SECTION 230500 – COMMON WORK RESULT FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods to complement other Division 15 Sections.

1. Piping materials and installation instructions common to most piping systems.
2. Concrete equipment base construction requirements.
3. Equipment nameplate data requirements.
4. Labeling and identifying mechanical systems and equipment is specified in Division 15 Section "Mechanical Identification."
5. Nonshrink grout for equipment installations.
6. Field-fabricated metal and wood equipment supports.
7. Installation requirements common to equipment specification Sections.
8. Mechanical demolition.
9. Cutting and patching.
10. Touchup painting and finishing.

B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

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

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

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

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

F. 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.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
B. Product data for following piping specialties:

1. Mechanical sleeve seals.
2. Identification materials and devices.

C. Samples of color, lettering style, and other graphic representation required for each identification material and device.

D. Shop drawings detailing fabrication and installation for metal and wood supports and anchorage for mechanical materials and equipment.

E. Coordination drawings for access panel and door locations.

F. Prepare coordination drawings according to Division 1 Section "Submittals" to a 1/4 inch equals 1 foot scale or larger. Detail major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Show space requirements for installation and access. Show where sequence and coordination of installations are important to the efficient flow of the Work. Include the following:

1. Proposed locations of piping, ductwork, equipment, and materials. Include the following:

   a. Planned piping layout, including valve and specialty locations and valve stem movement.
   b. Planned duct systems layout, including elbow radii and duct accessories.
   c. Clearances for installing and maintaining insulation.
   d. Clearances for servicing and maintaining equipment, including space for equipment disassembly required for periodic maintenance.
   e. Equipment service connections and support details.
   f. Exterior wall and foundation penetrations.
   g. Fire-rated wall and floor penetrations.
   h. Sizes and location of required concrete pads and bases.

2. Scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.

G. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code--Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

D. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

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

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors."

H. Coordinate installation of identifying devices after completing covering and painting where devices are applied to surfaces. Install identifying devices prior to installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Refer to individual piping system specification Sections in Division 15 for special joining materials not listed below.

B. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness, except where 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. ASME B16.20 for grooved, ring-joint, steel flanges.
3. AWWA C110, rubber, flat face, 1/8 inch thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

D. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

E. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95 percent) and silver (approximately 5 percent), having 0.10 percent lead content.

2. Alloy Sn50: Tin (50 percent) and lead (50 percent).
3. Alloy E: Tin (approximately 95 percent) and copper (approximately 5 percent), having 0.10 percent maximum lead content.
4. Alloy HA: Tin-antimony-silver-copper-zinc, having 0.10 percent maximum lead content.
5. Alloy HB: Tin-antimony-silver-copper-nickel, having 0.10 percent maximum lead content.
6. Alloy Sb5: Tin (95 percent) and antimony (5 percent), having 0.20 percent maximum lead content.

F. Brazing Filler Metals: AWS A5.8.

1. BCuP Series: Copper-phosphorus alloys.
2. BAg1: Silver alloy.

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

H. Solvent Cements: Manufacturer's standard solvents complying with the following:

1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.

I. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

J. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

K. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A 126, Class B, gray iron.
2. Followers: ASTM A 47, Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Escutcheons: Manufactured wall, ceiling, and floor plates; deep-pattern type where required to conceal protruding fittings and sleeves.

1. Inside Diameter: Closely fit around pipe, tube, and insulation.
2. Outside Diameter: Completely cover opening.
3. Cast Brass: One-piece, with set-screw.
    a. Finish: Rough brass.
    b. Finish: Polished chrome plate.
4. Cast Brass: Split casting, with concealed hinge and set-screw.
    a. Finish: Rough brass.
    b. Finish: Polished chrome plate.
5. Stamped Steel: One-piece, with set-screw and chrome-plated finish.
6. Stamped Steel: One-piece, with spring clips and chrome-plated finish.
7. Stamped Steel: Split plate, with concealed hinge, set-screw, and chrome-plated finish.
8. Stamped Steel: Split plate, with concealed hinge, spring clips, and chrome-plated finish.
9. Stamped Steel: Split plate, with exposed-rivet hinge, set-screw, and chrome-plated finish.
10. Stamped Steel: Split plate, with exposed-rivet hinge, spring clips, and chrome-plated finish.
11. Cast-Iron Floor Plate: One-piece casting.

B. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.

3. Dielectric Unions: Factory-fabricated, union assembly for 250-psig minimum working pressure at a 180 deg F temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150- or 300-psig minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

    a. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure to suit system pressures.

6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300-psig minimum working pressure at 225 deg F temperature.
7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300-psig working pressure at 225 deg F temperature.

C. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

D. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gage or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.
4. Wall Penetration Systems: Wall sleeve assembly, consisting of housing, gaskets, and pipe sleeve, with 1 mechanical-joint end conforming to AWWA C110 and 1 plain pipe-sleeve end.

    a. Penetrating Pipe Deflection: 5 percent without leakage.
    b. Housing: Ductile-iron casting having waterstop and anchor ring, with ductile-iron gland, steel studs and nuts, and rubber gasket conforming to AWWA C111, of housing and gasket size as required to fit penetrating pipe.
    c. Pipe Sleeve: AWWA C151, ductile-iron pipe.
    d. Housing-to-Sleeve Gasket: Rubber or neoprene push-on type of manufacturer's design.

5. Cast-Iron Sleeve Fittings: Commercially made sleeve having an integral clamping flange, with clamping ring, bolts, and nuts for membrane flashing.

    a. Underdeck Clamp: Clamping ring with set-screws.

6. PVC Plastic: Manufactured, permanent, with nailing flange for attaching to wooden forms.
7. PVC Plastic Pipe: ASTM D 1785, Schedule 40.
8. PE Plastic: Manufactured, reusable, tapered, cup-shaped, smooth outer surface, with nailing flange for attaching to wooden forms.

2.4 IDENTIFYING DEVICES AND LABELS

A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 15 Sections. Where more than one type is specified for listed application, selection is Installer's option, but provide single selection for each product category.

B. Equipment Nameplates: Metal nameplate with operational data engraved or stamped, permanently fastened to equipment.

1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and similar essential data.
2. Location: An accessible and visible location.

C. Stencils: Standard stencils, prepared for required applications with letter sizes conforming to recommendations of ASME A13.1 for piping and similar applications, but not less than 1-1/4-inch -high letters for ductwork and not less than 3/4-inch -high letters for access door signs and similar operational instructions.

1. Material: Fiberboard.
2. Material: Brass.
3. Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
4. Identification Paint: Standard identification enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ASME A13.1 for colors.

D. Snap-On Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid snap-on, color-coded pipe markers, conforming to ASME A13.1.

E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, conforming to ASME A13.1.

F. Plastic Duct Markers: Manufacturer's standard laminated plastic, color coded duct markers. Conform to following color code:

1. Green: Cold air.
2. Yellow: Hot air.
3. Yellow/Green: Supply air.
4. Blue: Exhaust, outside, return, and mixed air.
5. For hazardous exhausts, use colors and designs recommended by ASME A13.1.
6. Nomenclature: Include following:

a. Direction of air flow.
b. Duct service (supply, return, exhaust, etc.).
c. Duct origin (from).
d. Duct destination (to).
e. Design cfm.

G. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white (letter color) melamine subcore, except when other colors are indicated.

1. Fabricate in sizes required for message.
2. Engraved with engraver's standard letter style, of sizes and with wording to match equipment identification.
3. Punch for mechanical fastening.
4. Thickness: 1/16 inch, except as otherwise indicated.
5. Thickness: 1/8 inch, except as otherwise indicated.
6. Thickness: 1/16 inch for units up to 20 square inches or 8 inches long; 1/8 inch for larger units.
7. Fasteners: Self-tapping stainless-steel screws or contact-type permanent adhesive.

H. Plastic Equipment Markers: Laminated-plastic, color-coded equipment markers. Conform to following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, use colors and designs recommended by ASME A13.1.
7. Nomenclature: Include following, matching terminology on schedules as closely as possible:

   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and rpm.

8. Size: Approximately 2-1/2 by 4 inches for control devices, dampers, and valves; and 4-1/2 by 6 inches for equipment.

I. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in mechanical identification, with corresponding designations indicated. Use numbers, lettering, and wording indicated for proper identification and operation/maintenance of mechanical systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are indicated, provide identification that indicates individual system number as well as service such as "Boiler No. 3," "Air Supply No. 1H," or "Standpipe F12."

2.5 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS--COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise. Individual piping system specification Sections in Division 15 specify piping installation requirements unique to the piping system.

B. General Locations and Arrangements: Drawings (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, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

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

L. Install couplings according to manufacturer's printed instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

Q. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, concrete floor and roof slabs, and where indicated.

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 above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.

3. Install large enough sleeves to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

a. PVC Pipe Sleeves: For pipes smaller than 6 inches.
b. Steel Pipe Sleeves: For pipes smaller than 6 inches.
c. Steel Sheet-Metal Sleeves: For pipes 6 inches and larger that penetrate gypsum-board partitions.
d. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Flashing is specified in Division 7 Section "Flashing and Sheet Metal."

1) Seal space outside of sleeve fittings with nonshrink, nonmetallic grout.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants specified in Division 7 Section "Joint Sealants."

R. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6 inches.
2. Install cast-iron wall pipes for sleeves 6 inches and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

S. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch annular clear space between pipe and sleeve for installation of mechanical seals.

T. Below Grade, Exterior Wall, Pipe Penetrations: Install ductile-iron wall penetration system sleeves according to manufacturer's printed installation instructions.

U. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestopping sealant material. Firestopping materials are specified in Division 7 Section "Firestopping."

V. Verify final equipment locations for roughing in.

W. Refer to equipment specifications in other Sections for roughing-in requirements.

X. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
4. Brazed Joints: Construct joints according to AWS "Brazing Manual" in the "Pipe and Tube" chapter.
5. 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 inside diameter. Join pipe fittings and valves as follows:

a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).

c. Align threads at point of assembly.
d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

6. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.
7. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
8. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:
   a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
   b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
   c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
   d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
   e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
   f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.

9. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.

   a. Plain-End Pipe and Fittings: Butt joining.
   b. Plain-End Pipe and Socket-Type Fittings: Socket joining.

Y. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2 inches and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch or smaller threaded pipe connection.
2. Install flanges in piping 2-1/2 inches and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.2 EQUIPMENT INSTALLATION--COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.

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

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 LABELING AND IDENTIFYING

A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.

1. Stenciled Markers: Complying with ASME A13.1.
2. Plastic markers, with application systems. Install on pipe insulation segment where required for hot noninsulated pipes.
3. Locate pipe markers wherever piping is exposed in finished spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums), and exposed exterior locations as follows:

    a. Near each valve and control device.
    b. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where flow pattern is not obvious.
    c. Near locations where pipes pass through walls, floors, ceilings, or enter inaccessible enclosures.
    d. At access doors, manholes, and similar access points that permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.
    f. Spaced at a maximum of 50-foot intervals along each run. Reduce intervals to 25 feet in congested areas of piping and equipment.
    g. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

B. Equipment: Install engraved plastic laminate sign or equipment marker on or near each major item of mechanical equipment.

1. Lettering Size: Minimum 1/4-inch -high lettering for name of unit where viewing distance is less than 2 feet, 1/2-inch -high for distances up to 6 feet, and proportionately larger lettering for greater distances. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
2. Text of Signs: Provide text to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to name of identified unit.

C. Duct Systems: Identify air supply, return, exhaust, intake, and relief ducts with duct markers; or provide stenciled signs and arrows, showing duct system service and direction of flow.

1. Location: In each space where ducts are exposed or concealed by removable ceiling system, locate signs near points where ducts enter into space and at maximum intervals of 50 feet.

D. Adjusting: Relocate identifying devices which become visually blocked by work of this Division or other Divisions.

3.4 PAINTING AND FINISHING

A. Refer to Division 9 Section "Painting" for field painting requirements.

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

3.5 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4 inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000-psi, 28-day compressive strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGE

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

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code--Steel."

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

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

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

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

3.8 DEMOLITION

A. Disconnect, demolish, and remove work specified under Division 15 and as indicated.

B. Where pipe, ductwork, insulation, or equipment to remain is damaged or disturbed, remove damaged portions and install new products of equal capacity and quality.

C. Accessible Work: Remove indicated exposed pipe and ductwork in its entirety.

D. Abandoned Work: Cut and remove buried pipe abandoned in place, 2 inches beyond the face of adjacent construction. Cap and patch surface to match existing finish.

E. Removal: Remove indicated equipment from the Project site.

F. Temporary Disconnection: Remove, store, clean, reinstall, reconnect, and make operational equipment indicated for relocation.

3.9 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.10 GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

END OF SECTION 230522

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes hangers and supports for mechanical systems piping and equipment.

1.3 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

1.4 PERFORMANCE REQUIREMENTS

A. Design seismic restraint hangers and supports, for piping and equipment.

B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and supports for piping and equipment.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of hanger and support.

C. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

D. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

E. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.

F. Licensed Engineer's hanger and support drawings specified in the "Quality Assurance" Article.

G. Licensed Engineer's hanger and support installation report specified in the "Field Quality Control" Article.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators according to AWS D1.1 "Structural Welding Code--Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Qualify welding processes and welding operators according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

C. NFPA Compliance: Comply with NFPA 13 for hangers and supports used as components of fire protection systems.

D. Listing and Labeling: Provide hangers and supports that are listed and labeled as defined in NFPA 70, Article 100.

1. UL and FM Compliance: Hangers, supports, and components include listing and labeling by UL and FM where used for fire protection piping systems.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. Licensed Operators: Use operators that are licensed by powder-operated tool manufacturers to operate their tools and fasteners.

F. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of piping and equipment. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. Hangers, Supports, and Components: Factory-fabricated according to MSS SP-58.

1. Components include galvanized coatings where installed for piping and equipment that will not have a field-applied finish.
2. Pipe attachments include nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.

B. Thermal-Hanger Shield Inserts: 100-psi average compressive strength, waterproofed calcium silicate, encased with sheet metal shield. Insert and shield cover entire circumference of pipe and are of length indicated by manufacturer for pipe size and thickness of insulation.

