NEWCOMER ASSOCIATES

architecture + engineering

PROJECT MANUAL FOR:

King Street Church Office Building Renovation Chambersburg, Pennsylvania

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COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes pipe, fittings, valves, and connections for combination sprinkler and standpipe systems.

B. Related Sections:

- 1. Section 01 73 00 Fire protection and Life Safety: Execution requirements for installation of sprinkler requirements.
- 2. Section 03 10 00 Concrete Forming and Accessories: Execution requirements for inserts and sleeves specified by this section.
- 3. Section 07 84 00 Firestopping: Firestopping of piping penetrations.
- 4. Section 09 90 00 Painting and Coating: Execution requirements for piping painting specified by this section.
- 5. Section 21 13 13 Wet Pipe Sprinkler Systems.
- 6. Section 26 05 03 Equipment Wiring connections: Execution requirements for electric.
- 7. Section 28 31 00 Fire Detection and Alarm.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
 - 2. ASME B16.11 Forged Steel Fittings Socket-Welding and Threaded.
 - 3. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 4. ASME B16.25 Buttwelding Ends.
 - 5. ASME B16.3 Malleable Iron Threaded Fittings.
 - 6. ASME B16.4 Gray Iron Threaded Fittings.
 - 7. ASME B16.5 Pipe Flanges and Flanged Fittings.
 - 8. ASME B16.9 Factory-Made Wrought Steel Buttwelding Fittings.
 - 9. ASME B36.10M Welded and Seamless Wrought Steel Pipe.
- B. ASTM International:
 - 1. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A135 Standard Specification for Electric-Resistance-Welded Steel Pipe.
 - 3. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 4. ASTM A795/A795M Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.
 - 5. ASTM B32 Standard Specification for Solder Metal.

- 6. ASTM F438 Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40.
- 7. ASTM F439 Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- 8. ASTM F442/F442M Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR).
- 9. ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- C. American Welding Society:
 - 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
 - 2. AWS D1.1 Structural Welding Code Steel.
- D. American Water Works Association:
 - 1. AWWA C110 American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in, for Water and Other Liquids.
 - 2. AWWA C111 American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 3. AWWA C151 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- E. National Fire Protection Association:
 - 1. NFPA 13 Installation of Sprinkler Systems.
 - 2. NFPA 14 Standard for the Installation of Standpipe, Private Hydrants and Hose Systems.
 - 3. NFPA 24 Installation of Private Fire Service Mains and Their Appurtenances.
 - 4. NFPA 72 national Fire Alarm Code.
- F. Underwriter Laboratories, Inc.:
 - 1. UL 1887 Fire Tests of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
- C. Product Data: Submit manufacturer's catalogue information. Indicate valve data and ratings. All valves with tamper switches shall have tamper switch information supplied with submitted valves.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and tag numbering.
- C. Operation and Maintenance Data: Submit spare parts lists.

1.5 QUALITY ASSURANCE

- A. Provide above grade fire sprinkler with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with UL 1887.
- B. Perform Work in accordance with NFPA 13 and local standards.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- 1.7 PRE-INSTALLATION MEETINGS
 - A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
 - B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Deliver and store valves in shipping containers, with labeling in place.
- C. Furnish cast iron and steel valves with temporary protective coating.
- D. Furnish temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.9 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for basic fire suppression materials and methods.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of valve stem packing for each size and type of valve installed for which the manufacturer recommends future repacking.

PART 2 PRODUCTS

2.1 VALVES

- A. Manufacturers:
 - 1. Tyco.
 - 2. Kennedy Valve Company.
 - 3. Watts.
 - 4. Hammond Valve.
 - 5. Victaulic.
 - 6. Substitutions: Section 01 60 00 Product Requirements
- B. Gate Valves:
 - 1. Up to and including 2 inches: Bronze body and trim, rising stem, hand wheel, solid wedge or disc, threaded ends.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem pre-grooved for mounting tamper switch, hand wheel, OS&Y, solid bronze or cast iron wedge, flanged or grooved ends.
 - 3. Over 4 inches: Iron body, bronze trim, non-rising stem with bolted bonnet, solid bronze wedge, flanged ends, iron body indicator post assembly.
- C. Globe or Angle Valves:
 - 1. Up to and including 2 inches: Bronze body, bronze trim, rising stem and hand wheel, inside screw, renewable rubber disc, threaded ends, with back seating capacity packable under pressure.
 - 2. Over 2 inches: Iron body, bronze trim, rising stem, hand wheel, OS&Y, plugtype disc, flanged ends, renewable seat and disc.
- D. Ball Valves:
 - 1. Up to and including 2 inches: Bronze two piece body, brass, chrome plated bronze, or stainless steel ball, teflon seats and stuffing box ring, lever handle, threaded ends.
 - 2. Over 2 inches: Manufacturers: Cast steel body, chrome plated steel ball, teflon seat and stuffing box seals, lever handle, flanged.
- E. Butterfly Valves:
 - 1. Bronze Body: Stainless steel disc, resilient replaceable seat, threaded or grooved ends, extended neck, hand wheel and gear drive and integral indicating device, and built-in tamper proof switch rated 10 amp at 115 volt AC.

- 2. Cast or Ductile Iron Body: Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, wafer, lug, or grooved ends. With extended neck, hand wheel and gear drive and integral indicating device, and tamper switch rated 10 amp at 115 volt AC.
- F. Check Valves:
 - 1. Up to and including 2 inches: Bronze body and swing disc, rubber seat, threaded ends.
 - 2. Over 2 inches: Iron body, bronze trim, swing check with rubber disc, renewable disc and seat, flanged ends with automatic ball check.
 - 3. 4 inches and over: Iron body, bronze disc with stainless steel spring, resilient seal, threaded, wafer, or flanged ends.
- G. Drain Valves:
 - 1. Compression Stop: Bronze with hose thread nipple and cap.
 - 2. Ball Valve: Brass with cap and chain, 3/4 inch hose thread.
- H. Tamper Switches:
 - 1. Provide tamper switches integral or field installed to all valves where required by NFPA 72.
 - 2. Tamper switches are to be rated at 10 amp at 115 volt AC.

2.2 BURIED PIPING

- A. Ductile Iron Pipe: AWWA C151 Pressure Class 250.
 - 1. Fittings: AWWA C110, standard thickness.
 - 2. Joints: AWWA C111, rubber gasket.
 - 3. Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

2.3 ABOVE GROUND PIPING

- A. Steel Pipe: ASTM A53, Grade A and Grade B; ASTM A135, Grade A or ASTM A795 Grade A; Schedule 10 or 40 black or galvanized.
 - 1. Steel Fittings: ASME B16.9, wrought steel, butt welded; ASME B16.25, butt weld ends; ASTM A234, wrought carbon steel and alloy steel; ASME B16.5, steel flanges and fittings; or ASME B16.11, forged steel socket welded and threaded.
 - 2. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings; or ASME B16.4, threaded fittings.
 - 3. Malleable Iron Fittings: ASME B16.3, threaded fittings or ASTM B47. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
 - 4. Mechanical Formed Fittings: Carbon-steel housing with integral pipe stop and Oring pocked and O-ring uniformly compressed into permanent mechanical engagement onto pipe.

B. CPVC Pipe: ASTM F442/F442M, SDR 13.5.

- 1. Fittings: ASTM F438 schedule 40, or ASTM F439 schedule 80, CPVC.
- 2. Joints: ASTM F493, solvent weld.
- 3. CPVC Pipe is not allowed in any exposed location, whether allowed by Code or not.
- 4. CPVC Pipe is not allowed to be part of a dry system.
- 5. CPVC Pipe is not allowed where piping is exposed to a fire area (such as where piping is contained in a concealed combustible space requiring sprinklering).
- C. Ductile Iron Pipe: AWWA C151 Pressure Class 350.
 - 1. Fittings: AWWA C110, standard thickness.
 - 2. Joints: AWWA C111, rubber gasket.
 - 3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped composition sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.

