommended by lamp manufacturer, which properly mates and matches lamps to electrical supply by providing appropriate voltages and impedances for which lamps are designed. Design ballast to operate lamp within the lamp's power trapezoid requirements.

2.5 LAMPS

A. Provide HID, fluorescent and incandescent lamps of types as indicated on the contract drawings. Acceptable lamp manufacturers are Osram Sylvania, Inc. and Philips Lighting Co.

PART 3 - EXECUTION

3.1 GENERAL

A. Examine all areas and conditions under which lighting fixtures are to be installed and structure which will support lighting fixtures. Notify the Contractor in writing of any conditions which are detrimental to proper installation and completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

B. Coordinate light fixture installations with other trades. Fluorescent light fixtures should be installed at least two feet away from smoke detectors. Coordinate all lighting fixtures with mechanical piping and duct work to allow for proper clearance.

3.2 INSTALLATION

A. Install all lighting fixtures at locations and heights indicated, in accordance with the architectural reflected ceiling plans.

B. All recessed lighting fixtures installed in ceiling which require a fire resistance rating shall be installed in accordance with the 1996 BOCA National Building Code Section 713.

C. Provide fixtures and/or fixture outlet boxes with hangers, channel or other method of fastening and supporting fixtures required for proper installation.

D. All pendant mounted fixtures shall be installed plumb and level or as detailed on the Contract Drawings. Pendant mounted fixtures longer than 18" shall have twin hangers of type specified.

E. Tighten connectors and terminals, including screws and bolts in accordance with equipment manufacturer's published torque tightening values for equipment connectors. All screws and bolts shall have washers.

3.3 SPLICES AND TERMINATIONS

A. Twist on wire connectors shall be installed which utilize square-wire spring grips and thermo plastic shells. Install connectors to meet the manufacturer's torquing requirements. Install wire connectors of size required as not to exceed the manufacturers UL-listed CSA recognized wire combinations.

3.4 FIELD QUALITY CONTROL

A. At date of substantial completion, all lamps which are not functioning, have color deficiencies, or are noticeably dimmed shall be replaced with new lamps as determined by the Engineer.

B. All lamps used for temporary lighting in new light fixtures shall be replaced with new lamps.

C. All light fixtures shall be cleaned of dirt and debris upon completion of construction. All finger prints and smudges shall be cleaned.

D. All installed fixtures during remainder of construction shall be protected in accordance with Section 2.1 Paragraph E of this specification section.

E. All light fixtures shall be grounded in accordance with article 250 and 410 of the NEC. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

F. All light fixtures damaged in shipping or during installation shall be replaced with new fixtures at no cost to the Owner.

G. Furnish stock or replacement lamps amounting to 15%, but no less than six lamps, of each type and size lamp used in each type of lighting fixture. Deliver replacement stock as directed to Owner's storage space.

END OF SECTION 16500

SECTION 16540

INTERIOR TRANSFORMERS

PART 1 - GENERAL

1.1 GENERAL

A. The provisions of Section 16010, General Requirements for Electrical Work apply to the Work of this Section.

B. This Section includes general purpose and specialty dry type transformers with windings rated 600 V or less.

1.2 CODES AND STANDARDS

A. Products shall comply with the following codes and standards and shall be UL-listed and labeled:

ANSI C89.2	Dry Type Transformer for General Applications
UL 1561	Dry Type General Purpose and Power Transformers

1.3 SUBMITTALS

A. Manufacturer's product data sheets indicating weights, dimensions, voltage, KVA, impedance ratings, efficiency at 25, 50, 75, and 100 percent load, rated temperature rise, sound level rating and insulation system.

1.4 MANUFACTURERS

A. Subject to compliance with the Specification requirements.

Eaton Corporation; Cutler-Hammer Products
General Electric Co.;Electrical Distribution & Controls
Siemens Energy & Automation, Inc.
Square D Co.

1.5 DELIVERY, STORAGE AND HANDLING

A. Apply temporary heat according to manufacturers written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when the transformer is not in a space that is continuously under normal control of temperature and humidity.

PART 2 - PRODUCTS

2.1 GENERAL

A. Interior transformers shall be of the sizes, and ratings shown on the Drawings.

B. Transformers shall be factory assembled and tested general purpose dry type, air-cooled and designed for 60-Hz service. Transformers 9 KVA and smaller shall be nonventilated, unless otherwise noted on the Drawings. Transformers 15 KVA and larger shall be ventilated Ventilated transformers installed outdoors shall be provided with NEMA 3R enclosures.