C. 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.

D. Mechanical-Anchor Fasteners: Insert-type 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.

2.2 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36, steel plates, shapes, and bars, black and galvanized.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex-head, track bolts and nuts.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Grout: ASTM C 1107, Grade B, nonshrink, nonmetallic.

1. Characteristics include post-hardening, volume-adjusting, dry, hydraulic-cement-type grout that is nonstaining, noncorrosive, nongaseous and is recommended for both interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Water: Potable.
4. Packaging: Premixed and factory-packaged.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger requirements are specified in the Section specifying the equipment and systems.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.

3.2 HANGER AND SUPPORT INSTALLATION

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

B. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible.

C. Install supports with maximum spacings complying with MSS SP-69.

D. Where pipes of various sizes are supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

E. Install building attachments within concrete or 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, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Install reinforcing bars through openings at top of inserts.

F. Install concrete inserts in new construction prior to placing concrete.

G. 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. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

H. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install according to fastener manufacturer's written instructions. Do not use in lightweight concrete slabs or in concrete slabs less than 4 inches thick.

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

J. Heavy-Duty Steel Trapezes: Field-fabricate from ASTM A 36 steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.

K. Support fire protection systems piping independent of other piping.

L. Install hangers and supports to allow controlled movement of piping systems, permit freedom of movement between pipe anchors, and facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

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

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

O. Insulated Piping: Comply with the following installation requirements.

1. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9.
2. Saddles: Install protection saddles MSS Type 39 where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
3. Shields: Install MSS Type 40, protective shields on cold piping with vapor barrier. Shields span an arc of 180 degrees and have dimensions in inches not less than the following:

NPS (Inches)	LENGTH (Inches)	THICKNESS (Inches)
1/4 to 3-1/2	12	0.048
4	12	0.060
5 and 6	18	0.060
8 to 14	24	0.075
16 to 24	24	0.105

4. Pipes 8 Inches and Larger: Include wood inserts.
5. Insert Material: Length at least as long as the protective shield.
6. Thermal-Hanger Shields: Install with insulation of same thickness as piping.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

B. Grouting: Place grout under supports for equipment, and make a smooth bearing surface.

3.4 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.

B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

A. Touching Up: Clean field welds and abraded areas of shop paint and paint exposed areas immediately after erection of hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touching Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal is specified in Division 9 Section "Painting."

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

3.7 FIELD QUALITY CONTROL

A. Licensed Engineer's Report: Prepare hanger and support installation report. Include seal and signature of Registered Engineer, licensed in jurisdiction where Project is located, certifying compliance with specifications.

END OF SECTION 230529

SECTION 230548 - VIBRATION AND SEISMIC CONTROL FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes vibration isolators, vibration isolation bases, vibration isolation roof curbs, and seismic restraints and snubbers.

1.3 SUBMITTALS

A. Product Data: Indicate types, styles, materials, and finishes for each type of isolator specified. Include load deflection curves.

B. Shop Drawings: Show designs and calculations, certified by a professional engineer, for the following:

1. Design Calculations: Calculations for selection of vibration isolators, design of vibration isolation bases, and selection of seismic restraints.
2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to the structure and to the supported equipment. Include auxiliary motor slides and rails, and base weights.
3. Seismic Restraint Details: Detail fabrication and attachment of restraints and snubbers.

1.4 QUALITY ASSURANCE

A. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the jurisdiction where the Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of vibration isolation bases and seismic restraints that are similar to those indicated for this Project in material, design, and extent.

1.5 PROJECT CONDITIONS

A. Project seismic zone is 4 with a zone factor of 0.40.

B. Building Importance Factor: 1.5.

1.6 COORDINATION

A. Coordinate layout and installation of vibration isolation and seismic-restraint devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of concrete housekeeping and vibration isolation bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Sections.

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. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. Apex Molded Products Co.
4. B-Line Systems, Inc.
5. Bramec Corp.
6. California Dynamics Corp.
7. Cannon Fabrication, Inc.
8. Diversitech Corp.
9. Fabreeka International, Inc.
10. GMT International Corp.
11. Greene Rubber Co.
12. Isolation Technology, Inc.
13. Karman Rubber.
14. Kinetics Noise Control, Inc.
15. King, H.A., Ltd.
16. Lord Industrial Products.
17. Mason Industries, Inc.
18. Metalastik, Inc.
19. Minor Rubber Co., Inc.
20. Rubatex Corp.
21. Service Rubber Group, Inc.
22. Stock Drive Products.
23. Tech Products Corp.
24. Vibration Eliminator Co., Inc.
25. Vibration Isolation Co., Inc.
26. Wagner Products Corp.

2.2 VIBRATION ISOLATORS

A. Isolator Pads: Oil and water resistant and factory cut to sizes that match requirements of the equipment supported.

1. Rubber Isolator Pads: Elastomer (neoprene or silicone) arranged in single or multiple layers and molded with a nonslip pattern and steel baseplates of sufficient stiffness to provide uniform loading over the pad area.
2. Fiberglass or Cork Isolator Pads: Molded cork or glass fiber not less than 1 inch thick and precompressed through 10 compression cycles at 3 times the rated load.
3. Load Range: From 10 to 50 psig and a deflection not less than 0.08 inch per 1 inch of thickness. Do not exceed a loading of 50 psig.

B. Rubber Isolator Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements, with encapsulated top- and baseplates. Factory-drilled and tapped top plate for bolted equipment mounting. Factory-drilled baseplate for bolted connection to structure. Color-code to indicate capacity range.

C. Spring Isolators: Freestanding, laterally stable, open-spring-type isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 1.2 times the rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Size baseplates to limit floor loading to 100 psig.
6. Top Plates: Provide threaded studs for fastening and leveling equipment.
7. Finishes: Manufacturer's standard corrosive-resistant finish.

D. Restrained Spring Isolators: Vertically restrained, freestanding, laterally stable, steel open-spring-type isolators.

1. Housing: Welded steel with resilient vertical limit stops to prevent spring extension due to wind loads or when weight is removed. Factory-drilled baseplate for bolting to structure and bonded to a 1/4-inch-thick, rubber isolator pad attached to the baseplate underside. Provide adjustable equipment mounting and leveling bolt.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 0.8 times the rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Finishes: Baked enamel for metal components on isolators for interior use. Hot-dip galvanized for metal components on isolators for exterior use.

E. Rubber Hangers: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements bonded to formed-steel housings with threaded connections for hanger rods. Color-code to indicate capacity range.

F. Spring Hangers: Combination spring and elastomeric hanger with coil spring and elastomeric insert in compression.

1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

2.3 SEISMIC CONTROLS

A. Thrust Restraints: Combination spring and elastomeric restraints with coil spring and elastomeric insert in compression. Factory set for thrust.
1. Frame: Formed steel, fabricated for connection to threaded rods and to allow for 30 degrees of angular hanger rod misalignment without binding or reducing isolation efficiency.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
5. Finishes: Baked enamel for metal components. Color-code to indicate capacity range.

B. Manufactured Seismic Snubbers: All-directional, double-acting snubbers.

1. Construction: Interlocking steel members restrained by a 3/4-inch-thick, replaceable, shock-absorbing neoprene insert. Maintain 1/8-inch clearance in all directions between rigid and resilient surfaces.

C. Fabricated Seismic Snubbers: Welded structural-steel shapes designed and fabricated to restrain equipment or vibration isolation bases from excessive movement during a seismic event. Design to resist gravity forces identified by authorities having jurisdiction.

1. Construction: Welded steel shapes conforming to ASTM A 36.
2. Resilient Components: 3/4-inch-thick, replaceable, shock-absorbing neoprene insert.

2.4 VIBRATION ISOLATION BASES

A. Fabricated Steel Bases: Structural-steel bases and rails designed and fabricated by the isolation equipment manufacturer. Include equipment static loadings, power transmission, component misalignment, and cantilever loadings.

1. Fabricate bases to shapes required, with welded structural-steel shapes, plates, and bars conforming to ASTM A 36. Include support brackets to anchor base to isolation units. Include prelocated equipment anchor bolts and auxiliary motor slide bases or rails.
2. Design and fabricate bases to result in the lowest possible mounting height with not less than 1-inch clearance above the floor.
3. Concrete-Filled Inertia Bases: Weld reinforcing bars to the structural frame. Pour concrete into base with relocated equipment anchor bolts.
4. Weld steel angles on frame for outrigger isolation mountings, and provide for anchor bolts and equipment support.
5. Configure inertia bases to accommodate equipment supported.
6. Pump Bases: Size to support pump and piping elbows.
7. Factory Finish: Manufacturer's standard corrosive-resistant finish.

2.5 VIBRATION ISOLATION ROOF CURBS

A. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb designed to resiliently support roof-mounted equipment and to withstand 125-mph wind impinging laterally against the side of the equipment. Design restraints to meet seismic requirements of authorities having jurisdiction.

B. Components: Upper support frame; lower support assembly; freestanding, unhoused, laterally stable steel springs; vertical and horizontal restraints.

1. Lower Support Assembly: Provide a means of attachment to the building structure and include a wood nailer stripe for attachment of roof material and 2 inches of rigid insulation on the inside of the assembly.
2. Spring Isolators: As indicated or scheduled. Include adjustment bolt to permit leveling of equipment after installation. Attach to lower assembly with a rubber isolation pad.

Locate spring isolators so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.

3. Water Seal: Elastomeric seal conforming to UL Class A roofing materials, attached to the upper support frame, extending down past the wood nailer of the lower support assembly, and counterflashed over the roof materials.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install and anchor vibration-, sound-, and seismic-control products according to manufacturer's written instructions and authorities having jurisdiction.

B. Anchor interior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural floors as required by authorities having jurisdiction.

C. Anchor exterior mounts, isolators, hangers, and snubbers to vibration isolation bases. Bolt isolator baseplates to structural supports as required by authorities having jurisdiction.

D. Fill concrete inertia bases, after installing base frame, with 3000-psig concrete, and trowel to a smooth, hard finish. Cast-in-place concrete is specified in Division 3.

E. Install pipe connectors at connections for equipment supported on vibration isolators.

3.2 SEISMIC CONTROL

A. Vibration Isolation Bases: Mount equipment on structural-steel bases or concrete inertia bases.

B. Snubbers: Install the required number of seismic snubbers on each spring-mounted piece of equipment. Locate snubbers as close as possible to the vibration isolators and bolt to supporting structure.

3.3 ADJUSTING AND CLEANING

A. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operations.

B. Adjust thrust restraints for a maximum of 1/4 inch of movement at start and stop.

END OF SECTION 230548

SECTION 232300 - REFRIGERANT PIPING

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 refrigerant piping used for air-conditioning applications, including pipes, tubing, fittings, and specialties; special-duty valves; and refrigerants.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each valve type and refrigerant piping specialty specified.

C. Shop Drawings showing layout of refrigerant piping, specialties, and fittings, including pipe and tube sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, wall and floor penetrations, and equipment connection details. Show interface and spatial relationship between piping and equipment.

1. Refrigerant piping indicated is schematic only. Size and design the layout and installation of the piping, including oil traps, double risers, specialties, and pipe and tube sizes, to ensure proper operation and conformance with warranties of connected equipment.

D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience.

E. Maintenance data for refrigerant valves and piping specialties to include in the operation and maintenance manual specified in Division 1 Sections and Division 15 Section "Basic Mechanical Requirements."

1.4 QUALITY ASSURANCE

A. ASME Compliance: Qualify brazing and welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with provisions of the following codes:

1. ASME B31.5, "Refrigeration Piping."
2. ASHRAE 15, "Safety Code for Mechanical Refrigeration."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

D. Listing and Labeling: Provide products specified in this Section that are UL listed and labeled.

1.5 SEQUENCING AND SCHEDULING

A. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

1.6 EXTRA MATERIALS

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

1. Refrigeration Oil Test Kits: 2 each, containing everything required to conduct 1 test.
2. Refrigerant: 2 containers each, with 20 lb of refrigerant.
3. Filter-Dryer Cartridges: 3 of each type.

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. Refrigerants:

a. Allied Signal Inc.; Genetron Refrigerants.
b. DuPont Company; Fluorochemicals Div.
c. Elf Atochem North America, Inc.
d. ICI Americas Inc.; Fluorochemicals Bus.

2. Refrigerant Valves and Specialties:

a. Danfoss Electronics, Inc.
b. Eaton Corporation; Industrial Control Div.
c. Emerson Electric Company; Alco Controls Div.
d. Henry Valve Company.
e. Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
f. Sporlan Valve Company.

2.2 PIPES AND TUBES

A. Soft Copper Tube: ASTM B 88, Type L, annealed temper.

2.3 PIPE AND TUBE FITTINGS

A. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

2.4 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).

B. Welding Materials: Comply with ASME Boiler and Pressure Vessel Code Section II, Part C, for welding materials appropriate for pipe being welded.

2.5 VALVES

A. Diaphragm Packless Valves: 500-psig working pressure and 275 deg F working temperature, globe or angle pattern, forged-brass or bronze body and bonnet, phosphor bronze and stainless-steel diaphragms, rising stem and handwheel, stainless-steel spring, nylon seat disc, with solder-end connections.

B. Packed-Angle Valves: 500-psig working pressure and 275 deg F working temperature, forged-brass or bronze body, forged-brass seal caps with copper gasket, back seating, rising stem and seat, molded stem packing, with solder-end connections.

C. Check Valves--Smaller than 1-Inch NPS: 500-psig operating pressure, 300 deg F operating temperature; cast-brass body, with removable piston, PTFE seat, and stainless-steel spring; straight-through globe design. Valve shall be straight-through pattern, with solder-end connections.

D. Check Valves--Larger than 1-Inch NPS: 450-psig operating pressure, 300 deg F operating temperature; cast-bronze body, with cast-bronze or forged-brass bolted bonnet; floating piston with mechanically retained PTFE seat disc. Valve shall be straight-through or angle pattern, with solder-end connections.

E. Service Valves: 500-psig pressure rating, forged-brass body with copper stubs, brass caps, removable valve core, integral ball check valve, with solder-end connections.

F. Solenoid Valves: Conform to ARI 760; 250 deg F temperature rating, 400-psig working pressure; forged brass, with PTFE valve seat, 2-way straight-through pattern, and solder-end connections; manual operator; with NEMA 250, Type 1 solenoid enclosure with 1/2-inch conduit adapter, and 24-V normally closed holding coil.