2.4 PIPE HANGERS AND SUPPORTS

- A. Conform to NFPA 13, NFPA 14, and local codes.
- B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- C. Hangers for Pipe Sizes 2 inch and Over: Carbon steel, adjustable, clevis.
- D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- E. Wall Support for Pipe Sizes to 3 inches: Cast iron hook.
- F. Wall Support for Pipe Sizes 4 inches and Over: Welded steel bracket and wrought steel clamp.
- G. Vertical Support: Steel riser clamp (all sizes), Angle ring (1-1/4" and less).
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

PART 3 EXECUTION

3.1 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and foreign material, from inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems, and NFPA 24 for service mains.
- B. Install Work in accordance with and local standards.
- C. Provide installation in compliance with NFPA and local code.
- D. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.
- E. Install piping to conserve building space, to not interfere with use of space and other work.
- F. Group piping whenever practical at common elevations.
- G. Install pipe sleeve at piping penetrations through footings, masonry partitions, masonry walls, and floors. Seal pipe and sleeve penetrations to maintain fire resistance equivalent to fire separation.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Pipe Hangers and Supports:
 - 1. Install in accordance with NFPA 13.
 - 2. Install hangers to with minimum 1/2 inch space between finished covering and adjacent work.
 - 3. Place hangers within 12 inches of each horizontal elbow.
 - 4. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where installing several pipes in parallel and at same elevation, provide multiple or trapeze hangers.
 - 7. Install copper plated hangers and supports for copper piping.
 - 8. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Slope piping and arrange systems to drain at low points. Install eccentric reducers to maintain top of pipe level.
- K. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding. Refer to Section 09 90 00.

- L. All exposed sprinkler pipe and pipe fittings (elbows, tees, weld-o-lets, saddle taps etc.) shall be painted glossy red. Paint shall not cover any gauges or pressure ports nor shall paint effect the operation of the sprinkler system. Painting sprinkler piping is not required in boiler rooms, electrical rooms, elevator machinery rooms, nor sprinkler rooms. Hangers and supports of sprinkler pipe shall be painted the color of the element being used for support. Apply paint in compliance with Section 09 90 00.
- M. Do not penetrate building structural members unless indicated.
- N. Where more than one piping system material is specified, install compatible system components and joints. Install flanges, union, and couplings at locations requiring servicing.
- O. Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.
- P. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.
- Q. Install gate, ball, or butterfly valves for shut-off or isolating service. Building service mains shall use OS&Y gate valves where aboveground and upstream of backflow preventer.
- R. Install drain valves at main shut-off valves, low points of piping and apparatus.
- S. Where inserts are omitted, drill through concrete slab/plank from below and install through-bolt with recessed square steel plate and nut above, flush with top of, or recessed into and grouted flush with slab/plank. The method of securing shall be determined by plank designer or architect.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Install hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

3.4 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean entire system after other construction is complete.

END OF SECTION

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wet-pipe sprinkler system, system design, installation, and certification.
- B. Related Sections:
 - 1. Section 01 73 00 Fire protection and Life Safety: Execution requirements for installation of sprinkler requirements.
 - 2. Section 21 05 00 Common Work Results for Fire Suppression: Product and execution requirements for pipe, fittings, supports, identification and painting for placement by this section.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 13 Installation of Sprinkler Systems.
 - 2. NFPA 291 Recommended practice for flow testing and marking of hydrants.

1.3 SYSTEM DESCRIPTION

- A. System to provide coverage for entire building.
- B. Provide hydraulically designed system to NFPA 13 light hazard occupancy requirements except where plans require more sprinkler demand.
- C. Sprinkler system shall be designed with a safety factor of 10% where a 10% drop in pressure at the city main will not compromise the sprinkler or standpipe system. Furnish hydraulic calculations indicating 10% factor of safety is utilized.
- D. Determine volume and pressure of incoming water supply from water flow test data. Flow test shall be performed as per NFPA 291.
- E. Interface system with building fire and smoke alarm system.
- F. Provide fire department connections as indicated on Drawings.

1.4 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Indicate layout of finished ceiling areas indicating sprinkler locations coordinated with ceiling installation. Indicate detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
- C. Product Data: Submit data on sprinklers, valves, hose cabinets, hose connections, fire department connections, and specialties, including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections. Sprinkler data must include element type (size/solder metal/glass bulb), finish, temperature rating, quick response or standard response and style (pendent/recessed concealed/upright/special application etc.).
- D. Samples: Submit one of each style of sprinkler specified where at least one of that style sprinkler will be visible to guests at the hotel.
- E. Design Data: Submit design calculations signed and sealed by professional engineer registered in the Commonwealth of Pennsylvania.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
- C. Operation and Maintenance Data: Submit components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service depot.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with NFPA 13 and local standards.
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- C. Design system under direct supervision of Professional Engineer experienced in design of this Work and licensed in the Commonwealth of Pennsylvania.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Store products in shipping containers until installation.
- C. Furnish piping with temporary inlet and outlet caps until installation.

1.10 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for system.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish extra sprinklers under provisions of NFPA 13.
- C. Furnish suitable wrenches for each sprinkler type.
- D. Furnish metal storage cabinet located adjacent to alarm valve unless otherwise indicated on plans.

PART 2 PRODUCTS

2.1 SPRINKLERS

- A. Manufacturers:
 - 1. Tyco Incorporated.
 - 2. Viking.
 - 3. Reliable Sprinkler Corp.
 - 4. Globe.
 - 5. Victaulic
 - 6. Substitutions: Not allowed.
- B. Suspended Ceiling Type:
 - 1. Type: Concealed pendant type.

- 2. Finish: Enamel white
- 3. Fusible Link: Glass Bulb type temperature rated for 155°F to 160°F.
- C. Exposed Area Type:
 - 1. Type: Standard upright type with guard.
 - 2. Finish: Brass
 - 3. Fusible Link: Glass bulb type temperature rated for 155°F to 160°F.
- D. Side-wall Type:
 - 1. Type: Recessed horizontal side wall type with matching push on escutcheon plate.
 - 2. Finish: Enamel, white
 - 3. Escutcheon Plate Finish: Is to match sprinkler.
 - 4. Fusible Link: Glass bulb type temperature rated for 155°F to 160°F.
- E. Concealed Area type:
 - 1. Type: Standard upright without guard or specific application attic sprinkler head.
 - 2. Finish: Brass
 - 3. Fusible Link: Glass bulb type temperature rated for 155°F to 160°F.
- F. Guards: Finish to match sprinkler finish.
- G. Sprinklers are to be "Quick Response" type.

2.2 PIPING SPECIALTIES

- A. Wet Pipe Sprinkler Alarm Valve: Check type valve with divided seat ring, rubber faced clapper to automatically actuate water motor alarm and electric alarm, with pressure retard chamber and variable pressure trim; with test and drain valve.
- B. Water Motor Alarm: Hydraulically operated impeller type alarm with aluminum alloy red enameled gong and motor housing, nylon bearings, and inlet strainer.
- C. Electric Alarm: Electrically operated red enameled gong with pressure alarm switch.
- D. Water Flow Switch: Vane type switch for mounting horizontal or vertical, with two contacts; rated 10 amp at 125 volt AC and 2.5 amp at 24 volt DC.
- E. Fire Department Connections:
 - 1. Reference Division 21 12 00

2.3 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Controls and Alarms: Supervisory switches and interlocks are to be coordinated with Fire Alarm Provider.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NFPA 13, and local standards.
- B. Install buried shut-off valves in valve box. Furnish post indicator.
- C. Install approved double check detector back-flow preventer assembly at sprinkler system water source connection.
- D. Locate fire department connection with sufficient clearance from walls, obstructions, or adjacent Siamese connectors to allow full swing of fire department wrench handle.
- E. Locate outside alarm-gong on building wall directly outside the fire entry unless otherwise indicated on plans.
- F. Place pipe runs to minimize obstruction to other work.
- G. Install piping in concealed spaces above finished ceilings unless noted as exposed on plans.
- H. Center sprinklers in two directions in ceiling tile and install piping offsets.
- I. Install and connect to fire pump system in accordance with Section 21 30 00 and NFPA 13.
- J. Hydrostatically test entire system.
- K. Require test be witnessed by Fire Marshal.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Verify signal devices are installed and connected to fire alarm system.

3.3 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Flush entire piping system of foreign matter.