C. Transformer sound levels shall meet NEMA/ANSI standard requirements, measured in accordance with ANSI standards. Sound levels shall not exceed 45 dB for transformer 15 to 45 KVA and 50 dB for transformers 75 to 225 KVA. Provide integral vibration and noise dampening supports.

D. Transformers 15 KVA and larger shall have 220 degrees C insulation system with temperature rise not exceeding 115 degrees C under full-rated load in maximum ambient of 40 degrees C. Transformers less than 15 KVA shall have 185 degrees C insulation with a 115 degrees C temperature rise.

E. Provide transformers with 6 full capacity taps, 2 at 2-1/2% above rated primary voltage and 4 at 2-1/2% below rated primary voltage.

F. Enclosure to be fabricated of heavy guage sheet steel (ventilated for 15 KVA and larger) with an ANSI-49 gray coating color.

G. Cores to be grain-oriented, non aging silicon steel.

H. Coils shall have continuous windings without splices (except for taps). Internal coil connections to be brazed or pressure type. Coil material shall be aluminum or copper.

I. Transformers shall be low loss type certified as meeting NEMA TP 1 Class 1 efficiency levels when tested according to NEMA TP 2.

2.2 SHIELDED ISOLATION TRANSFORMERS

A. Where indicated on the drawings, provide shielded isolation transformers.

B. Shielded isolation transformers shall be provided with a full-width copper electrostatic shield between the primary and secondary windings to minimize interwinding capacitance. Provide separate terminal for grounding of electrostatic shield. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.

C. Capacitance between Primary and Secondary Windings not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz. Common-Mode noise attenuation of minus 120 dBA minimum at 0.5 to 1.5 kHz and minus 60 dBA minimum at 1.5 to 100 kHz. Normal-Mode Noise Attenuation to be minus 52 dBA minimum at 1.5 to 10 lHz.

2.3 K-FACTOR RATED TRANSFORMERS

A. Where indicated on the Drawings, provide transformers with a K-factor indicated that complies with UL 1561 requirements for non-linear, nonsinusoidal loads and harmonic currents. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.

B. Transformers shall be K-factor rated and UL listed. The K-Factor shall be indicated on the transformer nameplate.

C. The neutral bus shall be rated 200%.

D. An electrostatic shield in accordance with Paragraph 2.2 shall be provided for all K-factor transformers.

E. K-Factor rated transformers shall be provided with 220°C insulation with a rated maximum temperature rise of 115°C.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Transformers shall be installed in accordance with Section 16050 Installation of Electrical Equipment.

3.2 GROUNDING

A. Ground transformer with grounding conductor sized in accordance with the latest edition of NEC Article 250.

3.1 TESTING

A. Transformers shall be installed in accordance with Section 16030 Electrical Acceptance Testing.

B. Upon completion of installation, inspect interiors and exteriors of accessible components. Remove paint splatters and other spots, dirt and construction debris. Touch up scratches and mars of finish to match original finish.

C. Adjust transformer taps to provide optimum voltage conditions at utilization equipment.

END OF SECTION 16540

DIVISION 17000

COMMUNICATIONS TECHNOLOGY

PART 1 - GENERAL

1.01 REGULATIONS AND CODE COMPLIANCE

A. The General Provisions of the Contract, including, General Requirements for Electrical Work (Section 16010), General and Supplementary General Conditions, and Division 1 General Requirements, apply to work specified in this section.

B. All work shall be performed strictly as required by rules, regulations, standards, codes, ordinances, and laws of Local, State, and Federal governments, and other authorities that have lawful jurisdiction. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of publications, standards, rulings, and determinations of:

a. Local and state building, plumbing, mechanical, electrical, fire and health department and public safety codes agencies.
b. National Fire Protection Association (NFPA).
c. Occupational Safety and Health Act (OSHA).
d. National Electrical Code (NEC).
e. National Electrical Safety Code (NESC).
f. The BOCA National Building Code.

1.02 SCOPE

A. The work to be accomplished under these specifications includes providing all labor, materials, equipment, consumable items, supervision, administrative tasks, tests and documentation required to install complete and fully operational communications systems as described herein and shown on the Drawings. The Communications Subcontractor shall completely coordinate the work of this section with the work of other trades.

B. The Communications Contractor shall file plans, obtain permits and licenses, pay fees and obtain necessary inspections and approvals from authorities that have jurisdiction, as required to perform work in accordance with all legal requirements.