G. Pressure Relief Valves: Straight or angle brass body and disc, neoprene seat, factory sealed and ASME labeled, for standard pressure setting.

H. Thermal Expansion Valves: Conform to ARI 750; thermostatic-adjustable, modulating type; size as required and factory set for superheat requirements; solder-end connections; with sensing bulb, distributor having side connection for hot-gas bypass line, and external equalizer line.

2.6 REFRIGERANT PIPING SPECIALTIES

A. Straight- or Angle-Type Strainers: 430-psig working pressure; forged-brass or steel body with stainless-steel wire or brass-reinforced Monel screen, and screwed cleanout plug, with solder-end connections.

B. Moisture/Liquid Indicators: 500-psig operating pressure, 200 deg F operating temperature; forged-brass body, with replaceable, polished, optical viewing window with color-coded moisture indicator, and solder-end connections.

C. Permanent Filter-Dryer: 350-psig maximum operating pressure, 225 deg F maximum operating temperature; steel shell, and wrought-copper fittings for solder-end connections; molded-felt core surrounded by desiccant.

D. Flexible Connectors: 500-psig operating pressure; seamless tin-bronze or stainless-steel core, high-tensile bronze-braid covering, solder-end connections, and synthetic covering; dehydrated, pressure tested, minimum 7 inches long.

2.7 REFRIGERANT

A. ASHRAE 34, R-22: Monochlorodifluoromethane.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for compliance with requirements for installation tolerances and other conditions affecting performance of refrigerant piping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Aboveground, within Building: Type L drawn-copper tubing.

B. Belowground for 2-Inch NPS and Smaller: Type L annealed-copper tubing.

C. Belowground for Larger than 2-Inch NPS: Type K annealed-copper tubing.

3.3 INSTALLATION

A. Install refrigerant piping according to ASHRAE 15.

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install piping in short and direct arrangement, with minimum number of joints, elbows, and fittings.

D. Arrange piping to allow normal inspection and service of compressor and other equipment. Install valves and specialties in accessible locations to allow for service and inspection.

E. Install piping with adequate clearance between pipe and adjacent walls and hangers, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

F. Belowground, install copper tubing in conduit. Vent conduit outdoors.

G. Insulate suction lines and liquid lines, but insulate them together if adjacent.

1. Do not install insulation until system testing has been completed and all leaks have been eliminated.

H. Install branch lines to parallel compressors of equal length, and pipe identically and symmetrically.

I. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

J. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope of 0.4 percent downward away from compressor.
2. Install horizontal suction lines with a uniform slope of 0.4 percent downward to compressor.

3. Install traps and double risers where indicated and where required to entrain oil in vertical runs.
4. Liquid lines may be installed level.

K. Use fittings for changes in direction and branch connections.

L. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

M. Reduce pipe sizes using eccentric reducer fittings installed with level side down.

N. Provide bypass around moisture-liquid indicators in lines larger than 2-inch NPS.

O. Install unions to allow removal of solenoid valves, pressure-regulating valves, expansion valves, and at connections to compressors and evaporators.

P. Install flexible connectors at the inlet and discharge connection, at right angles to axial movement of compressor, parallel to crankshaft.

Q. Install replaceable-core filter-dryers, with isolation valves and valved bypass.

R. Install refrigerant valves according to manufacturer's written instructions.

S. When brazing, remove solenoid-valve coils; remove sight glasses; and remove stems, seats, and packing of valves, and accessible internal parts of refrigerant specialties. Do not apply heat near bulb of expansion valve.

T. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

U. Mount thermostatic expansion valves in any position, close to evaporator.

1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

V. Install pressure relief valves as required by ASHRAE 15. Pipe pressure relief valves on receivers to outdoors.

W. Charge and purge systems, after testing, and dispose of refrigerant following ASHRAE 15 procedures.

X. Charge system as follows:

1. Install filter-dryer core after leak test, but before evacuation.
2. Evacuate refrigerant system with vacuum pump, until temperature of 35 deg F is indicated on vacuum dehydration indicator.
3. Maintain vacuum for a minimum of 5 hours.
4. Break vacuum with refrigerant gas and charge to 2 psig.

3.4 HANGERS AND SUPPORTS

A. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet in length.

B. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.

C. Pipe rollers for multiple horizontal runs, 20 feet or longer supported by a trapeze.

D. Spring hangers to support vertical runs.

E. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes. Tube sizes are nominal or standard tube sizes as expressed in ASTM B 88.

1. 1/2 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. 5/8 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. 1 Inch: Maximum span, 60 inches; minimum rod size, 1/4 inch.
4. 1-1/4 Inches: Maximum span, 72 inches; minimum rod size, 1/4 inch.
5. 1-1/2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
6. 2 Inches: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. 2-1/2 Inches: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. 3 Inches: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. 4 Inches: Maximum span, 12 feet; minimum rod size, 1/2 inch.

F. Support vertical runs at each floor.

3.5 PIPE JOINT CONSTRUCTION

A. Basic pipe and tube joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide) during brazing to prevent formation of scale.

3.6 VALVE INSTALLATIONS

A. Install refrigerant valves according to manufacturer's written instructions.

B. Install valves on suction and discharge of compressor, for gage taps at compressor inlet and outlet, for gage taps at hot-gas bypass regulators, on inlet and outlet, and on each side of strainers.

C. Install check valves on compressor discharge and on condenser liquid lines on multiple condenser systems.

D. Install refrigerant-charging (packed-angle) valve in liquid line between receiver shutoff valve and expansion valve.

E. Install globe valves on each side of strainers and dryers, in liquid and suction lines at evaporators, and elsewhere as indicated.

F. Install a full-sized, 3-valve bypass around each dryer.

G. Install solenoid valves ahead of each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

1. Electrical wiring for solenoid valves is specified in Division 16 Sections. Coordinate electrical requirements and connections.

H. Mount thermostatic expansion valves in any position, close to evaporator.

1. Where refrigerant distributors are used, mount directly on expansion-valve outlet.
2. Install valve so diaphragm case is warmer than bulb.
3. Secure bulb to clean, straight, horizontal section of suction line using 2 bulb straps. Do not mount bulb in a trap or at the bottom of the line.
4. Where external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

I. Install pressure-regulating and relief valves as required by ASHRAE 15.

3.7 SPECIALTIES APPLICATION AND INSTALLATION

A. Install liquid indicators in liquid line leaving condenser, in liquid line leaving receiver, and on leaving side of liquid solenoid valves.

B. Install strainers immediately upstream of each automatic valve, including expansion valves, solenoid valves, hot-gas bypass valves, and compressor suction valves.

C. Install strainers on main liquid line where multiple expansion valves with integral strainers are used.

D. Install strainers in suction line of steel pipe.

E. Install moisture-liquid indicators in liquid lines between filter-dryers and thermostatic expansion valves and in liquid line to receiver.

F. Install pressure relief valves on ASME receivers, and pipe to outdoors.

G. Install replaceable-core filter-dryers in vertical liquid line adjacent to receivers and before each solenoid valve.

H. Install permanent filter-dryers in low-temperature systems, in systems using hermetic compressors, and before each solenoid valve.

I. Install solenoid valves in liquid line of systems operating with single pump-out or pump-down compressor control, in liquid line of single or multiple evaporator systems, and in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into suction line when system shuts down.

J. Install receivers on systems 5 tons and larger, and on systems with long piping runs, sized to accommodate pump-down charge.

K. Install flexible connectors at or near compressors where piping configuration does not absorb vibration.

3.8 CONNECTIONS

A. Electrical: Conform to applicable requirements of Division 16 Sections for electrical connections.

3.9 FIELD QUALITY CONTROL

A. Inspect and test refrigerant piping according to ASME B31.5, Chapter VI.

1. Pressure test with nitrogen to 200 psig. Perform final tests at 27-psig vacuum and 200 psig using halide torch or electronic leak detector. Test to no leakage.

B. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

C. Repair leaks using new materials; retest.

3.10 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat requirements.

3.11 CLEANING

A. Before installation of copper tubing other than Type ACR, clean tubing and fittings with trichloroethylene.

3.12 COMMISSIONING

A. Charge system using the following procedures:

1. Install core in filter dryer after leak test, but before evacuation.
2. Evacuate refrigerant system with vacuum pump until temperature of 35 deg F is indicated on vacuum dehydration indicator.
3. During evacuation, apply heat to pockets, elbows, and low spots in piping.
4. Maintain vacuum on system for minimum of 5 hours after closing valve between vacuum pump and system.
5. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
6. Complete charging of system, using new filter-dryer core in charging line. Provide full-operating charge.

END OF SECTION 232300

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Requirements of the following Division 15 Sections apply to this section:

1. "Basic Mechanical Requirements."
2. "Basic Mechanical Materials and Methods."

1.2 SUMMARY

A. This Section includes rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage.

1.3 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
2. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.4 SYSTEM PERFORMANCE REQUIREMENTS

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

1. Sealing Materials.
2. Fire-Stopping Materials.

C. Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire-rated and other partitions.
7. Terminal unit, coil, and humidifier installations.
8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

D. Coordination drawings for ductwork installation in accordance with Division 15 Section "Basic Mechanical Requirements." In addition to the requirements specified in "Basic Mechanical Requirements" show the following:

1. Coordination with ceiling suspension members.
2. Spatial coordination with other systems installed in the same space with the duct systems.
3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.

E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

F. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

G. Maintenance data for volume control devices, fire dampers, and smoke dampers, in accordance with Division 15 Section "Basic Mechanical Requirements" and Division 1.

1.6 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."

B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.

C. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
2. NFPA 96, "Standard for the Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors for Commercial Cooking Equipment," Chapter 3, "Duct System," for kitchen hood duct systems, except as indicated otherwise.

D. Field-Constructed Mock-Up: Prior to installation of duct systems erect mock-ups representing duct systems pressure classifications greater than 2 inches. Build mock-ups to comply with the following requirements, using materials indicated for final unit of Work.

1. Locate mock-ups on the site. Mock-up may be a representative section of the actual duct system.
2. Include the minimum number of each of the following features and fittings:

    a. Five transverse joints.
    b. One access door.
    c. Two typical branch connections each with at least one elbow.
    d. Two typical flexible duct or flexible connector connections for each type duct and apparatus.

3. Perform tests specified in "Field Quality Control." Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results.
4. Obtain approval of mock-ups before beginning final fabrication.
5. Retain and maintain mock-ups during construction in undisturbed condition as a standard for judging completed unit of Work.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant and fire-stopping materials to site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant fire-stopping materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.

B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for exposed surfaces of ducts exposed to view.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALING MATERIALS

A. Joint and Seam Sealants, General: The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide, glass-fiber-fabric reinforced.

C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.

D. Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 75 percent solids.

E. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.3 FIRE-STOPPING

A. Fire-Resistant Sealant: Provide one-part elastomeric sealant formulated for use in a through-penetration fire-stop system for filling openings around duct penetrations through walls and floors, having fire-resistance ratings indicated as established by testing identical assemblies per ASTM E 814 by Underwriters Laboratory, Inc. or other testing and inspecting agency acceptable to authorities having jurisdiction.

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

1. "Dow Corning Fire Stop Foam"; Dow Corning Corp.
2. "Pensil 851"; General Electric Co.
3. "Dow Corning Fire Stop Sealant"; Dow Corning Corp.
4. "3M Fire Barrier Caulk CP-25"; Electrical Products Div./3M.
5. "RTV 7403"; General Electric Co.
6. "Fyre Putty"; Standard Oil Engineered Materials Co.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.

1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
2. Straps and Rod Sizes: Conform with Table 4-1 in SMACNA HVAC Duct Construction Standards, 1985 Edition, for sheet steel width and gage and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.

1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.

2.5 RECTANGULAR DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," Tables 1-3 through 1-19, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Fabricate kitchen hood exhaust ducts with 16-gage, carbon steel sheets for concealed ducts and 18-gage stainless steels for exposed ducts. Weld and flange seams and joints. Conform to NFPA Standard 96.

C. Fabricate dishwasher hood exhaust ducts with 18-gage stainless steels. Weld and flange seams and joints.

D. Acid-Resistant Ducts: Provide factory-fabricated ducts and fittings only; no shop or field fabrication will be allowed. Refer to PVC-Coated Galvanized Steel Sheets in this Section for materials.

E. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications:

1. Supply Ducts: 3 inches water gage.
2. Return Ducts: 2 inches water gage, negative pressure.
3. Exhaust Ducts: 2 inches water gage, negative pressure.

F. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standard," Figure 1-4, unless they are lined or are externally insulated.

2.6 RECTANGULAR DUCT FITTINGS

A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 1985 Edition, Figures 2-1 through 2-10.

2.7 ROUND AND FLAT OVAL DUCT FABRICATION

A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.

B. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seams Types RL-2 or RL-3 may be used if spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.

2.8 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figures 3-4 and 3-5 and with metal thicknesses specified for longitudinal seam straight duct.

B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.

   a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
   b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:

      1) 3 to 26 inches: 24 gage.
      2) 27 to 36 inches: 22 gage.
      3) 37 to 50 inches: 20 gage.
      4) 52 to 60 inches: 18 gage.
      5) 62 to 84 inches: 16 gage.

   c. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:

      1) 3 to 14 inches: 24 gage.
      2) 15 to 26 inches: 22 gage.
      3) 27 to 50 inches: 20 gage.
      4) 52 to 60 inches: 18 gage.
      5) 62 to 84 inches: 16 gage.

   d. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.
   e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vanes.

2. Round Elbows - 8 Inches and Smaller: 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 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
5. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.
6. Round Gored Elbows Gages: Same as for nonelbow fittings specified above.
7. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.
8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gage.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION, GENERAL

A. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

B. Install ducts with the fewest possible joints.

C. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.

D. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.

E. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.

H. Install insulated ducts with 1-inch clearance outside of insulation.

I. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.

J. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.2 KITCHEN HOOD EXHAUST DUCT INSTALLATIONS

A. Provide for thermal expansion of ductwork through 2,000-deg F temperature range.

B. Install without dips or traps that may collect residues, except where traps have continuous or automatic residue removal.