3.4 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 Execution and Closeout Requirements: Protecting installed construction.
- B. Apply masking tape or paper cover to protect concealed sprinklers, cover plates, and sprinkler escutcheons. Remove after painting. Replace painted sprinklers with new.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Piping curbs.
 - 6. Exterior pipe supports.
 - 7. Sleeves.
 - 8. Mechanical sleeve seals.
 - 9. Formed steel channel.
 - 10. Firestopping
 - 11. Equipment bases and supports.
 - 12. Flashing

B. Related Sections:

- 1. Section 03 10 00 Concrete Forming and Accessories: Execution requirements for placement of inserts and sleeves in concrete forms specified by this section.
- 2. Section 03 30 00 Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
- 3. Section 07 62 00 Sheet Metal Flashing and Trim: Installation requirements for roof flashing installation.
- 4. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
- 5. Section 07 90 00 Joint Protection: Product requirements for sealant materials for placement by this section.
- 6. Section 09 90 00 Painting and Coating: Product and execution requirements for painting specified by this section.
- 7. Section 22 11 00 Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
- 8. Section 22 13 00 Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
- 9. Section 22 14 00 Facility Storm Drainage: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 Power Piping.
 - 2. ASME B31.9 Building Services Piping.

B. ASTM International:

- 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
- 3. ASTM E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops.
- 4. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
- 5. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society:
 - 1. AWS D1.1 Structural Welding Code Steel.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
- E. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.
- F. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: Conform to UL to achieve fire ratings as noted on Drawings for adjacent construction.
- B. Firestop interruptions to fire rated assemblies, materials, and components. Reference Division 07 84 00 for details.

1.5 PERFORMANCE REQUIREMENTS

A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.

B. Firestopping: Provide written authorization from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required UL listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

- A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- B. Perform Work in accordance with local standards.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum 3 years documented experience.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for pipe hangers and supports.

PART 2 PRODUCTS

- 2.1 PIPE HANGERS AND SUPPORTS
 - A. Manufacturers:
 - 1. Carpenter & Paterson Inc.

- 2. Creative Systems Inc.
- 3. Flex-Weld, Inc.
- 4. Glope Pipe Hanger Products Inc.
- 5. Michigan Hanger Co.
- 6. Superior Valve Co.
- 7. Substitutions: Section 01600 Product Requirements.
- B. Plumbing Piping DWV Sanitary and Storm:
 - 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 - 2. Hangers for Pipe Sizes ¹/₂ to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Pipe Support: Copper-plated, carbon-steel adjustable, ring.
- C. Plumbing Piping Water:
 - 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69, MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
 - 9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 - 10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 - 11. Vertical Support: Steel riser clamp.
 - 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 13. Floor Support for Hot Pipe Sizes 4 inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 - 15. Copper Pipe Support: Copper-plated, Carbon-steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Manufacturers:
 - 1. Grinnel.
 - 2. Tolco.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 PIPING CURBS

- A. Manufacturers:
 - 1. Thycurb
 - 2. Curbs Plus
 - 3. Pate Curbs
 - 4. Substitutions: Section 01600 Product Requirements
- B. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation, 1-1/2 inch thick insulation, factory installed wood nailer. ABS thermoplastic korad acrylic or galvanized steel cover. Provide graduated boots for top entrance and 2x8 wood nailer for side entrance. Coordinate with roofing contractor to install curb and roof cricket.
- C. Provide curbs for piping penetrations of roofing where the roof has a slope of 1" in 12" or less. Provide boots for piping penetrations where slope is greater than 1" in 12"

2.6 EXTERIOR PIPE SUPPORTS

- A. Manufacturers:
 - 1. MIRO
 - 2. ERICO CADDY

- 3. Eberl Iron Works
- 4. Substitutions: Section 01600 Product Requirements
- B. Pipes 1-1/2" and smaller
 - 1. MIRO model: 1.5
 - 2. Pipe support is 6" square and the base is gently rounded to prevent gouging the roof. The outer edges are raised 1-1/2" and increased elevations may be achieved by stacking Model 1.5 on 2 or 3 spacers, each with a height of 1-1/2". Four drainage ports are provided to prevent ponding within the device. The dimensional area resting on the roof is 5-7/8 inches square and 34.52 square inches exist of contact roof support.
 - 3. Pipe support shall be constructed of a one-piece roof deck base made of MIRON TPCTM or polycarbonate resin with, stacking/alignment pins, and interior cross hatch support structure. Carbon black added for UV resistance and protection.
 - 4. Pipe support shall be compatible for use with all current types of decking and with all commonly used built-up and single-ply roofing membranes where roof-mounted pipes occur.
- C. Pipes 1-1/2" 3"
 - 1. MIRO model: 3-R-2
 - 2. A "roller-bearing" pipe support used to support roof mounted gas pipes, electrical conduit, solar piping and other mechanical piping. Unique design absorbs thermal expansion and contraction of pipes thus preventing damage to the roof membrane. Pipes rest on a polycarbonate resin roller and a polycarbonate axle situated in a MIRON TPCTM or polycarbonate resin base.
 - 3. The polycarbonate roller serves to keep the pipestand system directly beneath the pipe without binding. It also allows for some lateral expansion of the pipe system. Guide holes are provided at the top of the cradle for any desired installation of a MIRO Pipe Strap using #8 x 1/2" screws to prevent separation of the pipe from the support. The base is gently rounded to prevent gouging the roof membrane.
 - 4. Support shall be a one-piece roof deck base, a roller housing support composed of rigid polycarbonate resin with carbon black added for UV resistance and protection, and a roller made of polycarbonate resin which rests on a MIRON TPCTM or polycarbonate axle of 9/16" diameter.
 - 5. Pipe support shall be compatible for use with all current types of decking and with all commonly used built-up and single-ply roofing membranes where roof-mounted pipes occur.
- D. Pipes 3-1/2" 6"
 - 1. MIRO model: 6-RAH
 - 2. A "roller-bearing" pipe support used to support roof mounted gas pipes, electrical conduit, solar piping and other mechanical piping. Unique design absorbs thermal expansion and contraction of pipes thus preventing damage to the roof membrane. Pipes rest on a self-lubricating roller which is a 304 stainless steel rod and a polycarbonate resin roller. The pipe support base is made of sturdy MIRON TPCTM or polycarbonate resin, the roller is polycarbonate and all metal parts are made of stainless steel.

- 3. The "U" shaped roller serves to keep the pipestand roller system directly beneath the pipe without binding and allows for some lateral expansion of the piping system.
- 4. The pipestand consists of two major components: (1) A one-piece polycarbonate resin roof deck base, (2) A roller made of polycarbonate resin and a stainless steel rod which rests in an adjustable height roller housing connected with 1/2" diameter stainless steel all thread on the base. Carbon black is added to the MIRON TPCTM and polycarbonate resin for UV resistance and protection.

2.7 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sealant: Acrylic (where not through rated entity); refer to Section 07 90 00.

2.8 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

2.10 FIRESTOPPING

- A. Manufacturers:
 - 1. 3M Fire Protection Products.
 - 2. Nelson Firestop Products.
 - 3. Johns Manville
 - 4. Substitutions: Section 01 60 00 Product Requirements.

B. Materials:

- 1. Caulk: CP25 (must be brick red)
- 2. Wrap/Strip: FS-195
- 3. Collar: RC-1
- 4. Composite Sheet: CS-195
- 5. Fire Barrier Moldable putty
- 6. Fire Dam Spray

2.11 FIRESAFING

- A. Manufacturer
 - 1. USG Acoustical Products
- B. Materials
 - 1. 4 inch mineral fiber stuffing insulation
 - 2. Density: 4 lb/cu ft.

2.12 ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- C. Labels: Red permanent marking "Fire Rated Assembly-Do not Disturb-See maintenance Instructions", include testing agency designation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install non-combustible backing damming materials to arrest liquid material leakage.

- D. Remove backing damming materials after firestopping material has solidified in exposed areas.
- E. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- F. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab/plank from below and provide through-bolt with recessed square steel plate and nut above flush with top of, recessed into and grouted flush with slab/plank as indicated on plans or directed by plank manufacturer. Where slab is utilized and direction is not given on plans then confirm with architect for method of attachment.