C. The Work shall be complete from point of service to each outlet or device including termination of all cable and wire with all accessory construction and materials required

to make each item of equipment or system complete and ready for operation. The Communications Contractor shall provide complete cabling infrastructure for Phone, Data Systems, CATV, and other systems as indicated on the drawings, including but not limited to the following:

1. Category 6 Data Station Cabling
2. Category 5E Voice Station Cabling
3. Category 3 Voice Riser Backbone Cabling
4. Category 6 and 5E RJ-45 Style Jacks
5. Category 6 and 5E RJ-45/110 Modular Patch Panels
6. Category 5E 110-style Voice Termination Blocks
7. Mode Fiber Optic Riser Cables
8. Multi Mode Fiber Optic Connectors
9. Fiber Optic Patch Panels
10. Coaxial cable
11. Splitters, directional couplers, and patch panels for CATV
12. Telecommunications Equipment Racks
13. Horizontal Cable Managers
14. Vertical Cable Managers
15. Cabling Distribution Support

D. It is the intent of the specification that one manufacturer, where practical, be selected for each particular classification of material.

1.03 TECHNICAL REFERENCES

A. ANSI/TIA/EIA 568-B.1, "Commercial Building Telecommunications Wiring Standards", including all subsequent changes, modifications, addenda that are in effect at the time of bidding.

B. ANSI/TIA/EIA 568-B.2, "Commercial Building Telecommunications Cabling Standard - Balanced Twisted Pair Cabling Components" including all subsequent changes, modifications, addenda that are in effect at the time of bidding.

C. ANSI/TIA/EIA 568-B.3, "Optical Fiber Cabling Components Standard" including all subsequent changes, modifications, addenda that are in effect at the time of bidding.

D. ANSI/TIA/EIA 569A: "Commercial Building Standard for Telecommunications Pathways and Spaces".

E. ANSI/TIA/EIA 606A: "The Administration Standard for the Telecommunications Infrastructures".

F. ANSI/TIA/EIA 607: "Grounding / Bonding".

G. BICSI: "Telecommunications Distribution Methods Manual" Ninth Edition.

1.04 SUBMITTALS

A. After the Contract is awarded, but prior to proceeding with the Work, the Contractor shall obtain complete shop drawings, product data and samples from manufacturers, suppliers, vendors, and contractors for all materials and equipment specified herein, and submit data and details of such materials and equipment for review by the Architect. Prior to submission of the shop drawings, product data and samples to the Architect, the Contractor shall review and certify that the shop drawings, product data and samples are in compliance with the Contract Documents. Further, the Contractor shall check all materials and equipment after their arrival on the jobsite and verify their compliance with the Contract Documents. A minimum period of ten working days, exclusive of transmittal time will be required in the Architect's office each time shop drawings, product data and/or samples are submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling his Work.

B. The Contractor shall submit to the Architect three (3) copies of shop drawings. All copies shall be neatly bound in folders. Additional copies required for distribution shall be the responsibility of the Contractor after reviewed copies are returned to him with the Architect's review comments and notes.

C. The shop drawing submittal shall include all data necessary for interpretation as well as manufacturer's name and catalog number. Sizes, capacities, colors, etc., specified on the drawings shall be specifically noted or marked on the shop drawings.

D. Submittals shall contain only information specific to systems, equipment and materials required by Contract Documents for this Project. Do not submit cut sheets that describe products, models, options or accessories, other than those required, unless irrelevant information is marked out or unless relevant information is highlighted clearly. Illegible copies of catalog pages will not be accepted. Marks on submittals, whether by Contractor, Subcontractor, manufacturer, etc., shall not be made in red ink. Red is reserved for review process.

E. All specification sheets, drawings and diagrams shall be submitted within 30 days from the date the Contractor signs the Contract. The Architect's review of such drawings shall not relieve the Contractor of responsibility for deviations from the Contract, Drawings or Specifications, unless he has in writing called the attention of the Architect to such deviations at the time of the submission. The Architect's review shall not relieve the Contractor from responsibility for errors or omissions in such drawings.

1.05 CLOSE-OUT SUBMITTALS

A. Technical Documentation: Submit for approval one draft of the complete Technical Documentation for the systems defined in this specification. This documentation shall include the following:

   a. Table of contents.
   b. Communications Systems installer Name, Contact Name, Address, Telephone Number, Fax Number, and email address.

c. Manufacturers' certificate of warranty for the complete (or each and every of the various subsystems) Communications System. Clear documentation of effective warranty periods. All warranties shall be filled out in the Owner's name.
d. Proposed Service Contract.
e. Maintenance Documentation including the following:
    i. Information necessary for the Owner's technical staff to perform routine and/or corrective maintenance.
    ii. List of all equipment by manufacturer.
    iii. List of all spare parts.
f. Original copies of manufacturers installation and operation instructions arranged alphabetically by manufacturer.