C. Install access openings at each change in direction and at 50-foot intervals. Locate on sides of duct 1-1/2 inches minimum from bottom, and fit with grease-tight covers of same material as duct.

D. Do not penetrate fire-rated assemblies.

3.3 DISHWASHER EXHAUST DUCT INSTALLATIONS

A. Install dishwasher exhaust duct systems in accordance with SMACNA "HVAC Duct Construction Standards," 1985 Edition, Figure 2-21.

3.4 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints as follows:

B. Pressure Classifications Greater Than 3 Inches Water Gage: All transverse joints, longitudinal seams, and duct penetrations.

C. Pressure Classification 2 and 3 Inches Water Gage: All transverse joints and longitudinal seams.

1. Pressure Classification Less than 2 Inches Water Gage: Transverse joints only.

D. Seal externally insulated ducts prior to insulation installation.

3.5 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards," Tables 4-1 through 4-3 and Figures 4-1 through 4-8.

B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated.

E. Install concrete insert prior to placing concrete.

F. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.6 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 15 Section "Duct Accessories."

B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-7 and 2-8.

C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figures 2-16 through 2-18.

D. Terminal Units Connections: Comply with SMACNA "HVAC Duct Construction Standards," Figure 2-19.

3.7 FIELD QUALITY CONTROL

A. The Owner will contract with an independent testing agency to perform, record, and report leakage tests.

B. Remake leaking joints as required and apply sealants to achieve specified maximum allowable leakage.

3.8 ADJUSTING AND CLEANING

A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 15 Section "TESTING, ADJUSTING, AND BALANCING" for requirements and procedures for adjusting and balancing air systems.

B. Vacuum ducts systems prior to final acceptance to remove dust and debris.

END OF SECTION 233113

SECTION 233423 – HVAC POWER VENTILATORS

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. Centrifugal roof ventilators.
2. Centrifugal wall ventilators.
3. Ceiling-mounted ventilators.
4. In-line centrifugal fans.

B. Products furnished, but not installed, under this Section include roof curbs for roof-mounted exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base air ratings on sea-level conditions.

B. Operating Limits: Classify according to AMCA 99.

C. Fan Unit Schedule: The following information is described in an equipment schedule on the Drawings.

1. Fan performance data including capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
2. Fan arrangement including wheel configuration, inlet and discharge configurations, and required accessories.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data including rated capacities of each unit, weights (shipping, installed, and operating), furnished specialties, accessories, and the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound power ratings.
3. Motor ratings and electrical characteristics plus motor and electrical accessories.
4. Material gages and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

C. Shop Drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, loadings, required clearances, method of field assembly, components, and location and size of each field connection.

D. Coordination Drawings, according to Division 15 Section "Basic Mechanical Requirements," for roof penetration requirements and for reflected ceiling plans drawn accurately to scale and coordinating penetrations and units mounted above ceiling. Show the following:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

E. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

F. Maintenance data for power ventilators to include in the operation and maintenance manual specified in Division 1 and in Division 15 Section "Basic Mechanical Requirements."

1.5 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with NFPA 70 and that are listed and labeled by UL where available.

B. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

C. AMCA Compliance: Provide products that meet performance requirements and are licensed to use the AMCA Seal.

D. NEMA Compliance: Provide components required as part of fans that comply with applicable NEMA standards.

E. UL Standard: Provide power ventilators that comply with UL 705.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions by field measurements. Verify clearances.

B. Do not operate fans until ductwork is clean, filters are in place, bearings are lubricated, and fans have been commissioned.

1.7 COORDINATION AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

B. Coordinate the installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.

1.8 EXTRA MATERIALS

A. Furnish one set of belts for each belt-driven fan that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Centrifugal Roof Ventilators:

    a. Ammerman Company, Inc.
    b. Broan Mfg. Co., Inc.
    c. Carnes Co.
    d. Central Blower Co.
    e. Cincinnati Fan & Ventilator Co.
    f. Cook (Loren) Co.
    g. Essick Air Products, Breidert.
    h. Greenheck Fan Corp.
    i. ILG Industries, Inc.
    j. Jenn Industries Inc.
    k. Lau Division Philips Industries, Inc.
    l. Quietaire Corp.

2. Centrifugal Wall Ventilators:

    a. Ammerman Company, Inc.
    b. Broan Mfg. Co., Inc.
    c. Carnes Co.
    d. Chelsea Fans & Blowers, Inc.
    e. Cook (Loren) Co.
    f. Greenheck Fan Corp.
    g. ILG Industries, Inc.
    h. Jenn Industries Inc.

3. Ceiling-Mounted Ventilators:

    a. Ammerman Company, Inc.
    b. Broan Mfg. Co., Inc.
    c. Carnes Co.
    d. Chelsea Fans & Blowers, Inc.
    e. Cook (Loren) Co.
    f. Greenheck Fan Corp.
    g. Essick Air Products, Breidert.
    h. FloAire, Inc.
    i. ILG Industries, Inc.
    j. Jenn Industries Inc.

4. In-Line Centrifugal Fans:

    a. Cook (Loren) Co.
    b. FloAire, Inc.
    c. Greenheck Fan Corp.

d. ILG Industries, Inc.
e. Jenn Industries Inc.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

1. Upblast Units: Provide spun-aluminum discharge baffle to direct discharge air upward, with rain and snow drains.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable 1/2-inch mesh, aluminum or brass wire.
4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
5. Roof Curbs: Galvanized steel; mitered and welded corners; 2-inch-thick, rigid, fiberglass insulation adhered to inside walls; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

a. Configuration: Self-flashing without a cant strip, with mounting flange.
b. Configuration: Built-in cant and mounting flange.
c. Configuration: Built-in raised cant and mounting flange.
d. Overall Height: 8 inches.
e. Overall Height: 12 inches.
f. Overall Height: 18 inches.

2.3 CENTRIFUGAL WALL VENTILATORS

A. Description: Belt-driven or direct-drive centrifugal fans, as indicated, consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and accessories.

B. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.

C. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.

D. Belt-Driven Drive Assembly: Resiliently mounted to the housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel drive shaft keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust air stream.

E. Accessories: The following items are required as indicated:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
4. Wall Grille: Ring type for flush mounting.
5. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in wall sleeve; factory set to close when fan stops.

2.4 CEILING-MOUNTED VENTILATORS

A. Description: Centrifugal fans designed for installing in ceiling or wall, or for concealed in-line applications.

B. Housing: Galvanized steel lined with acoustical insulation.

C. Fan Wheel: Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Stainless-steel, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Variable-Speed Controller: Solid-state control to reduce speed from 100 percent to less than 50 percent.

G. Accessories: Manufacturer's standard roof jack or wall cap, and transition fittings.

2.5 IN-LINE CENTRIFUGAL FANS

A. Description: In-line, belt-driven centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, drive assembly, motor and disconnect switch, mounting brackets, and accessories.

B. Housing: Split, spun-aluminum housing, with aluminum straightening vanes; inlet and outlet flanges; and support bracket adaptable to floor, side wall, or ceiling mounting.

C. Direct-Drive Units: Motor encased in housing out of air stream, factory wired to disconnect located on outside of fan housing.

D. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

E. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

F. Accessories: The following accessories are required as indicated:

1. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.
2. Companion Flanges: For inlet and outlet duct connections.
3. Fan Guards: Expanded metal in removable frame. Provide belt guards for units not connected to ductwork.

2.6 MOTORS

A. Refer to Division 15 Section "Motors" for general requirements for factory-installed motors.

B. Motor Construction: NEMA MG 1, general purpose, continuous duty, Design B.

C. Enclosure Type: The following features are required as indicated:

1. Open dripproof motors where satisfactorily housed or remotely located during operation.
2. Guarded dripproof motors where exposed to contact by employees or building occupants.

2.7 FACTORY FINISHES

A. Sheet Metal Parts: Prime coat before final assembly.

B. Exterior Surfaces: Baked-enamel finish coat after assembly.

C. Aluminum Parts: No finish required.

2.8 SOURCE QUALITY CONTROL

A. Testing Requirements: The following factory tests are required as indicated:

1. Sound Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA Seal.
2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements of installation tolerances and other conditions affecting performance of the power ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install power ventilators according to manufacturer's written instructions.

B. Support units using the vibration-control devices indicated. Vibration-control devices are specified in Division 15 Section "Vibration Control."

1. Secure roof-mounted fans to roof curbs with cadmium-plated hardware.

a. Installation of roof curbs is specified in Division 7 Sections.

2. Suspend units from structural steel support frame using threaded steel rods and vibration isolation springs.
3. Ceiling Units: Suspend units from structure using steel wire or metal straps.

C. Install units with clearances for service and maintenance.

3.3 HOUSEKEEPING BASES

A. Construct concrete housekeeping pads as follows:

1. Coordinate size of housekeeping bases with actual unit sizes provided. Construct base 4 inches larger, in both directions, than the overall dimensions of the supported unit.
2. Form concrete pads with steel channels conforming to ASTM A 36, size and location as indicated. Miter and weld corner and provide cross bracing. Anchor or key to floor slab.
3. Form concrete pads with framing lumber with form-release compounds. Chamfer top edge and corners of pad.
4. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves to facilitate securing units.
5. Place concrete and allow to cure before installing units. Use portland cement conforming to ASTM C 150, 4000-psi compressive strength, and normal-weight aggregate.
6. Clean exposed steel form according to SSPC Surface Preparation Specifications SP 2 or SP 3 and apply 2 coats of rust-preventive metal primer.

3.4 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors.

B. Electrical: Conform to applicable requirements in Division 16 Sections.

C. Grounding: Ground equipment. Tighten electrical connectors and terminals, including grounding connections, according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly of components and installation of fans, including duct and electrical connections, and to report results in writing.

3.6 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Lubricate bearings.

3.7 CLEANING

A. After completing installation, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.

B. Clean fan interiors to remove foreign material and construction debris. Vacuum clean fan wheel and cabinet.

3.8 COMMISSIONING

A. Final Checks before Startup: Perform the following operations and checks before startup:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connections for piping, ducts, and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnects.
3. Perform cleaning and adjusting specified in this Section.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
6. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in the fully open position.
7. Disable automatic temperature-control operators.

B. Starting procedures for fans are as follows:

1. Energize motor; verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
2. Measure and record motor voltage and amperage.

C. Shut unit down and reconnect automatic temperature-control operators.

D. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for procedures for air-handling-system testing, adjusting, and balancing.

E. Replace fan and motor pulleys as required to achieve design conditions.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout."

C. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

D. Demonstrate operation of power ventilators. Conduct walking tour of the Project. Briefly identify location and describe function, operation, and maintenance of each power ventilator.

END OF SECTION 233423

SECTION 233713 – DIFFUSER, REGISTER, AND GRILLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK:

A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.

B. Types of outlets and inlets required for project include the following:

1. Ceiling air diffusers.
2. Wall registers and grilles.
3. Louvers.

C. Refer to other Division-15 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this section.

D. Refer to other Division-15 sections for balancing of air outlets and inlets; not work of this section.

1.3 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. ARI Compliance: Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".
2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:

1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

B. Samples: 3 samples of each type of finish furnished.

C. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

D. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 - PRODUCTS

2.1 CEILING AIR DIFFUSERS:

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule.

1. Diffuser Faces:

a. Round (RD): Round housing, core of concentric rings, round duct connection.
b. Square (SQ): Square housing, core of square concentric louvers, square or round duct connection.
c. Rectangular (RCT): Rectangular housing, core of rectangular concentric louvers, square or round duct connection.

d. Perforated (PR): Round, square, or rectangular housing covered with removable perforated panel in frame. Conceal air pattern devices above panel.
e. Linear (LR): Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings:

a. Flush (FL): Diffuser housing above ceiling surface with flush perimeter flange and gasket to seal against ceiling.
b. Lay-In (L-I): Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

3. Diffuser Patterns:

a. Fixed (FX): Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.
b. 1 Way (1-W): Fixed louver face for 1-direction air flow, direction indicated on drawings.
c. 2 Way (2-W): Fixed louver face for 2-direction air flow, directions indicated on drawings.
d. 3 Way (3-W): Fixed louver face for 3-direction air flow, directions indicated on drawings.
e. 4 Way (4-W): Fixed louver face for 4-direction air flow, directions indicated on drawings.

4. Diffuser Dampers:

a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of diffuser.
b. Butterfly (BTFY): Two semicircular flaps connected to linkage adjustable from face of diffuser with key, and with straightening grid.

5. Diffuser Accessories:

a. Plaster Ring (P-R): Perimeter ring designed to act as a plaster stop and diffuser anchor.
b. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at diffuser take-off.

6. Diffuser Finishes:

a. White Enamel (W-E): Semi-gloss white enamel prime finish.
b. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering diffusers which may be incorporated in the work include, but are not limited to, the following:

1. Anemostat Products Div.; Dymanics Corp. of America.
2. Cranes Co.; Div. of Wehr Corp.
3. Krueger Mfg. Co.
4. Titus Products Div.; Philips Industries, Inc.
5. Tuttle & Bailey; Div. of Interpace Corp.

2.2 WALL REGISTERS AND GRILLES:

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device and listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Griller Materials:

    a. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register and Grille Faces:

    a. Horizontal Straight Blades (H-S): Horizontal blades, individually adjustable, at manufacturer's standard spacing.
    b. Vertically Straight Blades (V-S): Vertical blades, individually adjustable, at manufacturer's standard spacing.
    c. Horizontal 45 Degree Fixed Blades (H-45 Degrees): Horizontal blades, fixed at 45 degrees, at manufacturer's standard spacing.

3. Register and Grille Patterns:

    a. Single Deflection (S-D): 1-set of blades in face.
    b. Double Deflection (D-D): 2-sets of blades in face, rear set at 90 degrees to face set.

4. Register and Grille Dampers:

    a. Opposed Blade (O-B): Adjustable opposed blade damper assembly, key operated from face of register.

5. Register and Grille Accessories:

    a. Extractor (EXTR): Curved blades mounted on adjustable frame to produce air scooping action in duct at register or grille take-off.
    b. Plaster Frame (P-F): Perimeter frame designed to act as plaster stop and register or grille anchor.
    c. Operating Keys (OP-KY): Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustable.