3.4 FIRESTOPPING/FIRESAFING

A. Install as indicated by UL to maintain rating indicated by architectural plans.

3.5 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with manufacturer's recommendation and this specification.
- B. Support horizontal piping as scheduled.
- C. Install hangers with minimum ¹/₂ inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support horizontal cast iron pipe adjacent to each hub, with 5 feet maximum spacing between hangers.
- G. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

- H. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- I. Support riser piping independently of connected horizontal piping.
- J. Provide copper plated hangers and supports for copper piping.
- K. Design hangers for pipe movement without disengagement of supported pipe.
- L. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.6 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 4 inches beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.7 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- C. Seal floor, shower, and mop sink drains watertight to adjacent materials.
- D. Flash and counter-flash roof curbs with sheet metal; seal watertight. Attach counterflashing and lap base flashing on roof curbs. Flatten and solder joints.
- E. Adjust storm collars and pipe boots tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.8 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.

- C. Size sleeves two pipe sizes larger than penetrating pipe to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates a fire rated or smoke rated floor, ceiling, or wall, close off space between pipe or duct and adjacent work with approved firestopping system. Provide close fitting metal collar or escutcheon covers at both sides of penetration where penetration is exposed.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.9 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.10 CLEANING

- A. Section 01 70 00 Execution Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.11 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers (marking of pipes shall extend to the limits of site).
 - 5. Labels.
 - 6. Lockout devices.
- B. Related Sections:
 - 1. Section 09 90 00 Painting and Coating: Execution requirements for painting specified by this section.
 - 2. Section 22 11 00 Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
 - 3. Section 22 13 00 Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
 - 4. Section 22 14 00 Facility Storm Drainage: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

- 2.1 NAMEPLATES
 - A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Brimar
 - 3. Safety Sign Co.
 - 4. Seton Identification Products
 - 5. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Where specific color scheme is required by local code the local color scheme shall be followed.
- C. Nameplates identifying equipment shall match tag in equipment schedule and shall also contain a description of equipment such as "P-1" "110°F HW Recirculation Pump". The tag shall be in 1-3/4" high letters and the description shall be in ½" letters.

2.2 TAGS

- A. Metal Tags: 1. Man
 - Manufacturers:
 - a. Same as Nameplates
 - 2. Brass or Aluminum with stamped letters; tag size minimum 1-1/2 inches diameter/square with finished edges. Hot water to have square tags, all others to be round.
- B. Information Tags:
 - 1. Manufacturers:
 - a. Same as Nameplates
 - 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- C. Tag Chart: Typewritten letter size list of applied tag numbers, valve size, fluid conveyed, room numbers served (if water) and valve location in anodized aluminum frame plastic laminated. Locate valve list in mechanical room directly above or adjacent to water entry.

2.3 STENCILS

- A. Manufacturers:
 - 1. Same as Nameplates.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 - 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 - 4. Equipment (where not labeled with plastic tags): 1-3/4 inches high letters.
- C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Same as Nameplates.

- 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Same as Nameplates.
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Pipe Markers:
 - 1. Manufacturers:
 - a. Same as Nameplates.
 - 2. Bright colored continuously printed plastic ribbon tape with aluminum foil core, minimum 6 inches wide by 4.5 mil thick, manufactured for direct burial service.
 - 3. Tape shall be colored to APWA color code.
 - 4. Tape shall be detectable to a depth of 10'.
 - 5. Taper marker shall comply with DOT Office of Pipeline Safety USAS B31.8, NTSB PSS-73-1, API RP1109, GSA Public Buildings Service Guide, American Gas Association 72-D-56, OSHA 1926.956 (c)(1) and Federal Gas Safety Regulation S 192-321 (e)
- 2.5 LABELS
 - A. Manufacturers:
 - 1. Same as Nameplates.
 - B. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

2.6 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers:
 - a. Idesco
 - b. Brady
 - c. Reese Safety Products
 - d. Substitutions: Section 01 60 00 Product Requirements
 - 2. Anodized aluminum hasp with erasable label surface; size minimum $7-1/4 \ge 3$ inches.
- B. Valve Lockout Devices:
 - 1. Manufacturers:
 - a. Same as Lockout Hasps
 - 2. Steel device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 90 00.
- B. Install identifying devices after completion of coverings and painting.
- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe. All underground pipes shall be marked using underground pipe marker tape, there shall be no exceptions for marking underground pipe except irrigation piping under 1" in nominal size. Installation of pipe markers shall extend to the limits of the site. Reference Civil plans for the extent of site and site piping. Coordinate with site contractor for location of site piping.
- G. Identify water heaters, pumps, tanks, master mixing valves, boilers, control panels, water softeners and other water treatment devices with plastic nameplates. Small pumps or master mixing valves may have labels adjacent item with an arrow pointing toward item or may have a large brass tag with identifying information "including description" stamped into it and affixed to item with a chain.
- H. Identify valves in main and branch piping with tags. All shutoff valves unless they are within 5' of equipment they serve shall have a tag.
- I. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service and flow direction for all pipes. For fuel gas piping identify nominal pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction. Non-Potable water shall be labeled as such in a manner consistent with code.
- J. Hydrants, hose bibs and other water outlets served by a non-potable source shall be clearly labeled as "Dangerous Non-Potable Water" as required by code.

END OF SECTION

SECTION 22 05 93

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of domestic hot water and pool systems.

B. Related Sections:

1. Section 22 14 30 – Water Pumps: Requirements for coordination between water pumps and testing and balancing.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty or Copy of NEBB Certificate of Conformance Certification.
- E. Submit draft copies of report for review prior to final acceptance of Project.
- F. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of

reduced drawings with balancing valves, filters, pumps and other equipment identified to correspond with data sheets.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with state standards.
- B. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance or ASHRAE 111 or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience by certified by AABC or Certified by NEBB.
- B. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 SEQUENCING

- A. Section 01 10 00 Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 SCHEDULING

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
 - 1. Systems are started and operating in safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Water systems are flushed and filled.
 - 6. Pumps are rotating correctly.
 - 7. Proper strainer baskets are clean and in place or in normal position.
 - 8. Service and balancing valves are open

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Domestic and pool water systems: Adjust to within plus or minus 10 percent of design.
- B. Flows through finned tube boiler or pool heater must be between manufacturers' minimum and maximum values and 10% of design.
- C. Water temperatures are to be at or within 2 degrees Fahrenheit under indicated temperatures.

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner or Engineer.

3.5 WATER SYSTEM PROCEDURE

- A. Adjust water systems, to obtain design quantities.
- B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.
- C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing.
- D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.
- E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.
- F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

3.6 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. Plumbing Pumps.
 - 2. Domestic hot water recirculation system
- B. Report Forms
 - 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location

- f. Project Architect
- g. Project Engineer
- h. Project Contractor
- i. Report date
- 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Nomenclature used throughout report
 - e. Test conditions
- 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM f. Sheav
 - Sheave Make/Size/Bore
- 5. Pump Data:
 - a. Identification/number
 - b. Manufacturer
 - c. Size/model
 - d. Impeller
 - e. Service
 - f. Design flow rate, pressure drop, BHP and kW
 - g. Actual flow rate, pressure drop, BHP and kW
 - h. Discharge pressure
 - i. Suction pressure
- 6. Domestic hot water recirculation system:
 - a. Balancing valve manufacturer
 - b. Balancing valve model number
 - c. Design flow rate, pressure drop
 - d. Actual flow rate, pressure drop

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plumbing piping insulation, jackets and accessories.