B. Technical Diagrams and Drawings:

a. Provide a simplified single line drawing showing functional relationships and interconnection of all equipment. These drawings should be sufficient to provide information that a technician who is unfamiliar with the installation be able to efficiently troubleshoot and service the system.
b. A complete set of all technical diagrams and drawings shall be mounted on the wall either behind a plastic cover or in a durable file holder (as determined by the owner) in each telecommunications and equipment room.

1.06 TRAINING

A. Conduct a training program for the Owner's staff.

B. Training program shall include:

a. Proper termination technique for Cat6 and 5e jacks and patch panels.
b. Circuit tracing techniques.
c. Review of cable test results and an explanation of the terminology and relevance of each component of the cable tests.
d. Review of technical manuals and diagrams.

1.07 SPARE PARTS

A. Provide the following spare parts:

a. Single gang 2-port faceplate. Quantity of 5.
b. Modular furniture 2-port faceplate. Quantity of 5.
c. Cat6 Data outlet jacks. Quantity of 10.
d. Cat5e Voice outlet jacks. Quantity of 10.
e. Cat6 24-port patch panel. Quantity of 1.
f. Cat6 cable. Quantity of 1000 feet.
g. Cat5e cable. Quantity of 1000 feet.

1.08 ALTERNATES

A. Manufacturer's names are listed herein and on the drawings to establish a standard for quality and design. Where one manufacturer's name is mentioned, products of other manufacturers will be acceptable if, in the opinion of the Architect, the substitute material is of quality equal to or better than that of the material specified.

B. Detailed specifications and, if the Architect determines it is necessary, samples of proposed alternate products shall be provided to the Architect for review prior to purchase or installation of proposed alternates.

C. Cost for removal and replacement of any unapproved alternates pertaining to the items specified in this section is the sole responsibility of the Communications Cabling Contractor.

1.09 ADDITONAL ITEMS

A. Provide unit pricing for installation of voice and data outlets at locations not indicated on the drawings at the time of bidding. Provide unit price for a 100' wiring run, voice/data outlet and all required terminations.

B. This pricing shall reflect work to be completed prior to the owner occupying the building.

C. Provide unit pricing for 1', 3', 7', 10', and 25' lengths of Cat6 and 5e patch cords manufactured and tested by the same company that manufactures the jacks and patch panels.

PART 2 – PRODUCTS

2.01 DEMARCATION ROOM (007) REQUIREMENTS

A. Three 4-foot by 8-foot by ¾-inch plywood backboard with 2 coats of fire resistant light or white colored paint shall be provided as shown on the drawings.

B. A ground bar and 2-AWG, green, insulated ground wire shall be installed by Division 16000 contractor.

C. Labeling shall follow the guidelines set forth in ANSI/TIA/EIA-606 -Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

2.02 TELECOMMUNICATION ROOM REQUIREMENTS

A. One 4-foot by 8-foot by ¾-inch plywood backboard with 2 coats of fire resistant light or white colored paint shall be provided as shown on the drawings.

D. A ground bar and 2-AWG, green, insulated ground wire shall be installed by Division 16000 contractor.

B. Two 7ft high 19 inch telecommunications racks with integrated cable management on all sides and between.

C. Cable tray as shown on the drawings.

D. Labeling shall follow the guidelines set forth in the standards of Core, Inc as outlined elsewhere in this document.

2.03 GROUNDING BARS

A. Each telecommunications room and/or equipment room shall have at least one appropriately sized ground bar mounted in a convenient location. ERICO Telecommunications Ground Bars or approved substitute. Ground bars installed by Division 16000 Contractor

B. Busbars should be: Positioned so that bonding conductors will generally follow the communications cabling, positioned near associated equipment, insulated from their support.

C. Busbar connections should be grouped with protector, busbar bonding, and approved building grounding conductors toward one end and equipment grounding conductors toward the other end.

D. Minimum size 2-AWG green insulated copper bonding conductors should be used to connect equipment to the building ground system.

2.04 EQUIPMENT RACKS

A. Provide a floor mount equipment racks in each Telecommunications Room as shown on the drawings.

B. Racks are to accommodate 19-inch mounting width, incorporate high capacity 6.5-inch deep vertical channels on each side to allow for safe management of large bundles of cabling. Vertical channels shall be tapped 12/24 on front and back with 4-inch x 4-inch side holes for easy cable entry shall be integrated into the racks. Top bars are to have parallel and perpendicular attachment points for cable trays, as well as built-in bend radius protection.