6. Register and Grille Finishes:

    a. White Enamel (W-E): Semi-gloss white enamel prime finish.
    b. Aluminum Anodize (A-A): Aluminum etched and anodized, covered with clear lacquer finish.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering registers and grilles which may be incorporated in the work include, but are not limited to, the following:

1. Anemostat Products Div.; Dynamics Corp. of America.
2. Carnes Co.; Div. of Wehr Corp.
3. Titus Products Div.; Philips Industries, Inc.

2.3 LOUVERS:

A. General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Substrate Compatibility: Provide louvers with frame and sill styles that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

D. Materials: Construct of aluminum extrusions, ASTM B 221, Alloy 6063-T52. Weld units or use stainless steel fasteners.

E. Louver Screens: On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

F. Available Manufacturers: Subject to compliance with requirements, manufacturers offering louvers which may be incorporated in the work include, but are not limited to, the following:

1. Airline Products Co.
2. Airolite Co.
3. American Warming & Ventilating Inc.
4. Arrow United Industries, Inc.
5. Construction Specialties, Inc.
6. Dowco Corp.
7. Industrial Louvers, Inc.
8. Louvers & Dampers, Inc.
9. Penn Ventilator Co., Inc.
10. Ruskin Mfg. Co.
11. Safe-Air Inc.
12. Snyder (E.G.) Co., Inc.
13. Vent Products Co., Inc.

PART 3 - EXECUTION

3.1 INSPECTION:

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

C. Locate ceiling air diffusers, registers, and grilles, as indicated on general construction "Reflected Ceiling Plans". Unless otherwise indicated, locate units in center of acoustical ceiling module.

3.3 SPARE PARTS:

A. Furnish to Owner, with receipt, 3 operating keys for each type of air outlet and inlet that require them.

END OF SECTION 233713

SECTION 236200 – PACKAGED COMPRESSOR AND CONDENSER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Division-15 Basic Mechanical Materials and Methods sections apply to work of this section.

1.2 SUMMARY:

A. Section includes:

1. Residential air-cooled condensing units.
2. Air-cooled condensing units.

B. Related Sections:

1. Section 15530 - Refrigerant Piping

1.3 SUBMITTALS:

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights (shipping, installed, and operating), dimensions, required clearances, and methods of assembly of components, furnished specialties and accessories; and installation and start-up instructions.

B. Wiring Diagrams: Submit ladder-type wiring diagrams for power and control wiring required for final installation of condensing units and controls. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

C. Operation and Maintenance Data: Submit maintenance data and parts list for each condensing unit, control, and accessory; including "trouble shooting" maintenance guide; plus servicing, and preventative maintenance procedures and schedule. Include this data and product data in maintenance manual; in accordance with requirements of Division 1.

1.4 QUALITY ASSURANCE:

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of condensing units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards:

1. Capacity ratings for condensing units shall be in accordance with ARI Standard 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".
2. Refrigeration system of condensing units shall be constructed in accordance with ASHRAE Standard ASHRAE 15 "Safety Code for Mechanical Refrigeration".
3. Condensing units shall meet or exceed the minimum COP/Efficiency levels as prescribed in ASHRAE 90A "Energy Conservation in New Building Design".
4. Construction and testing of water cooled condensing units shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII.

5. Condensing units shall be listed by UL and have UL label affixed.

1.5 DELIVERY, STORAGE, AND HANDLING:

A. Handle condensing units and components carefully to prevent damage. Follow manufacturer's written instructions for rigging. Replace damaged condensing units or components.

B. Store condensing units and components in clean dry place off the ground. Protect from weather, water, and physical damage.

1.6 SPECIAL PROJECT WARRANTY:

A. Warranty on Motor/Compressor: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, motors/compressors with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.

1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS

2.1 RESIDENTIAL AIR-COOLED CONDENSING UNITS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering residential air-cooled condensing units which may be incorporated in the work include, but are not limited to, the following:

1. BDP Co; Div Carrier Corp.
2. Carrier Air Conditioning; Div Carrier Corp.
3. Fedders Air Conditioning USA; Fedders Corp.
4. Lennox Industries, Inc.
5. Trane (The) Co; Div American Standard Inc.
6. York; Div York International.

B. General: factory-assembled and tested air-cooled condensing units, consisting of compressor, condenser coil, fan, motor, refrigerant reservoir, and operating controls. Capacity and electrical characteristics are scheduled (on the Drawings) (at the end of this Section).

C. Casing: galvanized steel finished with baked enamel, complete with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Unit shall be complete with brass service valves, fittings, and gage ports on exterior of casing.

D. Compressor: hermetically sealed with built-in overloads and vibration isolation. Compressor motor, shall have thermal and current sensitive overload devices, internal high-pressure protection, high and low pressure cutout switches, start capacitor and relay, 2-pole contactor, crankcase heater, and temperature actuated switch and timer to prevent compressor rapid cycle.

E. Condenser: coil shall have copper tubes and aluminum fins, or aluminum tubes and aluminum fins; complete with liquid accumulator and liquid subcooler. Aluminum propeller fan shall be direct driven, with permanently lubricated fan motor having thermal overload protection.

F. Accessories:

1. Low-voltage thermostat and subbase to control condensing unit and evaporator fan.
2. Precharged and insulated suction and liquid tubing of length indicated.
3. Head pressure control to modulate condenser fan motor speed for low ambient conditions.
4. Heat reclaim device providing preheating of domestic hot water with hot gas from condensing unit.
5. Low-voltage control transformer.
6. Water-to-refrigerant heat exchanger.

2.2 AIR-COOLED CONDENSING UNITS:

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering air-cooled condensing units which may be incorporated in the work include, but are not limited to, the following:

1. BDP Co; Div Carrier Corp.
2. Carrier Air Conditioning; Div of Carrier Corp.
3. McQuay Air Conditioning Group; McQuay Inc.
4. Trane (The) Co; Div American Standard Inc.
5. York; Div of York International.

B. General: factory-assembled and tested air-cooled condensing units, consisting of casing, compressors, condensers, coils, condenser fans and motors, and unit controls. Capacities and electrical characteristics are scheduled (on the Drawings) (at the end of this Section).

C. Unit Casings: designed for outdoor installation and complete with weather protection for components and controls, and complete with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include:

1. steel, galvanized or zinc-coated, for exposed casing surfaces, treated and finished with manufacturer's standard paint coating;
2. lifting lugs to facilitate rigging of units;
3. factory-installed metal grilles, for protection of condenser coil during shipping, installation, and operation;
4. hinged and gasketed control panel door.

D. Compressor: reciprocating hermetic-type compressor, 1,750 RPM, designed for air-cooled condensing, complete with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports. Capacity shall be controlled through cylinder unloading. Additional features include:

1. Crankcase heater in well within crankcase;
2. Capacity steps as scheduled, or greater number;
3. Compressor of same manufacturer as condensing unit.

E. Controls: Operating and safety controls shall include high and low pressure cutouts, oil pressure cutout, compressor winding thermostat cutout, 3-leg compressor overload protection, and condenser fan motors with thermal and overload cutouts. Control transformer if required

shall be 115-volts. Provide magnetic contactors for compressor and condenser fan motors. Additional features include:

1. Reset relay circuit for manual resetting of cutouts from remote thermostat location;
2. Automatic nonrecycling pumpdown, and timing device to prevent excessive compressor cycling;
3. Unfused disconnect switch, factory-mounted and wired, for single external electrical power connection.

F. Condensing Section: Condenser coil shall be seamless copper tubing mechanically bonded to heavy-duty, configurated aluminum fins, with separate and independent refrigeration circuit for each compressor. Units shall include liquid accumulator and subcooling circuit, and backseating liquid line service access valve. Condenser coils shall be factory-tested at 450 psig, vacuum dehydrate, and filled with a holding charge of nitrogen.

G. Condenser fans and drives: propeller-type condenser fans for vertical air discharge; either direct drive or belt drive. Additional features include:

1. Permanent lubricated ball bearing condenser fan motors;
2. Separate motor for each condenser fan;
3. Constant speed condenser fan motors;
4. Each fan assembly shall be dynamically and statically balanced.

H. Low ambient control: factory-installed low ambient damper assembly, fan speed control, or fan cycling control.

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Verify roof structure, mounting supports, and membrane installations are completed to the proper point to allow installation of roof mounted units. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

A. General: Install condensing units in accordance with manufacturers installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

B. Support:

C. Install ground-mounted units on 4 inches thick reinforced concrete pad, 4 inches larger on each side than condensing unit. Concrete is specified in Division 3. Coordinate installation of anchoring devices.

D. Install roof-mounted units on equipment supports specified in Division 7. Anchor unit to supports with removable fasteners.

E. Residential Units: Connect pre-charged refrigerant tubing to unit's quick-connect fittings. Run tubing so as not to interfere with access to unit.

1. Install furnished accessories.

F. Air-Cooled Condensing Units: Connect refrigerant piping to unit; maintain required access to unit.

1. Install furnished field-mounted accessories.

3.3 FIELD QUALITY CONTROL:

A. Testing:

B. Charge systems with refrigerant and oil, and test for leaks. Repair leaks and replace lost refrigerant and oil.

3.4 DEMONSTRATION:

A. Provide services of manufacturer's authorized service representative to provide start-up service and to instruct Owner's personnel in operation and maintenance of condensing units.

B. Start-up condensing units, in accordance with manufacturer's start-up instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

C. Train Owner's personnel on start-up and shut-down procedures, troubleshooting procedures, servicing, and preventative maintenance schedule and procedures. Review with the Owner's personnel, the data contained in the Operating and Maintenance Manuals specified in Division One.

1. Schedule training with Owner, provide at least 7-day prior notice to Architect/Engineer.

END OF SECTION 236200

SECTION 238223 - UNIT VENTILATORS

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 unit ventilators with the followingcooling elements:

1. Chilled-water cooling coil.
2. Refrigerant cooling coil.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Wiring diagrams detailing wiring for power and control systems and differentiating clearly between manufacturer-installed and field-installed wiring.

D. Samples of cabinet finish colors for approval.

E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

F. Field test reports from a qualified independent inspecting and testing agency indicating and interpreting test results relative to compliance with performance requirements of unit ventilators.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage a firm experienced in manufacturing unit ventilators similar to those indicated for this Project and that have a record of successful in-service performance.

B. Comply with ARI 440 for testing and rating units.

C. Comply with ASHRAE 33 for testing steam and hydronic coils.

D. Comply with NFPA 70 for components and installation.

E. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

1.5 EXTRA MATERIALS

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

1. Unit Ventilator Filters: Furnish one spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. ABB Aerovent Inc.
2. York
3. Carrier
4. The Trane Co.

2.2 MATERIALS

A. Cabinet: Galvanized steel with removable panels on front and ends.

B. Coil Section Insulation: Faced, heavy-density, glass-fiber insulation over entire section.

C. Adjustable discharge vanes located beneath discharge grilles.

D. Removable inlet grilles.

E. Drain Pans: Galvanized steel, with connection for drain. Drain pan insulated with polystyrene or polyurethane insulation.

F. Plastic Laminate Top Surface: Color and pattern as selected by Architect.

G. Cabinet Finish: Metal surfaces filled, coated with baked-on primer, and finished with manufacturer's standard baked enamel; color as selected by Architect.

2.3 COMPONENTS

A. Unitary Refrigeration Chassis: Condensing unit with suction line accumulator, antislugging devices, crankcase heater, filter, drier, winding thermal protection, overcurrent protection, pressure-limiting valve, and operating controls.

1. Refrigeration Coils: 2-row copper tubes with aluminum fins, conforming to ARI 210. Include thermal expansion valve.
2. Exterior Louver: Extruded aluminum sized to refrigeration unit capacity by manufacturer.

B. Hydronic Cooling Coils: Fin-and-tube coil fabricated of copper, with copper or aluminum fins spaced no closer than 0.1 inch, rated 200 psig. Leak test to 300 psig underwater.

C. Fan and Motor: Centrifugal blower, direct driven by a single phase, 2-speed, electric motor with inherent overload protection and resilient motor/fan mount.

D. Wiring Terminations: Match conductor materials and sizes indicated.

E. Filter: Manufacturer's standard throwaway filter, 1 inch thick, on inlet of each fan.

F. Automatic Temperature Controls: Refer to Division 15 Sections.

G. Safety Devices: Each unit has the following safety devices:

1. Manual disconnect switch completely deenergizes unit.
2. Spring-loaded interlock switch deenergizes control circuit and deenergizes fan and heating elements when front panel is removed.
3. Heat-dissipation switch keeps fans running when unit discharge temperature rises above 100 deg F.
4. Overcurrent protection fuses.
5. Branch circuit fusing to protect heating-element subdivision circuits (maximum 48 A).
6. Motor and control circuit fuses.
7. Low-temperature, cut-out thermostat strapped to air coil prevents coil from freezing and liquid from slugging.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and supports to receive unit ventilators for compliance with requirements for installation tolerances and other conditions affecting performance of unit ventilators. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install unit ventilators as indicated, to comply with manufacturer's written instructions and NFPA 90A.

B. Connect unit ventilators and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening requirements specified in UL 486A.

C. Connect fan-coil unit ventilators to hydronic piping according to Division 15 Section "Hydronic Piping." Provide shutoff valve and union or flange at each connection.

3.3 FIELD QUALITY CONTROL

A. Testing: After installing unit ventilators and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

B. Remove and replace malfunctioning units with new units, and retest.

3.4 CLEANING

A. Replace filters in each unit ventilator.

3.5 COMMISSIONING

A. Startup Services: Engage a factory-authorized service representative to provide startup service.

B. Operate fan motor to verify proper rotation.

C. Operate electric heating elements through each stage to verify proper operation and electrical connections.

D. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment.