B. Related Sections:

- 1. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
- 2. Section 09 90 00 Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
- 3. Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment: Execution requirements for sleeves and protective measures to be taken for the installation of insulation.
- 4. Section 22 11 00 Facility Water Distribution: Execution requirements for placement of hangers and supports specified by this section.
- 5. Section 22 13 00 Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
- 6. Section 22 14 00 Facility Storm Drainage: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement.
 - 5. ASTM C449/C449M Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - 6. ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 7. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 8. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
 - 9. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

- 10. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- 11. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- 12. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- 13. ASTM C921 Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- 14. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- 15. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- 16. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 17. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Samples: Submit two samples (1' long) of 1"closed cell foam insulation when closed cell foam insulation is to be used anywhere on project.
- D. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Pipe insulation shall have a maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Perform Work in accordance with local standards.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.
- D. Fibrous insulation such as fibreglass insulation found by architect's construction administrator to be moist or to have been exposed to wet conditions shall be removed from job site and disposed of regardless of whether insulation has been installed

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.1 MANUFACTURER

- A. Manufacturers for Glass Fiber Insulation Products:
 - 1. Knauf.
 - 2. Johns Manville.
 - 3. Owens-Corning.
 - 4. CertainTeed.
 - 5. Substitutions: Section 01 60 00 Product Requirements

2.2 CELLULAR GLASS FIBER

- A. Insulation: ASTM C547 Mineral Fiber Pipe Insulation, Type I, 850 degrees F. Conform to ASTM C795 for application on Austenitic stainless steel.
- B. Vapor Retarder Jacket:
 - 1. ASTM C921, White Kraft paper with glass fiber yarn, bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.02 perm-inches.
- C. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.
- D. Vapor Retarder Lap Adhesive:1. Compatible with insulation.
- E. Insulating Cement/Mastic:1. ASTM C195; hydraulic setting on mineral wool.
- F. Glass Fiber Fabric:
 - 1. Cloth: Untreated; 9 oz/sq yd weight.
 - 2. Blanket: 1.0 lb/cu ft density.
- G. Indoor Vapor Retarder Finish:
 - 1. Vinyl emulsion type acrylic, compatible with insulation, white color.
- H. Outdoor Vapor Retarder Mastic:
 - 1. Product Description: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- I. Outdoor Breather Mastic:
 - 1. Product Description: Vinyl emulsion type, black acrylic or mastic, compatible with insulation.
- J. Insulating Cement:
 - 1. ASTM C449

K. Cellular glass fiber shall have a flame spread index of 25 or less and a developed smoke index of 50 or less when tested in accordance with ASTM E 84.

2.3 PIPE INSULATION JACKETS

- A. PVC Plastic Jacket:
 - 1. Manufacturers:
 - a. Knauf: Model Proto
 - b. Johns Manville International
 - c. Ceelco
 - d. Substitutions: Section 01600 Product Requirements.
 - 2. Product Description: ASTM D1784, One piece molded type fitting covers and sheet material, off-white color
 - 3. Minimum Service Temperature: -40 degrees F.
 - 4. Maximum Service Temperature: 150 degrees F.
 - 5. Moisture Vapor Transmission: ASTM E96; 0.002 perm-inches.
 - 6. Thickness: 10 mil.
 - 7. Connections: Brush on welding adhesive.
 - 8. PVC jacketing shall have a flame spread index of 25 or less and a developed smoke index of 50 or less when tested in accordance with ASTM E 84.
- B. Aluminum Pipe Jacket: ASTM B209 formed aluminum sheet.
 - 1. Thickness: 0.016 inch thick sheet.
 - 2. Finish: Smooth.
 - 3. Joining: Longitudinal slip joints and 2 inch laps.
 - 4. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
 - 5. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.

2.4 PIPE INSULATION ACCESSORIES

- A. Vapor Retarder Lap Adhesive: Compatible with insulation.
- B. Covering Adhesive Mastic: Compatible with insulation.
- C. Piping 1-1/2 inches diameter and smaller: Galvanized steel insulation protection shield. MSS SP-69, Type 40. Length: Based on pipe size and insulation thickness.
- D. Piping 2 inches diameter and larger: Wood insulation saddle, hard maple. Inserts length: not less than 6 inches long, matching thickness and contour of adjoining insulation.
- E. Adhesives: Compatible with insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify piping and equipment has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION - PIPING SYSTEMS

- A. Piping Exposed to View in Finished Spaces: Locate insulation and cover seams in least visible locations.
- B. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07 84 00 for penetrations of fire resistance rated assemblies.
- C. Piping Systems Conveying Fluids Below Ambient Temperature:
 - 1. Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies (not including booster pumps), and expansion joints.
 - 2. Furnish factory-applied or field-applied vapor retarder jackets. Secure factoryapplied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
 - 3. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers.
- D. Hot Piping Systems less than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Do not insulate unions and flanges at equipment, but bevel and seal ends of insulation at such locations.
- E. Hot Piping Systems greater than 140 degrees F:
 - 1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 - 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.
 - 3. Insulate flanges and unions at equipment.

- F. Inserts and Shields:
 - 1. Piping 1-1/2 inches Diameter and Smaller: Install galvanized steel shield between pipe hanger and insulation.
 - 2. Piping 2 inches Diameter and Larger: Install insert between support shield and piping and under finish jacket.
 - a. Insert Configuration: Minimum 6 inches long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 - b. Insert Material: Compression resistant insulating material suitable for planned temperature range and service.
 - 3. Piping Supported by Roller Type Pipe Hangers: Install galvanized steel shield between roller and inserts.
- G. Insulation Terminating Points:
 - 1. Coil Branch Piping: water piping and associated components up to coil connection.
 - 2. Condensate Piping: Insulate entire piping system and components to prevent condensation.
- H. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.
- I. Piping Exterior to Building: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal piping.
- J. Buried Piping: Insulate only where insulation manufacturer recommends insulation product may be installed in trench, tunnel or direct buried. Install factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 1 mil thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with polyester film.
- K. Heat Traced Piping Interior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer.
- L. Heat Traced Piping Exterior to Building: Insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size insulation large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water.
- M. Prepare exposed pipe insulation for finish painting. Refer to Section 09 90 00.
- N. Apply Plenum Fire Wrap to plastic piping located in supply, return, transfer or exhaust plenum.

1.

3.3 SCHEDULES

- A. Domestic Hot Water Supply:
 - Cellular Glass Insulation:
 - a) Pipe Size Range: $\frac{1}{2}$ 6 inch
 - b) Thickness: 1 inch
- B. Domestic Hot Water Re-circulation:
 - 1. Cellular Glass Insulation:
 - a) Pipe Size Range: $\frac{1}{2}$ 6 inch
 - b) Thickness: 1 inch
- C. Domestic Cold Water Metallic Piping:
 - 1. Cellular Glass Insulation:
 - a) Pipe Size Range: ¹/₂ to 2 inch
 - (1) Thickness: $\frac{1}{2}$ inch
 - b) Pipe Size Range: $2\frac{1}{2}$ 6 inch
 - (1) Thickness: 1 inch
- D. Domestic Cold Water Non-Metallic Piping: 1. Insulation not required.
- E. Plumbing Vents Within 10 feet of Exterior:
 - 1. Cellular glass fiber:
 - a) Thickness: 1 inch

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Buried domestic water piping.
- 2. Domestic water piping, above grade.
- 3. Unions and flanges.
- 4. Valves.
- 5. Relief valves.
- 6. Recessed valve box.
- 7. Hydrants.
- 8. Backflow preventers.
- 9. Water hammer arresters.
- 10. Diaphragm-type compression tanks.
- 11. Pressure gages.
- 12. Pressure gage taps.
- 13. Thermostats.
- 14. Piping Expansion.
- 15. Circuit Setter.
- 16. Thermostatic mixing valves.
- B. Related Sections:
 - 1. Section 03 30 00 Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
 - 2. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
 - 3. Section 08 31 13 Access Doors and Frames: Product requirements for access doors for placement by this section.
 - 4. Section 09 90 00 Painting and Coating: Product and execution requirements for painting specified by this section.
 - 5. Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 6. Section 22 05 53 Identification for Plumbing Piping and Equipment: Product requirements for pipe identification and valve tags for placement by this section.
 - 7. Section 22 07 00 Plumbing Insulation: Product and execution requirements for pipe insulation.
 - 8. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.
 - 9. Section 31 05 13 Soils for Earthwork: Soils for backfill in trenches.
 - 10. Section 31 05 16 Aggregates for Earthwork: Aggregate for backfill in trenches.