C. Each rack shall have at least one rack mount power strip, which meets the surge protection requirements of UL 1449 with a minimum of 8-15Amp outlets. Additional power requirements will be noted on drawings.

D. All racks and cabinets shall be grounded.

2.05 CABLE MANAGEMENT

A. Vertical cable management shall be integrated into freestanding racks.

B. Horizontal cable management shall be located between each patch panel to accommodate patch cables on front of rack without overcrowding.

C. Velcro cable ties to be used to maintain neat cable routing on and around racks and cable trays without over tightening and crimping cable jackets.

2.06 CABLE TRAY WITHIN TELECOMMUNICATIONS ROOMS

A. Cable tray to be ladder style manufactured of tubular steel and painted black (typical example Hubbell HLS10__B).

B. Tray shall be the width as noted on Drawings with 9" rung spacing.

C. Acceptable support methods for wall mount applications include triangular support brackets (Hubbell HLTSB12B), and Wall angle support brackets (Hubbell HLS0612).

D. Cable tray shall be firmly mounted to Racks using a mounting kit (Hubbell HLMPK19B).

E. Install tray system with hardware, splice connectors, support components, and accessories furnished by the manufacturer.

F. A cable drop out shall be used for all vertical transitions to maintain recommended bend radius in cables (Hubbell HLCD12).

G. Cable tray shall be bonded to the building ground system.

2.07 CABLE TRAY FOR HORIZONTAL DISTRIBUTION

A. Cable tray for Horizontal cable distribution to be aluminum center rail design with rung spacing of no more than 12-inches.

B. Width shall be as shown on drawings.

C. Cable drop-outs that preserve minimum bend radius requirements shall be used for vertical transitions and cables entering or leaving the cable tray system from below.

D. Multiple levels of rungs shall be used when necessary to accommodate large quantities of cables or to avoid obstructions

2.08 CABLE TRAY FOR UNDERFLOOR

A. Cable tray for Under-floor cable distribution to be aluminum center rail design with rung spacing of no more than 12-inches.

B. Feet for securely fastening tray just above sub-floor shall be utilized.

C. Shallow center rail and no higher than 4" rungs shall be used.

D. Width shall be as noted on drawings.

2.09 INNERDUCT

A. Innerduct with a minimum diameter of 1-1/4in shall be used for routing of fiber optic cables.

B. Innerduct shall have proper fire ratings for the environment that it is to be routed through (i.e. un-rated in metallic conduit, riser and/or plenum as required by code and AHJ).

C. A spare 2" innerduct shall be installed between the server room (313) and the service entrance room (107) for future use. Utilize sleeves indicated on the drawings.

D. A spare pull line shall be left in all innerduct to facilitate future cable pulls.

2.10 CABLE FROM DEMARCATION POINT TO MAIN DISTRIBUTION FRAME

A. Cable from Telecommunications Service Entrance Facility (007) to the Server Room (313) shall have 50 pairs with 24AWG solid conductors, Plenum rated (CMP), and Category 3 or higher.

B. Install cable such that strain relief is supporting the cable at each floor to avoid excessive weight on any single point.

C. In the service entrance room (007) cable shall be terminated by the communications cabling contractor 110 blocks adjacent to the service entrance terminal(s) provided by the owners' service provider.

D. In the Server Room (313) cable shall be terminated by the communications cabling contractor to wall mounted 110 block(s) adjacent to the phone equipment.

E. Ten (10) Cat6 cables shall be provided between the Voice 110 blocks in the Telecommunications Service Entrance Facility (007) to Server Room (313) at the phone system backboard.

F. Ten (10) Cat6 cables shall be provided between the Voice 110 blocks in the Telecommunications Service Entrance Facility (007) to the Server Room (313) at the data racks.

2.11 COPPER BACKBONE (PHONE)– INSIDE PLANT

A. All telephone backbone cabling shall be Cat3 or higher and PLENUM (CMP) rated.

B. A 300-pair cable shall be homerun from the telecommunications room on each floor to the Server Room (313) at the on the 3rd floor.

C. Install cable such that strain relief is supporting the cable at each floor to avoid excessive weight on any single point.

D. Large cables and bundles of cables running vertically between sleeves or horizontally on backboards shall be supported with large D-Rings

E. Copper backbone cabling shall terminate on wall mount 110 blocks, which shall be mounted on 4-foot by 8-foot by ¾-inch plywood backboard with 2 coats of fire resistant light or white colored paint as shown on the drawings.