END OF SECTION 238223

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 PRODUCTS

1.1 MATERIALS

A. Common Work Results for Electrical:
1. Medium-Voltage Cables:
a. Single and Multiple Conductor Types: UL 1072.
b. Cable: Cross-linked polyethylene, XLP, insulated, NEMA WC 7.
c. Cable: Ethylene propylene rubber, EPR, insulated, NEMA WC 8.
d. Conductors: Class B stranded, annealed copper.
e. Conductors: Class B stranded, aluminum.
f. Cable Jacket: PVC.
g. Cable Jacket: PVC extruded over metal armor.
h. Cable Jacket: Cross-linked polyolefin.
i. Metallic Shielding: Copper shielding tape.
j. Metallic Shielding: Solid copper wires.
k. Cable Voltage Rating: 15 kV phase to phase.
l. Insulation Thickness: Corresponding to referenced standard.
m. Circuit Identification: Color-coded tape.
n. Three-Conductor Cable Assembly: Shield conductors with grounding conductor.
o. Type MC Cable Armor: Aluminum interlocked armor.
p. Type MC Cable Armor: Galvanized steel interlocked armor.
q. Splices, Terminations, Kits, Cable Seals, Junctions: Suitable for service.
r. Arc-Proofing Materials: UL fireproofing intumescent tape.
s. Fault Indicators: Manual reset fault indicator to clamp to cable sheath.
2. Low-Voltage Cables:
a. Armored Cable: UL Types AC.
b. Metal-Clad Cable in Cable Trays: UL Type MC.
c. Nonmetallic-Sheathed Cable for Lighting Wiring: UL Type NM and NMC.
d. Aboveground Service Entrance Cable: UL Type SE.
e. Underground Service Entrance Cable: UL Type USE.
f. Underground Feeder and Branch-Circuit Cable: UL Type UF.
g. Portable Cord for Flexible Pendant Leads to Outlets and Equipment: UL Type S.
h. Control/Signal Transmission Media: Single conductor coaxial type.
i. Flat Cabling System for Power Under Carpet Tile: Factory-laminated assembly.
j. Flat Cabling System for Tel/Data Transmission Under Carpet Tile: Flat cable.
k. Fiber Optic Cables: Single channel low-loss glass type.
l. 7.Wire Components:
m. Conductors, No. 10 AWG and Smaller: Solid.
n. Conductors, No. 8 AWG and Larger: Stranded.
o. Insulation: THW, THHN/THWN or XHHW as applicable.
p. Jackets: Factory-applied nylon or PVC.
q. Conductor Material: Copper.
r. Conductor Material: Copper-clad aluminum.
s. Conductor Material: Aluminum.
3. Metal Conduit and Tubing:
a. Rigid Aluminum Conduit: ANSI C80.5.
b. Rigid Steel Conduit: ANSI C80.1.
c. Intermediate Steel Conduit: UL 1242.

d. PVC Coated Rigid Steel Conduit and Fittings: ANSI C80.1, NEMA RN 1.
e. Electrical Metallic Tubing (EMT) and Fittings: ANSI C80.3.
f. PVC Coated Electrical Metallic Tubing and Fittings: ANSI C80.3, NEMA RN 1.
g. Flexible Metal Conduit: UL 1 aluminum.
h. Flexible Metal Conduit: UL 1 zinc-coated steel.
i. Liquidtight Flexible Metal Conduit and Fittings: UL 360.

4. Nonmetallic Conduit and Ducts:
   a. Electrical Nonmetallic Tubing (ENT): NEMA TC 13.
   b. Rigid Nonmetallic Conduit (RNC): NEMA TC 2 and UL 651, PVC.
   c. Underground PVC and ABS Plastic Utilities Duct: NEMA TC 6.
   d. PVC and ABS Plastic Utilities Duct Fittings: NEMA TC 9.
   e. Liquidtight Flexible Nonmetallic Conduit and Fittings: UL 1660.
5. Boxes and Fittings:
   a. Cabinet Boxes: UL 50, sheet steel, NEMA 1.
   b. Pull and Junction Boxes: UL 50, steel boxes.
   c. Metal Outlet, Device and Small Wiring Boxes: UL 514A and OS 1.
   d. Nonmetallic Outlet, Device and Small Wiring Boxes: NEMA OS 2.
6. Raceway Accessory Materials:
   a. Conduit Bodies: NEC requirements.
   b. Wireways: NEC requirements.
   c. Surface Raceways, Metallic: Galvanized steel, with snap-on covers.
   d. Surface Raceways, Nonmetallic: Rigid PVC, UL 94.
7. Cable Trays:
   a. Materials: Mill galvanized steel.
   b. Materials: Hot-dip galvanized steel.
   c. Materials: PVC-coated steel.
   d. Configuration: Ladder type, trough-type, solid-bottom type, channel type.
   e. Covers: Solid type, louvered type, and ventilated-hat type.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Provide lighting control devices.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
   1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lighting Control Devices:
   1. Manufacturers: Refer to www.arcat.com/divs/sec/sec13807.html
   2. Application: Locations indicated.
   3. Sustainable Design: Utility efficient equipment and fixtures.
   4. Sustainable Design: Commissioning.
   5. Lighting Control Equipment Systems:
      a. Manual Modular Dimming System: Factory fabricated, 1 to 4 channels.
      b. Integrated Multi-preset Modular Dimming System: Microprocessor-based.
      c. Multi-channel Remote-Controlled Dimming System: Microprocessor-based.
      d. Programmable Lighting Control System: UL 916, microprocessor-based.
      e. Programmable Lighting Control System: Multiple remote addressable units.
   6. Lighting Control Equipment Components:
      a. Surge Protection: UL 1449 solid-state, line-voltage equipment surge protection.
      b. Dimmers: UL 508.
      c. Contactors and Relays: NEMA ICS 2, electrically operated.
      d. Time Switches and Sensors: UL 917 and UL 773A.
      e. Occupancy Sensors: UL listed, Class 2, ultrasonic, ceiling-mounted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform

appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

C. Provide core drilling as required for new work.

D. Conceal conduit to the greatest extent practical.

E. Install light switches at uniform height above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.

F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other.

G. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

H. Test all systems for proper operation. Label circuits in electrical panels.

I. Restore damaged finishes. Clean and protect work from damage.

J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 10 00
MEDIUM-VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Provide medium-voltage electrical distribution.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used. List project-specific information, including incoming service characteristics, connection types, transformers, and distribution system characteristics if available.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Medium-Voltage Electrical Distribution:
1. Manufacturers: Refer towww.arcat.com/divs/sec/sec16300.html
2. Application: Locations indicated.
3. Sustainable Design: Utility efficient equipment and fixtures.
4. Sustainable Design: Commissioning.
5. Secondary Unit Substations:
   a. Secondary Unit Substation Assembly: ANSI C37.121.
   b. Incoming Line Section: Bushings, terminal chamber, switches and fuses.
   c. Transformer Section: Liquid filled.
   d. Transformer Section: Weather-resistant, ventilated, dry type.
   e. Transformer Section: Cast-coil, dry type.
   f. Transformer Section: Total enclosed, nonventilated, dry type.
   g. Outgoing Section: Motor control center type.
   h. Outgoing Section: Metal enclosed, low-voltage power switchgear.
   i. Enclosure: NEMA Type 1, general purpose.
   j. Enclosure: NEMA Type 2, dripproof.
   k. Enclosure: NEMA Type 3, rainproof and sleet resistant.
   l. Enclosure Type: Non-walk-in, front accessible.
   m. Enclosure Type: Non-walk-in, front and rear accessible.
   n. Enclosure Type: Walk-in aisle.
6. Medium Voltage Transformers:
   a. Dry-Type Secondary Substation Type: NEMA ST 20, ANSI/IEEE C.57.12.01.
   b. Pad-Mounted Type: ANSI/IEEE C57.12.22, C57.12.26.

c. Liquid-Filled Secondary Substation Type: ANSI/IEEE C57.12.00, C57.12.13.

7. Medium Voltage Switchgear:
   a. Metal-Clad Circuit Breaker Switchgear: ANSI/IEEE C37.20.2.
   b. Metal-Enclosed Interrupter Switchgear: ANSI/IEEE C37.20.3.
   c. Switchgear Ratings: Nominal system voltage, main bus continuous amperes.
   d. Switchgear Load-Interrupter Switches: Stationary mounted, gang operated.
   e. Switchgear Circuit Breakers: Draw-out mounting with operation at rated voltage.
   f. Grounding and Test Devices: Suitable for phasing out and testing.
   g. Switchgear Control Battery and Charger: Control battery, racks, control panel.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Test all systems for proper operation. Label circuits in electrical panels. Restore damaged finishes. Clean and protect work from damage.

D. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 20 00
LOW-VOLTAGE ELECTRICAL DISTRIBUTION

PART 1 PRODUCTS

1.1 MATERIALS

A. Low-Voltage Electrical Distribution:
   1. Low-Voltage Transformers:
      a. Dry Type Transformers: NEMA ST 20, copper windings.
      b. Drive Isolation Transformers: NEMA ST 1, UL 506, 2 winding dry type.
      c. Buck-Boost Transformers: NEMA ST 1, UL 506, self-cooled dry type.
      d. Control and Signal Transformers: NEMA ST 1, UL 506, self-cooled.
      e. Voltage Regulating Transformers: ANSI/IEEE C57.15, ventilated, self-cooled.
      f. Voltage Stabilizing Transformers: NEMA ST 1, UL 506, dry-type, self-cooled.
      g. Induction Type Voltage Regulator: ANSI/IEEE C57.15, solid state type.
   2. Low Voltage Switchgear Assemblies: IEEE C37.20.1 and UL 1558.
   3. Low Voltage Drawout Power Circuit Breakers: IEEE C37.13 and UL 1066.
   4. Switchboards:
      a. Utility Metering Compartment: Acceptable to local utility company.
      b. Buses and Connections: Three-phase, four-wire type.
      c. Overcurrent Protective Devices (OCPDs): Ratings, settings suitable for use.
      d. Circuit Control and Protective Devices: Transfer switches, surge arrestors.
      e. Instrument Transformers: NEMA EI 21.1, IEEE C57.13.
      f. Ratings: System voltage, main bus amperage, short-circuit-current rating.
      g. Switchboard Type: Front-connected, front-accessible, panel-mounted branches.
      h. Switchboard Type: Front and side accessible sections.
      i. Switchboard Type: Front and rear accessible sections.
      j. Enclosure: NEMA 1, indoor.
      k. Enclosure: NEMA 3R, rainproof.
   5. Panelboards:
      a. Panelboards: NEMA PB 1, UL 50, 61, IEEE C62.1 surge arresters.
      b. Panelboard Type: Load-center-type panelboards.
   6. Wiring Devices and Components:
      a. Receptacles: UL 498 and NEMA WD 1.
      b. Industrial Receptacles: UL 498; UL 1010 at hazardous locations.
      c. Ground-Fault Interrupter Receptacles: Feed-thru type ground-fault circuit type.
      d. Isolated Ground Receptacles: Listed and labeled, integral to receptacle.
      e. Plugs: 15 amperes, 125 volts, 3 wire, grounding, armored cap plugs.
      f. Plug Connectors: 1bakelite-body armored connectors, 3 wire grounding unit.
      g. Snap Switches: UL 20 and NEMA WD 1, AC switches.
      h. Combination Switch and Receptacles: 3-way switch, grounding receptacle.
      i. Dimmer Switches, Incandescent Lamps: NEMA WD 1, solid state modular unit.
      j. Dimmer Switches, Fluorescent Lamps: Full-wave modular type AC dimmer.
      k. Telephone Jacks: Modular, flush in face of wall, plated.
      l. Wall Plates: Single and combination types, steel plate with baked-on finish.
      m. Floor Service Outlets: Modular, above-floor type floor service outlets and fittings.
      n. Poke-Through Assembly Devices: Above-floor service and below-floor box.
      o. Telephone/Power Service Poles: Combination phone and power poles with trim.
   7. Grounding:
      a. Grounding Equipment: UL 467; copper conductors; wire and cable conductors.
      b. Grounding Electrodes: Copper-clad steel ground rods; copper plate electrodes.

8. Busways:
   a. Busways: Feeder type, ANSI/UL 857, NEMA BU 1.
   b. Busways: Plug-in type, ANSI/UL 857, NEMA BU 1.
   c. Busways: General purpose plug-in type, ANSI/UL 857, NEMA BU 1.
   d. Plug-In Devices: Circuit breaker, fusible switch, fuse, combination starter plugs.
9. Fuses:
   a. Cartridge Fuses: ANSI/IEEE FU 1, nonrenewable cartridge type.
   b. Spare Fuse Cabinet: Wall-mounted steel unit.
10. Overcurrent Protective Devices:
   a. Overcurrent Protective Devices: Integral to panelboards and switchboards.
   b. Cartridge Fuses: NEMA FU 1, class suitable for use.
   c. Fusible Switches: UL 98, NEMA KS 1.
   d. Fused Power Circuit Devices: UL 977.
   e. Molded Case Circuit Breakers: UL 489, NEMA AB 1.
   f. Insulated Case Circuit Breakers: UL 489, NEMA AB 1.
11. Motor Controllers:
   a. Manual Motor Controllers: Quick-make, quick-break toggle action.
   b. Magnetic Motor Controllers: Full-voltage nonreversing, across-the-line type.
   c. Multispeed Motor Controllers: Full-voltage nonreversing, across-the-line type.
   d. Reduced-Voltage Motor Controllers: Star-delta magnetic type.
   e. Reduced-Voltage Motor Controllers: Part winding magnetic type.
   f. Reduced-Voltage Motor Controllers: Autotransformer magnetic type.
   g. Reduced-Voltage Motor Controllers: Solid state type.
   h. Solid-State, Variable-Speed Motor Controllers: NEMA Design B.
   i. Combination Controller/Disconnect: Suitable for use.
12. Enclosed Controllers, Motor Control Center (MCC) Components:
   a. MCC Features: Modular motor controllers.
   b. MCC Wiring Classification: Class I, NEMA ICS 2.
   c. MCC Wiring Classification: Class II, NEMA ICS 2.
   d. MCC Enclosure: NEMA Type I.
   e. Buses: Plated copper, ampacity rating as applicable to main buses.
   f. Buses: Plated aluminum, ampacity rating as applicable to main buses.

SECTION 26 30 00
Facility Electrical Power Generating and Storing Equipment

PART 1 GENERAL

1.1 SUMMARY

A. Provide electrical systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Arrangement of systems indicated on the drawings is diagrammatic, and indicates the minimum requirements for electrical work. Site conditions shall determine the actual arrangement of conduits, boxes, and similar items. Take field measurements before fabrication. Be responsible for accuracy of dimensions and layout.