- 11. Section 31 23 16 Excavation: Product and execution requirements for excavation and backfill required by this section.
- 12. Section 31 23 17 Trenching: Execution requirements for trenching required by this section.
- 13. Section 31 23 23 Fill: Requirements for backfill to be placed by this section.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI Z21.22 Relief Valves for Hot Water Supply Systems.
- B. American Society of Mechanical Engineers:
 - 1. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
 - 3. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 4. ASME B31.9 Building Services Piping.
 - 5. ASME B40.1 Gauges Pressure Indicating Dial Type Elastic Element.
 - 6. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.
 - 7. ASME Section IX Boiler and Pressure Vessel Code Welding and Brazing Qualifications.
- C. American Society of Sanitary Engineering:
 - 1. ASSE 1010 Performance Requirements for Water Hammer Arresters.
 - 2. ASSE 1011 Performance Requirements for Hose Connection Vacuum Breakers.
 - 3. ASSE 1012 Performance Requirements for Backflow Preventer with Intermediate Atmospheric Vent.
 - 4. ASSE 1013 Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers.
 - 5. ASSE 1019 Performance Requirements for Vacuum Breaker Wall Hydrants, Freeze Resistant, Automatic Draining Type.
 - 6. ASSE 5013 Performance Requirements for Reduced Pressure Principle Backflow Preventers (RP) and Reduced Pressure Fire Protection Principle Backflow Preventers (RFP).
 - 7. ASSE 5015 Performance Requirements for Testing Double Check Backflow Prevention Assemblies (DC) and Double Check Fire Protection Backflow Prevention Assemblies (RPDF).
- D. ASTM International:
 - 1. ASTM A53/A53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM A395/A395M Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - 4. ASTM A536 Standard Specification for Ductile Iron Castings.
 - 5. ASTM B32 Standard Specification for Solder Metal.

- 6. ASTM B42 Standard Specification for Seamless Copper Pipe, Standard Sizes.
- 7. ASTM B88 Standard Specification for Seamless Copper Water Tube.
- 8. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications.
- 9. ASTM E1 Standard Specification for ASTM Thermometers.
- 10. ASTM E77 Standard Test Method for Inspection and Verification of Thermometers.
- 11. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
- 12. ASTM D 1784 Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
- 13. ASTM D 2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics.
- 14. ASTM D 2846 Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot and Cold Water Distribution Systems.
- 15. ASTM D 6394 Specification for Sulfone Plastics (SP).
- 16. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- 17. ASTM E 119 Standard Test Methods for Fire Tests of Building Construction and Materials.
- 18. ASTM E 814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- 19. ASTM F441 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Schedules 40 and 80.
- 20. ASTM F439 Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
- 21. ASTM F493 Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- 22. ASTM F656 Standard Specification for Primers for Use In Solvent Cement Joints of Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
- 23. ASTM F 876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing.
- 24. ASTM F 877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
- 25. ASTM F 1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
- E. American Welding Society:
 - 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
- F. American Water Works Association:
 - 1. AWWA C104 American National Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
 - 2. AWWA C105 American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - 3. AWWA C110 American National Standard for Ductile-Iron and Grey-Iron Fittings, 3 in. through 48 in. (75 mm through 1200 mm), for Water and Other Liquids.

- 4. AWWA C111 American National Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
- 5. AWWA C151 American National Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
- 6. AWWA C651 Disinfecting Water Mains.
- 7. AWWA C904 Standard for Cross-linked Polyethylene (PEX) Pressure Pipe, 1/2 in. Through 3 in., for Water Service.
- G. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 67 Butterfly Valves.
 - 3. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 4. MSS SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 5. MSS SP 71 Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 6. MSS SP 78 Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 7. MSS SP 80 Bronze Gate, Globe, Angle and Check Valves.
 - 8. MSS SP 85 Cast Iron Globe & Angle Valves, Flanged and Threaded.
 - 9. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
 - 10. MSS SP 110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- H. Plumbing and Drainage Institute:
 - 1. PDI WH201 Water Hammer Arrester Standard.
- I. Underwriters Laboratories Inc.:
 - 1. UL 393 Indicating Pressure Gauges for Fire-Protection Service.
 - 2. UL 404 Gauges, Indicating Pressure, for Compressed Gas Service.
- J. NSF International
 - 1. Standard 14 Plastic Piping System Components and Related Materials.
 - 2. Standard 61 Drinking Water System Components Health Effects.
 - 3. Standard 359 Valves for Crosslinked Polyethylene (Pex) Water Distribution Tubing Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Domestic Water Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- C. Manufacturer's Installation Instructions: Submit installation instructions for pumps, valves and accessories.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves and equipment.
- C. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with latest International Plumbing Code and local municipality requirements, whichever is more stringent.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience and with service facilities within 50 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

F. CPVC and PEX tubing shall not be exposed to direct sunlight for greater than 30 days. If CPVC or PEX tubing is exposed to direct sunlight for greater than 30 days, all piping contained on pallet or shipping crate of exposed pipe shall be permanently marked and removed from the job site.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. PEX-a manufacturer system warranty shall cover piping and fittings for a duration of 25 years from the date of installation. Piping system warranty shall apply to potable water distribution and water service systems constructed of pipe and fitting products sourced from the same manufacturer.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish four loose keys for outside hose bibs and a spare cartridge for each size of thermostatic mixing valve.

PART 2 PRODUCTS

2.1 BURIED DOMESTIC WATER PIPING

- A. This section shall apply to all buried domestic water piping installed in any of the following locations.
 - 1. Below the building envelope and up to five feet away from the exterior of the building envelope.
 - 2. Where specifically called out on plans as part of this division=s work.
 - 3. The connecting piping to an item specifically called out on plans as part of this division=s work.
 - 4. Below the overhang of any building element.
- B. Ductile Iron Pipe: AWWA C151

- 1. Fittings: AWWA C110, ductile or gray iron, standard thickness.
- 2. Joints: AWWA C111, rubber gasket with rods.
- 3. Jackets: AWWA C105 polyethylene jacket.
- C. Copper Tubing: ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.18, cast copper, or ASME B16.22, wrought copper.
 - 2. Joints: Compression connection or Brazed, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- D. PEX Tubing: ASTM F876, ASTM F877, ASTM F2080 tubing shall be manufactured using PEX-a Engel method.
 - 1. Fittings: ASTM F1960, cast copper, wrought copper, cast brass or engineered plastic
 - 2. Joints: Joints shall be made by expanding PEX tubing over fitting then adding locking ring. Joints using crimp ring are not acceptable.
 - 3. Cold water tubing is to be blue, hot water and recirculated water are to be red.
 - 4. PEX tubing is allowed only above guest room ceiling from the manifold to the plumbing fixture.
 - 5. There shall be no joints in PEX tubing except at bathroom manifold and fixture rough-in.
 - 6. Stub outs: Stub outs for individual fixtures including but not limited to sinks, lavatories, water closets and shower/baths (heads, valve connections and tub spout) shall be Type L copper. Connection from copper stub out to CPVC material shall be by solvent welded connection to CPVC insert (threaded transitions are not acceptable). CPVC insert shall be factory installed. Copper stub outs and CPVC supply pipes shall be supported securely and independently. CPVC insert/Copper stub out and support shall be as manufactured by Sioux Chief Manufacturing Company or equal.

2.2 WATER PIPING, ABOVE GRADE

- A. Copper Tubing: ASTM B88 Type L, drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.
- B. CPVC Pipe: ASTM D-1784, NSF standard and 14 and 61 certified with cell class of 24448. ¹/₂" through 2" sizes shall be CPVC Copper Tube Size manufactured to standard dimension ratio (SDR) 11 conforming to ASTM D-2846. 2-1/2" through 6" sizes shall be CPVC Schedule 80 iron pipe size (IPS) conforming to ASTM F-441. CPVC piping shall be made using Flowguard Gold CPVC compound or Corzan CPVC compound.
 - 1. Fittings: CPVC with a cell class of 23447, ½" through 2" size transition fittings to copper pipe to have brass male or female connections with integral CPVC socket. 3" through 6" size socket type fittings shall conform to ASTM F-439 with transition to metal piping made using 150# flanged connections.