2.12 FIBER OPTIC BACKBONE (DATA)- INSIDE PLANT

A. All computer network cabling between telecommunications rooms shall be 24 strand Multimode Fiber Optic cable.

B. Multimode Fiber Optic Backbone cabling shall have a core to cladding ratio of 50/125µ and be "Laser Optimized" for Gigabit and 10 Gigabit transmission speeds using VCSEL light sources.

C. Inside plant fiber optic cable shall be tight-buffered design with a 900µ coating on each strand and be plenum rated (OFNP)

D. Fiber Optic Backbone cables shall be routed through innerduct provided by Telecommunications Cabling Contractor.

2.13 CAT6 AND 5E CABLE (DATA AND PHONE)

A. Cat6 and 5E cable shall be Plenum rated (CMP).

B. See Appendix A for list of acceptable manufacturers and performance grade.

2.14 PATCH PANELS (DATA)

A. Data Patch panels shall meet a minimum of Cat6 performance and be of the same manufacturer as workstation jacks.

B. Patch panels shall follow the T568B wiring scheme.

C. See Appendix A for list of acceptable manufacturers and performance grade.

D. A rear cable support bar shall be provided for each 1U of patch panels.

E. Spare patch panel capacity equal to at least 20% of the installed ports shall be installed for each telecommunications rack.

F. Minimum number of ports per patch panel shall be 48.

2.15 OPTICAL FIBER PATCH PANELS

A. Optical Fiber Patch Panels shall be rack mountable and black in color.

B. The panel(s) in Server Room (313) shall be capable of holding a minimum of 120 fibers terminated with SC connectors.

C. The panels in each of the other telecommunications rooms shall be capable of holding a minimum of 36 fibers terminated with SC connectors.

D. There shall be integrated cable management on both the cable entrance side and the jumper side of the panel.

E. Optical fiber patch panels shall be loaded with SC adapter panels capable of supporting all fiber strands entering and leaving the panel.

F. Adapters shall have either ceramic or metallic sleeves.

G. Any unused spaces within the panel shall have blank fillers installed.

2.16 CONDUITS

A. Conduit fill ratios should follow the guidelines set forth in ANSI/TIA/EIA-569-A.

B. The table below shall be used as guideline for sizing conduits, regardless of sizes noted on drawings.

Inside Diameter mm	Trade Size	Cable Outside Diameter mm (in)									
		3.3 (0.13)	4.6 (0.18)	5.6 (0.22)	6.1 (0.24)	7.4 (0.29)	7.9 (0.31)	9.4 (0.37)	13.5 (0.53)	15.8 (0.62)	17.8 (0.70)
16	1/2	1	1	0	0	0	0	0	0	0	0
21	3/4	6	5	4	3	2	2	1	0	0	0
27	1	8	8	7	6	3	3	2	1	0	0
35	1-1/4	16	14	12	10	6	4	3	1	1	1
41	1-1/2	20	18	16	15	7	6	4	2	1	1
53	2	30	26	22	20	14	12	7	4	3	2
63	2-1/2	45	40	36	30	17	14	12	6	3	3
78	3	70	60	50	40	20	20	17	7	6	6
91	3-1/2							22	12	7	6
103	4							30	14	12	7

C. Where conduit is required a minimum trade size of ¾" shall be used regardless of number or size of conductors.

D. Conduit system shall accommodate minimum bend radius of 4-times the diameter of copper cables and 10-times the diameter of fiber optic cables. No condulets shall be used to change direction of a conduit run.

2.17 FACEPLATES/JACKS

A. Jacks shall be rated Category 6 for data and 5E for voice.

B. Follow the T568B wiring scheme.

C. See Appendix A for list of acceptable manufacturers.

D. Jacks designated for Data shall be BLUE and those designated for phone shall be OFFICE WHITE.

E. Wall mount faceplates shall be office white in color.

F. Modular furniture faceplates shall be black in color.

G. Jacks and faceplates shall be of an aesthetic appearance suitable to the space they are installed in. Samples of any substitutions must be supplied to architect and owner for evaluation prior to acceptance.

H. Faceplates shall have integral method for incorporating labeling behind a clear plastic cover.

2.18 FIBER CONNECTORS

A. Fiber connectors shall be type SC. Epoxy or adhesive shall be used to fix the fiber within the ferrule.

B. Connectors with only a mechanical/pressure type method of fixing the fiber to the connector are NOT acceptable.

C. Care shall be taken to insure that all fiber optic connectors are protected by a dust boot to avoid damage after termination and testing.