C. Comply with the National Electrical Code and applicable local regulations.

D. Include primary service, transformers, distribution center, grounding, power and lighting panels, wiring, outlet boxes, receptacles, lighting fixtures, switches, conduits, and raceways and all accessories.

E. Provide telephone and data outlets with cutout, box and pull string only.

F. Modify and extend existing service to accommodate new work. Re-lamp existing fixtures consistent with building standards. Remove existing systems and wiring, which are abandoned.

G. Maintain fire alarm system in operation during construction.

H. Coordinate with Owner's room uses to provide adequate system for all contract areas.

I. Coordinate location of ductwork and fire protection systems to avoid interference with location of designated lighting fixture locations. Notify Owner prior to construction of conflicts, which cannot be resolved.

J. Coordinate schedule of telephone and data outlet completion with Owner's communications requirements and installer as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

A. Electrical Systems:
1. Manufacturers:FSR Inc.;Genesis;Leviton Mfg. Co., Inc..
2. Application: Interior lighting.
3. Application: Emergency lighting.
4. Application: Exit signs.
5. Application: Special purpose lighting.
6. Application: Exterior lighting.
7. Application: Photovoltaic collectors.
8. Application: Packaged generator assemblies.
9. Application: Emergency generators.
10. Application: Battery equipment.
11. Application: Lightning protection.
12. Application: Cathodic protection.
13. Application: Modifications to existing electrical system.
14. Sustainable Design: Occupancy sensors.
15. Sustainable Design: Perimeter daylighting controls.
16. Sustainable Design: Energy efficient equipment and fixtures.
17. Sustainable Design: Energy efficient bulbs.
18. Sustainable Design: Energy modeling.
19. Sustainable Design: Commissioning.
20. Type: Instrumentation and control for electrical systems.
    a. Power monitoring and control.
    b. Lighting control devices.
    c. Photoelectric switches.
    d. Occupancy sensors.
    e. Central dimming controls.
    f. Manual dimming controls.
    g. Network lighting controls.
    h. Theatrical lighting controls.
21. Type: Wiring devices.
    a. Receptacles.
    b. Switches.
    c. Dimmers.
    d. Finish plates.
    e. Door chimes.
22. Type: Facility electrical power generating and storing equipment.
    a. Photovoltaic collectors.
    b. Diesel-engine generators.
    c. Gas engine generators.
    d. Steam-turbine generators.
    e. Hydro-turbine generators.
    f. Wind energy equipment.
    g. Uninterruptible power units.
23. Type: Lighting.
    a. Interior lighting fixtures, lamps, and ballasts.
    b. Emergency lighting.
    c. Exit signs.
    d. Hazardous area location lighting.
    e. Special purpose lighting.
    f. Underwater lighting.
    g. Security lighting.
    h. Display lighting.
    i. Theatrical lighting.
    j. Detention lighting.

k. Healthcare lighting.
l. Exterior lighting poles and standards.
m. Parking lighting.
n. Roadway lighting.
o. Area lighting.
p. Landscape lighting.
q. Site lighting.
r. Walkway lighting.
s. Flood lighting.
t. Exterior athletic lighting.

24. Connected Loads: Suitable for service.
a. Public area lighting.
b. Internal operations lighting.
c. Garage lighting.
d. Site lighting.
e. Convenience power.
f. Mechanical cooling.
g. Mechanical and plumbing equipment.
h. Elevators.
i. Emergency generator system.

25. IEEE Illumination Levels: Suitable for service.
a. Public areas.
b. Offices.
c. Circulation.
d. Kitchen.
e. Storage.
f. Mechanical.
g. Garage.
h. Parking lots.

26. Components: Suitable for service.
a. Cables, conduit, and tubing.
b. Grounding and bonding devices.
c. Hangers and supports.
d. Raceways, boxes, and cabinets.
e. Cable trays.
f. Vibration and seismic controls.
g. Identification devices and warning labels.
h. Service entrance components.
i. Switchboards.
j. Low-voltage power switchgear.
k. Grounding components.
l. Transformers.
m. Motor controllers.
n. Busways.
o. Overcurrent protective devices.
p. Panelboards.
q. Fuses.

27. Electrical Standards.
a. Code: NFPA 70 National Electrical Code.
b. Fluorescent Fixtures: Fixtures, UL 1570; ballasts, UL 935, energy-saving.
c. HID Fixtures: UL 1572; ballasts, UL 1029; instant restrike device.
d. Incandescent Fixtures: UL 1571.
e. Fixtures for Hazardous Locations: UL 844.
f. Track Lighting Systems: UL 1574.
g. Exit Signs: UL 924.
h. Emergency Lighting Units: UL 924.

i. Emergency Fluorescent Power Supply: UL 924.
j. Lamps: ANSI Standards, C78 series.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and building code requirements.

B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

C. Center ceiling-mounted elements in center of ceiling tiles as applicable.

D. Install light switches 48" above finished floor. Locate switches within rooms at strike side of door unless noted otherwise.

E. Install thermostats centered above light switches at 60" above finished floor.

F. Gang-mount multiple switching locations. Mount multiple types of controls as close together as possible and in-line with each other at a height of 48" above finished floor.

G. Group multiple junction boxes, telephone and electrical outlets together on wall not more than 6" apart. Avoid back-to-back box locations.

H. Mount electrical, data, and telephone outlets vertically, 18" above finished floor unless noted otherwise.

I. Test all systems for proper operation. Restore damaged finishes. Clean and protect work from damage.

J. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 32 00
PACKAGED GENERATOR ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Provide packaged generator assemblies.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: NFPA 110.

PART 2 PRODUCTS

2.1 MATERIALS

A. Packaged Generator Assemblies:
1. Manufacturers: Refer to www.arcat.com/divs/sec/sec16230.html
2. Application: Locations indicated.
3. Sustainable Design: Utility efficient equipment and fixtures.
4. Sustainable Design: Commissioning.
5. Packaged Engine Generator System Components:
   a. Engine: NFPA 37.
   b. Engine Fuel: Diesel fuel oil grade DF-2.
   c. Cooling System: Closed-loop, liquid-cooled, radiator mounted.
   d. Fuel Supply System: NFPA 30, 37; day tank, piping and storage tank.
   e. Engine Exhaust System: Muffler type suitable for use.
   f. Combustion Air-Intake System: Filter type air intake silencer, intake duct
   g. Starting System: Electric with negative ground.
   h. Control and Monitoring: Operating and safety indications, engine gages.
   i. Generator, Exciter, and Voltage Regulator: NEMA MG 1, direct drive.
   j. Load Bank: Permanent outdoor, remotely controlled, forced-air cooled.
   k. Outdoor Generator Set Enclosure: Weatherproof steel housing, louvers.
   l. Transfer Switches: Automatic.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved

submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Clearly label and tag all components.

D. Test and balance all systems for proper operation.

E. Restore damaged finishes. Clean and protect work from damage.

F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 51 00
INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Provide interior lighting.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: NFPA 70 "National Electrical Code."

PART 2 PRODUCTS

2.1 MATERIALS

A. Interior Lighting:
1. Manufacturers: ENCELIUM; Legrand: Wattstopper; Wenger Corporation, JR Clancy and GearBoss.
2. Application: Locations indicated.
3. Sustainable Design: Utility efficient equipment and fixtures.
4. Sustainable Design: Commissioning.
5. Components: Suitable for service.
   a. Fluorescent Fixtures: UL 1570; ballasts, UL 935, energy saving.
   b. High Intensity Discharge (HID) Fixtures: UL 1572; ballasts, UL 1029.
   c. Incandescent Fixtures: UL 1571.
   d. LED Fixtures: UL 844.
   e. LED Light Source: UL 8750.
   f. Fixtures for Hazardous Locations: UL 844.
   g. Track Lighting Systems: UL 1574.
   h. Exit Signs: UL 924, self-powered battery type and luminous source type.
   i. Emergency Lighting Units: UL 924.
   j. Emergency Fluorescent Power Supply: UL 924.
   k. Lamps: ANSI Standards, C78 series.
   l. Suspended Fixture Support Components: Stem, rod, and hook hangers.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Test all systems for proper operation. Label circuits in electrical panels.

D. Restore damaged finishes. Clean and protect work from damage.

E. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Provide exterior lighting.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: NFPA 70 "National Electrical Code."

PART 2 PRODUCTS

2.1 MATERIALS

A. Exterior Lighting:
1. Manufacturers:ENCELIUM;FEC Heliports;Wenger Corporation, JR Clancy and GearBoss.
2. Application: Area and site lighting.
3. Application: Parking garage lighting.
4. Application: Wall mount lighting.
5. Application: Architectural floodlighting.
6. Application: Industrial floodlighting.
7. Application: Accent and pathway lighting.
8. Application: Locations indicated.
9. Sustainable Design: Utility efficient equipment and fixtures.
10. Sustainable Design: Commissioning.
11. Exterior Lighting Components:
    a. Fluorescent Fixtures: UL 1570; ballasts, UL 935, energy-saving.
    b. High Intensity Discharge (HID) Fixtures: UL 1572; ballasts, UL 1029.
    c. Incandescent Fixtures: UL 1571.
    d. LED Fixtures: UL 844.
    e. LED Light Source: UL 8750.
    f. Lamps: ANSI Standards, C78 series.
12. Fixture Support Poles, Mast Arms and Brackets:
    a. Steel tubing.
    b. Aluminum.
    c. Fiberglass.
    d. Laminated wood.

e. Pressure-treated wood.
f. Prestressed concrete.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Clearly label and tag all components.

C. Test and balance all systems for proper operation.

D. Restore damaged finishes. Clean and protect work from damage.

E. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 05 00
COMMUNICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Provide communications systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: FCC regulations.

PART 2 PRODUCTS

2.1 MATERIALS

A. Communications:
1. Manufacturers: Hillrom.
2. Application: Communications equipment room fittings.
3. Application: Communications cabling.
4. Application: Data communications.
5. Application: Voice communications for telephones, fax, modems and messaging.
6. Application: Audio-video systems.
7. Application: Communications and monitoring systems.
8. Application: Modifications to existing communications systems.
9. Sustainable Design: Energy efficient equipment and fixtures.
10. Sustainable Design: Commissioning.
11. Type: Communications cabling.
    a. Copper cabling.
    b. Optical fiber cabling.
    c. Coaxial cabling.
    d. Dial tone cabling.
    e. T1 services cabling.
    f. DSL services cabling.
    g. Cable services cabling.
    h. Satellite cabling.
12. Type: Data communications equipment.
    a. Firewalls.
    b. Routers.
    c. Network management.

d. Wireless access points.

13. Type: Voice communications.
    a. Telephone sets.
    b. Wireless transceivers.
    c. Elevators telephones.
    d. Ring-down emergency telephones.
    e. Facsimiles and modems.
    f. TTY equipment.
14. Type: Audio-video communications.
    a. Restaurant and bar systems.
    b. Conference room systems.
    c. Board room systems.
    d. Classroom systems.
    e. Theater systems.
    f. Auditorium systems.
    g. Stadium and arena systems.
15. Type: Digital signage systems.
    a. Point of sale systems.
    b. Transportation information display systems.
    c. Public information systems.
16. Type: Communications and monitoring systems.
    a. Paging systems.
    b. Public address and mass notification systems.
    c. Sound masking systems.
    d. Intercommunication systems.
    e. Patient monitoring and telemetry systems.
    f. Healthcare imaging systems.
    g. Nurse call/code blue systems.
    h. Clock systems.
    i. Internal cellular, paging, and antenna systems.
17. Components: Suitable for service.
    a. Communications services.
    b. Cables, conduit, and tubing.
    c. Grounding and bonding devices.
    d. Hangers and supports.
    e. Surface raceways, boxes, and cabinets.
    f. Underground ducts and raceways.
    g. Utility poles.
    h. Cable trays.
    i. Vibration and seismic controls.
    j. Identification devices and warning labels.
    k. Transformers.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Clearly label and tag all components.

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Clearly label and tag all components.

D. Test and balance all systems for proper operation.

E. Restore damaged finishes. Clean and protect work from damage.

F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 41 00
AUDIO-VIDEO SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Provide audio-video systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Audio-Video Systems:
1. Manufacturers: Wenger Corporation, JR Clancy and GearBoss.
2. Application: Locations indicated.
3. Sustainable Design: Utility efficient equipment and fixtures.
4. Sustainable Design: Commissioning.
5. CCTV System Components:
   a. Cameras: CCD imaging type.
   b. Lenses: Fixed lenses; motorized remote controlled zoom lenses.
   c. Camera Supporting Equipment: Minimum safety factor of 2.0.
   d. Pan Units: Motorized automatic scanning units.
   e. Pan and Tilt Units: Motorized units for remote-controlled aiming of cameras.
   f. Accessories: Mounting brackets, steel dustproof housings for fixed cameras.
   g. Monitors: Monochrome, metal cabinet units designed for continuous operation.
   h. Visual Tape Recorder: Industrial time lapse type for continuous operation.
   i. Manual Switch Bank: Low-loss, high-isolation multiple video switches.
   j. Sequential Switchers: Automatically sequence outputs of multiple cameras.
   k. Pan, Tilt, and Zoom Controls: Arranged for multiple-camera control.
   l. CCTV Master Control Station: Modular metal furniture with wiring.
   m. CCTV Coaxial Cable Connectors: Type BNC, 75 ohms.
6. MATV System Components:
   a. Antennas: Weatherproof broadband log-periodic type.
   b. FM Antenna: Omnidirectional type.
   c. Antenna-Supporting Structures: EIA 222-D, FCC Part 17.
   d. Preamplifiers: Coaxial downlead broadband or single channel type.
   e. Headend Equipment: Processors, broadband and single channel amplifiers.

f. Processors for UHF to VHF Translation: 6 MHz bandwidth.
g. Amplifiers: Broadband, single channel and distribution power amplifiers.
h. Power Supplies: NRTL listed, regulated, modular units.
i. Line Taps: Signal power splitters and isolation taps.
j. Signal Traps: Packaged filters tuned to interference frequencies.
k. Attenuators: Adjustable to eliminate overload.
l. Terminating Resistors: Enclosed units rated 1/2 watts.
m. Outlets: Flush type, wall plates with female type connectors.
n. MATV Coaxial Cable Connectors: Type F, 75 ohms.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Clearly label and tag all components.