- 2. Joints: Joints shall be solvent welded using ASTM F-493 compliant solvent. Pipes 2-1/2" through 6" shall be primed before welding using ASTM F656 compliant primer. Pipes smaller than 2-1/2" shall be primed using ASTM F656 compliant primer unless primer is not required by manufacturer=s instructions. Connections to brass valves or equipment shall be made using solvent weld CPVCx threaded brass or copper adapters, threaded CPVC is not acceptable.
- 3. CPVC piping shall be rated for use with domestic hot water at 140°F at a pressure of 175 psig or greater.
- 4. CPVC pipe shall not be used for water piping with a design temperature above 140°F
- 5. Stub outs: Stub outs for individual fixtures including but not limited to sinks, lavatories, water closets and shower/baths (heads, valve connections and tub spout) shall be Type L copper. Connection from copper stub out to CPVC material shall be by solvent welded connection to CPVC insert (threaded transitions are not acceptable). CPVC insert shall be factory installed. Copper stub outs and CPVC supply pipes shall be supported securely and independently. CPVC insert/Copper stub out and support shall be as manufactured by Sioux Chief Manufacturing Company or equal.
- 6. All exposed hot & cold water piping exposed such as mechanical equipment rooms, kitchens, engineer's office, etc., shall be copper. Transitions from copper to CPVC shall occur within the room with the exposed piping.
- C. PEX Tubing:
 - 1. Manufactures:
 - a. Uponor.
 - b. Viega.
 - c. Substitutions: No substitutions allowed.
 - 2. ASTM F876, ASTM F877, ASTM F2080 tubing shall be manufactured using PEX-a Engel method.
 - 3. Fittings: ASTM F1960, cast copper, wrought copper, cast brass or engineered plastic
 - 4. Joints: Joints shall be made by expanding PEX tubing over fitting then adding locking ring. Joints using crimp ring are not acceptable.
 - 5. Cold water tubing is to be blue, hot water and recirculated water are to be red.
 - 6. PEX-a Fittings: elbows, adapters, couplings, plugs, tees and multi-port tees (1/2 inch through 2 inch nominal pipe size): ASTM F1960 cold-expansion fitting manufactured from the following material types:
 - a. UNS No. C69300 Lead-free (LF) Brass.
 - b. 20% glass-filled polysulfone as specified in ASTM D 6394.
 - c. Unreinforced polysulfone (group 01, class 1, grade 2) as specified in ASTM D 6394.
 - d. Polyphenylsulfone (group 03, class 1, grade 2) as specified in ASTM D 6394.
 - e. Blend of polyphenylsulfone (55-80%) and unreinforced polysulfone (rem.) as specified in ASTM D 6394.
 - f. Reinforcing cold-expansion rings shall be manufactured from the same source as PEX-a piping manufacturer and marked "F1960".

- 7. PEX-to-Metal Transition Fittings:
 - a. Manufacturers: Provide fittings from the same manufacturer of the piping.
 - b. Threaded Brass to PEX-a Transition: one-piece brass fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
 - c. Brass Sweat to PEX-a Transition: one-piece brass fitting with sweat adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- 8. PEX-to-Thermoplastic Transition Fittings: CPVC or PP-R to PEX-a Transition: one-piece thermoplastic fitting with male or female threaded adapter and ASTM F 1960 cold-expansion end, with PEX-a reinforcing cold-expansion ring.
- 9. PEX-to-PEX, Lead Free (LF) Brass Ball Valves (1/2 inch through 2 inch nominal pipe size) :
 - a. Manufacturers: Provide ball valve(s) from the same manufacturer as the piping system.
 - b. Full-port ball valve: two-piece, ASTM F1960 cold-expansion ends, with PEX-a reinforcing cold-expansion ring.
 - c. LF brass valve with a positive stop shoulder manufactured from C69300 brass.
 - d. In compliance with: 250 CWP, ANSI/NSF 359, ANSI/NSF 14/61, cNSFus-pw G lead free 0.25% Lead max., ASTM F1960, ASTM F 877.
- 10. Stub outs: Stub outs for individual fixtures including but not limited to sinks, lavatories, water closets and shower/baths (heads, valve connections and tub spout) shall be Type L copper. Connection from copper stub out to CPVC material shall be by solvent welded connection to CPVC insert (threaded transitions are not acceptable). CPVC insert shall be factory installed. Copper stub outs and CPVC supply pipes shall be supported securely and independently. CPVC insert/Copper stub out and support shall be as manufactured by Sioux Chief Manufacturing Company or equal.

2.3 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe 2 inches and Smaller:
 - 1. Ferrous Piping: Class 150, malleable iron, threaded.
 - 2. Copper Piping: Class 150 bronze unions with soldered ends.
 - 3. CPVC piping: Class 150, solvent welded
 - 4. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
 - 1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
 - 2. Copper Piping: Class 150, slip-on bronze flanges.
 - 3. CPVC piping: Class 150, solvent welded
 - 4. Gaskets: 1/16 inch thick preformed neoprene gaskets.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.4 PIPE HANGERS AND SUPPORTS

A. Provide and install per Section 220529 of this specification.

2.5 VALVES

A. Globe Valves:

1.

- Manufacturers:
 - a. Watts
 - b. Appollo.
 - c. Nibco.
 - d. Wilkens.
 - e. Substitutions: Section 016000 Product Requirements.
- 2. 2 inches and Smaller: MSS SP 80, Class 125, bronze body, bronze trim, hand wheel, Teflon disc, solder or threaded ends.
- 3. 2-1/2 inches and Larger: MSS SP 85, Class 125, iron body, bronze trim, hand wheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends.
- 4. Furnish chain-wheel operators for valves 6 inches and larger mounted over 8 feet above floor.
- B. Bronze Ball Valves:
 - 1. Manufacturers:
 - a. Watts.
 - b. Appollo.
 - c. Nibco.
 - d. Wilkens.
 - e. Substitutions: Section 016000 Product Requirements.
 - 2. 4 inches and Smaller: MSS SP 110, Class 150, 400 psi CWP, bronze, two piece body, stainless steel ball, full port, teflon seats and stuffing box ring, blow-out proof stem, solder or threaded ends with union.
- C. CPVC Ball Valves:
 - 1. Manufacturers:
 - a. Nibco.
 - b. Spears Manufacturing
 - c. Sioux Chief
 - d. Substitutions: Section 016000 Product Requirements.
 - 2. 2 inches and Smaller: Single piece CPVC body, CPVC ball, full port, teflon seats and stuffing box ring, blow-out proof stem, socket ends. Socket ends shall be per ASTM D-2846. Valves shall be NSF 61 approved.
 - 3. 2-1/2" and larger: CPVC valves are not allowed.
 - 4. Valves shall be pressure rated at a minimum of 130 psig at 140°F.
- D. Butterfly Valves:

1.

- Manufacturers:
 - a. Watts
 - b. Nibco.

- c. Wilkens.
- d. Stockham.
- e. Substitutions: Section 016000 Product Requirements.
- 2. 1-1/2 inches and Larger: MSS SP 67, cast or ductile iron body, stainless steel disc, resilient replaceable EPDM seat, grooved ends, extended neck, infinite position lever handle with memory stop
- E. Horizontal Swing Check Valves:
 - 1. Manufacturers:
 - a. Watts
 - b. Crane Valve, North America
 - c. Hammond Valve
 - d. Milwaukee Valve Company
 - e. NIBCO, Inc.
 - f. Stockham Valves & Fittings
 - g. Substitutions: Section 016000 Product Requirements.
 - 2. 2 inches and Smaller: MSS SP 80, Class 150, bronze body and cap, bronze seat, Buna-N disc, solder or threaded ends.
 - 3. 2-1/2 inches and Larger: MSS SP 71, Class 125, cast iron body, bolted cap, bronze or cast iron disc, renewable disc seal and seat, flanged ends.
- F. Spring Loaded Check Valves:
 - 1. Manufacturers:
 - a. Watts
 - b. Crane Valve, North America
 - c. Hammond Valve
 - d. Milwaukee Valve Company
 - e. NIBCO, Inc.
 - f. Stockham Valves & Fittings
 - g. Substitutions: Section 016000 Product Requirements
 - 2. 2 inches and Smaller: MSS SP 80, class 250, bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, solder or threaded ends.
 - 3. 2-1/2 inches and Larger: MSS SP 71, Class 125, globe style, cast iron body, bronze seat, center guided bronze disc, stainless steel spring and screws, flanged ends

2.6 RELIEF VALVES

- A. Manufacturers:
 - 1. Wilkins
 - 2. Watts
 - 3. Substitutions: Section 016000 Product Requirements.
- B. Pressure Relief:
 - 1. ANSI Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuate. Pressure relief valves shall be set at 125 psig.
- C. Temperature and Pressure Relief:

- 1. ANSI Z21.22 certified, bronze body, teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F, pressure relief shall be set at not more than 125 psig capacity ASME Section IV certified and labeled.
- D. Vacuum Relief:
 - 1. ANSI Z21.22 certified. The vacuum relief valve shall have all brass body and protective cap.