2.19 COAXIAL VIDEO CABLING SYSTEM

A. General

1 All passive components including cable shall be 1 GHz rated.
2 Wiring for Video Distribution System shall be coaxial broadcast quality Plenum rated 75-ohm cable.

B. Drop cable shall be either RG6U or RG11U, as required to provide between 3dB and 10dB of signal strength at each wall tap.

1 CommScope 5726 RG-6/U, utilize shielding of aluminum bonded to both sides of a polypropylene or polyester tape with 60% aluminum braid and meet or exceed the following maximum attenuation specifications:

Frequency	Max. Attenuation dB/100 feet
1 MHz	.26
10 MHz	.81
50 MHz	1.46
100 MHz	2.05
200 MHz	2.83
400 MHz	4.05
700 MHz	5.60
900 MHz	6.23
1000 MHz	6.80

2 CommScope 5913 RG11, utilize shielding of aluminum bonded to both sides of a polypropylene or polyester tape with 60% aluminum braid and meet or exceed the following maximum attenuation specifications:

Frequency	Max. Attenuation dB/100 feet
1 MHz	.22
10 MHz	.49
50 MHz	.98
100 MHz	1.29
200 MHz	1.84
400 MHz	2.68
700 MHz	3.67
900 MHz	4.25
1000 MHz	4.52

C. "F" Style Connectors:

1 "F" connectors shall be crimp-on style, twist-on connectors at not acceptable.
2 "F" connectors shall be pass-through modular style connectors. Pass-through connectors requiring the use of additional adapters shall not be accepted. Provide angled connectors as required to accommodate workbox depth and width.

2.20 VIDEO SPLITTERS, DIRECTIONAL COUPLERS AND WALL TAPS

A. The contractor is responsible for the selection of the appropriate tap values for splitters, directional couplers, and wall taps to insure balanced signal strength throughout the installation. The system shall be designed to provide a minimum of 3dB and a maximum of 10 dB of signal strength at each wall tap without requiring the systems provider to install amplifiers outside telecommunications closets. Amplifiers and head end equipment to be provided under separate contract.

B. Cabling shall originate in the Service Entrance room (007) and route to wall taps as a broadband network.

C. All splitters, directional couplers and wall taps shall be designed to perform at frequencies up to 1000MHz. Basis of design is Blonder Tongue solder back series.

2.21 MEDICAL ALERT PHONE CABLING

A. A Cat5e phone cable shall be installed between the Medical-alert location shown in the fitness room to the 110 panels at the owner side of the telecommunications entrance facility.

B. A wall mount faceplate shall be installed in the fitness room at the location indicated on the drawings.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION GUIDELINES

A. Design is based on most recent versions of ANSI/EIA/TIA-568-B.1, .2, and .3 Standards.

B. Additional guidelines can be found in the BICSI Telecommunications Distribution Methods Manual, Ninth Edition.

3.02 ROUTING

A. All phone and data horizontal cables to be home run from workstation outlet to telecommunications room.

B. Horizontal cabling from plaza level voice and data locations shall be routed through service entrance room (007) and terminated on 110 blocks and patch panels in First Floor Telecommunications room (104).

C. Route cables, in large groups, down the main cable pathways, until a direct path to the point of access to the workstation outlet can be taken. At that point, route the cables, above all building systems, to the outlet location in accordance with standard installation practices, as described herein. Cable pathways should follow walkways within the building and generally minimize the number of bends as is practicably

possible.

D. When not in conduit or tray, support cables to the deck and/or beams, not more than every five feet throughout the length of the installed run. Use J-hooks to group the cables in bundles of no more than 15 and keep them away from electric wires, fixtures and the other systems installed in the building. Multiple bundles can be run in parallel. Ensure that hangers, ties, and other methods of securing cable do not compress cable or damage insulation.

E. Attach to beams with minimal disruption of any fireproofing. The contractor will be responsible to restore ALL fireproofing to appropriate levels, including penetrations of fire rated walls and disruption of any protective coatings on building structures.

F. Make cable routes with 90 degree sweeps whenever possible; do not install cables randomly or diagonally across rooms or through the building(s).

G. Cables installed partially or fully within communications rooms are to be routed through and secured in cable tray whenever possible. Cables placed in cable tray are to be tie wrapped with hook and loop (Velcro) every 24in to keep them neatly bundled and not permitted to shift from one side of the tray to the other as they are routed in the tray.

H. Recommended bend radius of 4X the diameter of copper cables and 20X the diameter of fiber cables shall be maintained whenever cables enter or leave conduits, cable trays, or other raceways.