D. Test and balance all systems for proper operation.

E. Restore damaged finishes. Clean and protect work from damage.

F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 51 16
PUBLIC ADDRESS AND MASS NOTIFICATION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Provide public address and mass notification systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Public Address and Mass Notification Systems:
1. Manufacturers: LogiSon Acoustic Network.
2. Application: Locations indicated.
3. Sustainable Design: Utility efficient equipment and fixtures.
4. Sustainable Design: Commissioning.
5. Public Address System Components:
a. Equipment: Solid state, rated for continuous duty.
b. Preamplifiers: Sized for anticipated service.
c. Power Amplifiers: Rack mounted.
d. Power Amplifier Monitoring: Automatic transfer to standby amplifier.
e. Microphones: Dynamic type, with cardiod polar or unidirectional characteristic.
f. Volume Limiter/Compressor: For each zone, maximum one percent distortion.
g. Control Console: Switches/pushbuttons controls, visual annunciation indicator.
h. Telephone Paging Adapter: Paging adapter for all zones.
i. Clock and Program System Adapter: Interface with central clock and program.
j. Equipment Cabinet: Steel cabinet with locking doors and rack, ventilation fan.
k. Equipment Rack: EIA standards.
l. Power Control Panel: Master switch and pilot light, cartridge fuse socket, light.
m. Monitor Panel: Volume unit or meter, speaker with volume control, switch.
n. Cone Type Loudspeakers: 45 decibels axial sensitivity.
o. Horn Type Loudspeakers: Single or double horn units with single driver.
p. Noise-Operated Gain Controller: Level adjustment range, 20 dB minimum.
q. Volume Attenuator Stations: For groups of speakers.
r. Microphone Outlets: Three pole, polarized, locking type, female receptacles.
s. Battery Backup Power Unit: Minimum one-hour capacity.

t. Wire and Cable: Speaker circuit conductors.
u. Weatherproof Equipment: For exterior or wet locations.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Clearly label and tag all components.

D. Test and balance all systems for proper operation.

E. Restore damaged finishes. Clean and protect work from damage.

F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 27 51 19
SOUND MASKING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Provide sound masking systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sound Masking Systems:
1. Manufacturers:LogiSon Acoustic Network.
2. Application: Locations indicated.
3. Sustainable Design: Utility efficient equipment and fixtures.
4. Sustainable Design: Commissioning.
5. Sound Masking System Components:
a. Components: Modular plug-in type, industrial grade integrated circuit devices.
b. Noise Generator and Filter Units: Pink noise generator output.
c. Programmable Audio Level Control Unit: Nonvolatile program memory.
d. Power Amplifiers: UL 1711, 6 RMS power rating.
e. Masking Speaker Assemblies: UL 1480 speakers with matching transformers.
f. Speaker Wire: Untinned, twisted pair, solid copper wire with PVC jacket.
g. Component Mounting Racks: Relay racks with steel cabinet with locks.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Comply with applicable regulations and code requirements. Provide proper clearances for servicing.

B. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

C. Clearly label and tag all components.

D. Test and balance all systems for proper operation.

E. Restore damaged finishes. Clean and protect work from damage.

F. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 28 05 00
ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 SUMMARY

A. Provide electronic safety and security systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
   1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: UL 609, 681, 1023, 1076, 1641, FM approval as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

A. Electronic Safety and Security Systems:
   1. Application: Access control and intrusion detection.
   2. Application: Video surveillance.
   3. Application: Personal alarm annunciation systems.
   4. Application: Fire detection and alarm.
   5. Application: Radiation detection and alarm.
   6. Application: Fuel-gas detection and alarm.
   7. Application: Fuel-oil detection and alarm.
   8. Application: Refrigerant detection and alarm.
   9. Application: Electronic detention monitoring and control.
   10. Application: Modifications to existing electronic safety and security systems.
   11. Type: Access control.
      a. Access door control.
      b. Intrusion detection.
      c. Video surveillance.
      d. Metal detectors.
      e. X-ray equipment.
      f. Sniffing equipment.
      g. Explosive detection equipment.
      h. Burglary systems.
      i. Perimeter security systems.
   12. Type: Electronic surveillance.

a. Video surveillance.
b. Alarm annunciation systems.
c. Emergency aid devices.

13. Type: Electronic detection and alarm.
a. Fire detection sensors.
b. Smoke detection sensors.
c. Carbon-monoxide sensors.
d. Fire alarm pull stations.
e. Fire alarm horns and strobes.
f. Radiation detection and alarm systems.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

C. Provide core drilling as required for new work.

D. Conceal conduit to the greatest extent practical.

E. Center ceiling-mounted elements in center of ceiling tiles as applicable.

F. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

G. Test all systems for proper operation. Label circuits in electrical panels.

H. Restore damaged finishes. Clean and protect work from damage.

I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 28 13 53
INTRUSION DETECTION

PART 1 GENERAL

1.1 SUMMARY

A. Provide intrusion detection system including sensors, signal equipment, controls, and alarm displays.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
   1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

C. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: UL 609, 681, 1023, 1076, 1641, FM approval as applicable.

PART 2 PRODUCTS

2.1 MATERIALS

A. Intrusion Detection Systems:
   1. Manufacturers:Digital Watchdog®;Eagle Eye Networks;Honeywell Commercial Security.
   2. Application: Locations indicated.
   3. Sustainable Design: Utility efficient equipment and fixtures.
   4. Sustainable Design: Commissioning.
   5. System Component Requirements:
      a. Surge protection.
      b. Interference protection.
      c. Tamper protection.
      d. Self-Testing devices.
      e. Antimasking devices.
      f. Addressable devices.
      g. Remote-Controlled devices.
   6. Secure And Access Devices:
      a. Keypad and display module.
      b. Key-operated switch.
   7. Intrusion Detection System Components:
      a. Surge Protection: UL 1449.
      b. Interference Resistance: Not affected by radio frequency and electrical.
      c. Tamper Protection: Tamper protection switches.

d. Intrusion Detection Devices: Types and mounting conditions as applicable.
e. Alarm Contact Arrangement: Single-pole, double-throw type.
f. Door and Window Switches: UL 634.
g. Space Intrusion Detection Devices: UL 639, devices as applicable.
h. System Control Panel: UL compliance for type of unit.
i. Duress alarm switches.
j. Secure-Access Control Stations: Keypad, display module, key-operated switch.
k. System Printer: Suitable for service with NRTL label.
l. Wire and Cable: Stranded copper.

8. Central-Station Control Units
   a. Annunciator.
   b. Central-station control-unit hardware.
   c. Central-station control-unit software.
   d. Audible and visual alarm devices.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

C. Provide core drilling as required for new work.

D. Conceal conduit to the greatest extent practical.

E. Center ceiling-mounted elements in center of ceiling tiles as applicable.

F. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

G. Test all systems for proper operation. Label circuits in electrical panels.

H. Restore damaged finishes. Clean and protect work from damage.

I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 28 31 00
FIRE DETECTION AND ALARM

PART 1 GENERAL

1.1 SUMMARY

A. Provide fire detection and alarm systems.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
   1. Shop drawings shall be prepared and stamped by a qualified engineer licensed in the jurisdiction of the project.

C. Warranty: Submit manufacturer's standard warranty. Include labor and materials to repair or replace defective materials.

D. Operation and Maintenance Data: Submit manufacturer's operation and maintenance data, including operating instructions, list of spare parts and maintenance schedule.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Compliance: NFPA 70, 71, 72, 72E, 72G, 72H.

PART 2 PRODUCTS

2.1 MATERIALS

A. Fire Detection and Alarm Systems:
   1. Manufacturers:Aerionics Inc dba Macurco Gas Detection;Brasch Environmental Technologies.
   2. Application: Locations indicated.
   3. Sustainable Design: Utility efficient equipment and fixtures.
   4. Sustainable Design: Commissioning.
   5. Signal Transmission: Hard-wired individual circuits.
   6. Audible Alarm Indication: Horns, bells, and voice alarm messages.
   7. Interface: Smoke removal systems, smoke dampers, air handling units control.
   8. Components: Suitable for service.
      a. Manual Pull Stations: Double-action type, metal or plastic.
      b. Smoke Detectors: UL 268, self-restoring type with visual indicator.
      c. Thermal Detectors: Fixed-temperature and rate-of-rise type.
      d. Flame Detectors: Ultraviolet type with delay.
      e. Fire Alarm Bells: Electric vibrating under-dome type.
      f. Fire Alarm Horns: Electric vibrating polarized type.
      g. Visual Alarm Devices: Dual-voltage strobe lights.
      h. Voice/Tone Speakers: UL 1480 type.
      i. Fire Fighters Telephones: Handset with supervised communication lines.

j. Device Location-Indicating Lights: System-voltage-indicating light.
k. Magnetic Door Holders: Wall or floor mounted type.
l. Fire Alarm Control Panel: UL 864.
m. Graphic Annunciator: LED indicators on graphic building floor plan.
n. Transmitter: Auto-dialer type.
o. Emergency Power Supply: Battery operated, 24-hour operation capacity.
p. Line-Voltage and Low-Voltage Circuits: Solid copper conductors, color-coded.
q. Conduit: Rigid steel, hardened, fire-rated.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections. Provide proper clearances for servicing.

B. Comply with National Electrical Code and building code requirements. Maintain continuity of circuits required to supply new or existing equipment in service.

C. Provide core drilling as required for new work.

D. Conceal conduit to the greatest extent practical.

E. Center ceiling-mounted elements in center of ceiling tiles as applicable.

F. Maintain indicated fire ratings of walls, partitions, ceilings and floors at penetrations. Seal with firestopping to maintain fire rating.

G. Test all systems for proper operation. Label circuits in electrical panels.

H. Restore damaged finishes. Clean and protect work from damage.

I. Instruct Owner's personnel in proper operation of systems.

END OF SECTION

SECTION 33 50 00
FUEL DISTRIBUTION UTILITIES

PART 1 GENERAL

1.1 SUMMARY

A. Provide piped energy distribution system piping, specialties, and accessories outside the building.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

1.3 QUALITY ASSURANCE

A. Comply with ANSI Z223.1 or NFPA 54 or AGA IFGC and local codes for materials, installation, testing, inspection, and purging.

B. Minimum Working-Pressure Ratings:
1. Piping and Valves: 100 psig.
2. Service Regulators: 100 psig.
3. Service Meters: 20 psig.
4. Aboveground Fuel Oil Piping: 150 psig.
5. Underground Fuel Oil Piping: 150 psig.
6. Vent, Gauge, and Fill Piping: 100 psig.
7. Fuel Oil Storage Tanks: 5 psig.
8. Fuel Oil Storage Tank, Outer Containment Shell Walls: 5 psig.
9. Containment Conduit Piping System, Carrier Pipe: 150 psig.
10. Containment Conduit Piping System, Containment Conduit: 5 psig.

PART 2 PRODUCTS

2.1 MATERIALS

A. Oil Storage Tanks:
1. Manufacturers: Refer towww.arcat.com/divs/sec/sec02550.html
2. Aboveground Types:
   a. Steel tanks Steel Tank Institute (STI) standards and UL 142; horizontal or vertical; double-wall.
   b. Containment-dike, single wall steel:
   c. Thermally insulated tanks complying with STI F941 and UL 2085.
3. Below Ground Types:
   a. Steel tanks complying with STI- P3 and UL 58.
   b. Composite tanks complying with STI F894 and UL 58.
   c. Jacketed tanks complying with STI F922 and UL 58.
   d. Glass-fiber-reinforced-plastic (FRP) tanks complying with UL 1316.
4. Tank Fittings and Accessories: Tank manholes, ladders, supply tube, tank supports.
5. Submersible turbine or multistage centrifugal fuel oil pump for flammable liquids.
6. Tank Specialties: Precast concrete manholes with cast-iron frame and cover, liquid-level gauge systems.
7. Gage System: Calibrated, liquid-level gage system.

8. Monitoring System: Calibrated, leak-detection and -monitoring system.
9. Fuel Oil: Grade as available.
10. Piping and Specialties: Suitable for service

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with local utility company requirements, pipe manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction. Coordinate with work of other sections.

B. Test for proper operation. Clean and protect work from damage.

END OF SECTION

SECTION 33 70 00
ELECTRICAL AND COMMUNICATIONS UTILITIES

PART 1 GENERAL

1.1 SUMMARY

A. Provide underground conduits and ducts, duct banks, pull boxes and handholes, manholes, and other underground utility structures.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

B. Shop Drawings: Submit shop drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.

1.3 QUALITY ASSURANCE

A. Comply with governing codes and regulations. Provide products of acceptable manufacturers, which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

B. Devices, and Accessories Including Ducts for Communications and Telephone Service: Listed and labeled as defined in NFPA 70, Article 100.

PART 2 PRODUCTS

2.1 MATERIALS

A. Underground Electrical and Communications Utilities:
1. Manufacturers: TerraTape, Div. of Reef Industries, Inc..
2. Application: Utility structures for building electrical and communications utilities.
3. Electrical Utility Service: Plastic utilities duct encased in concrete.
4. Electrical Feeders: Direct buried rigid plastic conduit.
5. Electrical Branch Circuits: Flexible corrugated conduit encased in concrete.
6. Telephone Utility Service: Plastic utilities duct encased in concrete.
7. Communication Circuits: Plastic underground conduit encased in concrete.
8. Conduit and Duct: Rigid steel and rigid nonmetallic conduit.
9. Pull Boxes and Handholes: Suitable for service.
10. Precast Concrete Utility Structures: Interlocking precast units.
11. Accessories:
    a. Duct Supports: Rigid PVC.
    b. Frames and Covers: Cast iron with cast-in legend.
    c. Sump Frame and Grate: FS RR-F-621, Type VII for frame and Type I for cover.
    d. Components: Pulling eyes in walls, pulling and lifting irons in floor, cable stanchions, arms and cable support insulators, ladder.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials in proper relation with adjacent construction and with uniform appearance for exposed work. Coordinate with work of other sections.

B. Test all systems for proper operation.

C. Restore damaged finishes. Clean and protect work from damage.

END OF SECTION