I. Route station cables to fixed wall locations through EMT to back box provided by electrical. Be sure to provide a bushing on any exposed conduit ends which cable is to be routed through to insure that cable jacket is not damaged during installation or over time.

J. Power poles are acceptable to distribute cables to clusters of workstations however only a single high capacity pole is allowed to each cluster of workstations.

K. Whenever cable is routed through rough openings (such as through steel studs) be sure to provide bushings or protective grommets to insure that cable jacket is not damaged either during installation or over time.

L. Cable routing should avoid areas of potential high temperatures. Areas of concern are hot water pipes, areas adjacent to roofs, and south facing eves.

3.03 GROUNDING

A. All equipment racks, enclosures, cable tray, equipment, and patch panels shall be properly grounded. Minimum of size 2-AWG, green, insulated ground wire shall be used.

3.04 TIE WRAPS

A. Tie wraps shall be used to maintain clear and organized cable management throughout the installation. Care should be taken not to over-tighten tie wraps. Hook and loop tie wraps shall be used exclusively in and around racks and enclosures to better facilitate moves, adds, and changes in the future.

3.05 FIRESTOPPING

A. UL approved firestopping systems and installation practices shall be followed for all penetrations of fire rated structures.

B. Division 17 contractor is responsible for firestopping all sleeves after cable and/or innerduct has been installed.

3.06 LABELING

A. Labeling scheme shall define each cable run based on originating location on the rack and patch panel.

a. Labeling on the cable, patch panel, and faceplate/jack should follow the following pattern:

i. FT-NNN
1. F = Floor Identifier (numeric)
2. T = Type Identifier D for Data or V for Voice
3. NNN = Port Number (numeric)

b. For example a data drop on the third floor from port number 154 would be 3D-154.

B. Cables shall be labeled within 12-inches of each end identical to the label on the faceplate and patch panel.

C. Labels shall be mechanically reproduced and resistant to smudging and rubbing off. Handwritten labeling is unacceptable.

D. The labeling requirements apply to all voice, and data cable runs.

3.07 TESTING CAT6 and CAT5E

A. All Cat5E cables shall be proven to pass the complete TIA/EIA-568-B.2-1 standard.

B. Test all cables from telecommunications closet/head end patch panel to workstation jack (Permanent Link).

C. Test results shall be provided for each link in both printed and electronically in Microsoft Excel format provided on a CD.

D. Labeling of all test results shall match the labeling on faceplate and patch panel.

3.08 TESTING FIBER OPTIC CABLES

A. All Fiber Optic Strands shall be tested with a light loss meter from each end at 850 and 1300nm.
   a. Mandrel wrap method shall be used.

B. Repair or replace any strands with a link loss in either direction of 5dB or greater at either 850 or 1300nm wavelengths.

C. Test results shall be provided for each link in both printed and electronically in Microsoft Excel format provided on a CD.

D. Labeling of all test results shall match the labeling on faceplate and patch panel.

3.09 DOCUMENTATION/AS-BUILTS/RECORDS

A. The Cable Installation shall be documented according to the TIA/EIA 606-A Standard.

B. Four (4) complete sets of as-builts shall be provided.

3.10 SUPPORT

A. Each vendor is to maintain a fully equipped service organization capable of providing full maintenance and service of the installed system(s) within 24 hours. This facility shall be available for inspection by the engineer. Provide the street address and staffing levels of all service locations that may provide support to this project.

B. Each vendor is to maintain the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being installed.

3.11 WARRANTY

A. Product and Applications Assurance Warranty documentation for the data system shall be for 15 years to the system design parameters. Provide complete documentation regarding the manufacturer's warranty at the time of the proposal. Include a sample of the warranty that would be provided to the customer when the installation is complete and documentation of the support procedure for warranty issues. Provide an application assurance manual documenting the vendor-supported applications and application guidelines.

B. Vendor/installer must be authorized to provide warranty services, components, and systems on behalf of the manufacturer.

C. This warranty is in addition to, not in lieu of, all other warranties in the contract documents, and all other rights and remedies available to the owner under the contract and under the law.

Appendix A

The following list contains acceptable manufacturers based on broad categories.

Copper Connectivity (patch panels, jacks, faceplates)
NORDX/CDT System 2400

Copper Cable (UTP)
NORDX/CDT System 2400

Fiber Optic Connectors/Enclosures
Avaya
NORDX/CDT
Tyco/AMP
Corning Cable systems

Fiber Optic Cable
Avaya
NORDX/CDT
Tyco/AMP
Corning Cable Systems

Racks and Enclosures
Chatsworth
APW
X-Mark
Hubbell

END OF DIVISION 17