2.7 STRAINERS

- A. Manufacturers:
 - 1. Watts.
 - 2. Appollo.
 - 3. Nibco.
 - 4. Wilkens.
 - 5. Substitutions: Section 016000 Product Requirements
- B. 2 inch and Smaller: Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 1-1/2 inch to 4 inch: Class 125, flanged iron body, Y pattern with 1/16-inch stainless steel perforated screen.
- D. 5 inch and Larger: Class 125, flanged iron body, basket pattern with 1/8 inch stainless steel perforated screen.

2.8 WATER SUPPLY BOX (WS-1)

- A. Manufacturers:
 - 1. Oatey Model: 391xx
 - 2. Acorn
 - 3. Guy Gray
 - 4. Symmons
 - 5. Sioux Chief
 - 6. Substitutions: Section 016000 Product Requirements.
- B. Box: High impact polystyrene with 4 support brackets and snap-in face plate that accommodates up to 1" of drywall.
- C. Trim: 1/4 turn brass valve, water hammer arrestor.
- D. Provide fire rated outlet box where box is located in a rated wall.

2.9 WALL HYDRANT (DWH-1)

- A. Manufacturers:
 - 1. Zurn Model: Z-1300

- 2. Watts
- 3. Woodford
- 4. Jay R Smith
- 5. Substitutions: Section 016000 Product Requirements.
- B. Body: Anti-siphon, automatic draining, non-freeze type integral backflow preventer, bronze casing and interior parts, nickel bronze box, and hinged cover with operating key and AWATER@ cast on cover.

2.10 BACKFLOW PREVENTERS

- A. Manufacturers:
 - 1. Watts.
 - 2. Wilkens
 - 3. Ames
 - 4. Substitutions: Not allowed.
- B. Reduced Pressure Backflow Preventers:
 - 1. Comply with ASSE 1013.
 - 2. Bronze body, with bronze or stainless steel internal parts and stainless steel springs for sizes 1/4" through 2". Cast iron body with FDA approved epoxy coating, with stainless steel internal parts and stainless steel springs for sizes 2-1/2" through 10".
 - 3. Two independently operating, spring loaded check valves; diaphragm type differential pressure relief valve located between check valves; third check valve opening under back pressure in case of diaphragm failure; non-threaded vent outlet; assembled with four test cocks.
 - 4. Assembly shall include two quarter turn brass/bronze ball valves and bronze strainer for sizes 1/4" through 2". Assembly shall include FDA approved epoxy coated cast iron quarter turn ball valves and FDA approved epoxy coated cast iron strainer for sizes 2-1/2" through 10".
 - 5. Provide indirect waste connection to floor drain per manufacturer with Model AG air gap fitting.
- C. Double Check Backflow Preventers:
 - 1. Comply with ASSE 1015.
 - 2. Bronze body, with bronze or stainless steel internal parts and stainless steel springs for sizes 1/4" through 2". Cast iron body with FDA approved epoxy coating, with stainless steel internal parts and stainless steel springs for sizes 2-1/2" through 10".
 - 3. Two independently operating, spring loaded check valves; assembled with four test cocks.
 - 4. Assembly shall include two quarter turn brass/bronze ball valves and bronze strainer for sizes 1/4" through 2". Assembly shall include FDA approved epoxy coated cast iron quarter turn ball valves and FDA approved epoxy coated cast iron strainer for sizes 2-1/2" through 10".
- D. Double Check Detector Backflow Preventers:

- 1. Comply with ASSE 1048.
- 2. Ductile iron body with epoxy coating, with bronze or stainless steel internal parts and stainless steel springs.
- 3. Two independently operating, spring loaded check valves; assembled with four test cocks. Check valves shall be accessible for maintenance without removing the device from the line,
- 4. Assembly shall include two full port gate valves.
- 5. Assembly shall include metered by-pass to detect leaks and unauthorized water use. Meter shall be equipped to read gallons of water.
- E. Dual Check Backflow Preventers:
 - 1. Comply with ASSE 1024.
 - 2. Bronze body, with plastic check valves, silicone disks and stainless steel springs; assembled with three plugged test ports.
 - 3. Two independently operating, spring loaded check valves.
- F. Ice makers, Soap Dispensers, and Pool Fill Connections
 - 1. Install Wilkins Model 975XL or 975XLV or equal by Watts, sized per feed, using factory elbows where practical.
- G. Coffee Makers, Carbonated Beverage Dispensers, Tea Makers or Other Beverage Dispensers:
 - 1. Provide NSF approved dual check valve meeting ASSE 1022 and 1032, Watts SD-3 or equal.

2.11 WATER HAMMER ARRESTORS

- A. Manufacturers:
 - 1. Zurn Model Z-1700.
 - 2. Sioux Chief
 - 3. Watts
 - 4. Wilkens
 - 5. Substitutions: Section 016000 Product Requirements.
- B. ANSI 1010; copper construction, piston type sized in accordance with PDI WH-201.
- C. Pre-charged suitable for operation in temperature range -100 to 300 degrees F and maximum 350 psi working pressure.
- D. Provide on all quick-close fixture connections based on schedule and symbols provided.

2.12 DIAPHRAGM-TYPE COMPESSION TANKS

- A. Manufacturers:
 - 1. Amtrol
 - 2. Wessel
 - 3. Watts
 - 4. Armstrong

- 5. Substitutions: Section 016000 Product Requirements.
- B. Construction: Welded steel, tested and stamped in accordance with ASME Section VIII; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gage and air-charging fitting, tank drain; pre-charge to 55 psig.
- D. Size: Based on drawing details for domestic water.
- E. Accessories:
 - 1. Shut-off valve on all outlets and inlets.
 - 2. Integral thermometer on outlet.
 - 3. Integral check valves on all inlets.
 - 4. Wall brackets.
 - 5. Integral thermostatic return limiter
 - 6. Integral sight flow indicator
 - 7. Spare cartridge for each valve.
 - 8. Include locking manufacturer cabinet with hinged door.

2.13 PRESSURE GAGES

- A. Manufacturers:
 - 1. Miljoco.
 - 2. Watts.
 - 3. Wilkins.
 - 4. Substitutions: Section 01 60 00 Product Requirements
- B. Gage: ASME B40.1, with bourdon tube, rotary brass movement, brass socket, front calibration adjustment, black scale on white background.
 - 1. Case: Stainless steel.
 - 2. Bourdon Tube: Brass.
 - 3. Dial Size: 2-1/2 inch diameter.
 - 4. Mid-Scale Accuracy: Two percent.
 - 5. Scale: 0-100 Psi.
 - 6. Gage shall be UL 393 listed when used for water conveying lines.

2.14 PRESSURE GAGE TAPS

- A. Manufacturers:
 - 1. Miljoco.
 - 2. Watts.
 - 3. Wilkins.
 - 4. Substitutions: Section 01 60 00 Product Requirements
- B. Needle Valve: Brass, 1/4 inch NPT for maximum 3000 psi.

C. Pulsation Damper: Pressure snubber, brass with 1/4 inch NPT connections. Miljoco model 1200.

2.15 STEM TYPE THERMOMETERS

- A. Manufacturers:
 - 1. Miljoco.
 - 2. Substitutions: Section 01 60 00 Product Requirements
- B. Thermometer: ASTM E1, green appearing mercury, lens front tube, cast aluminum case with enamel finish and brass swivel with 1-1/8" jam nut.
 - 1. Size: 7-inch scale.
 - 2. Window: Clear glass.
 - 3. Stem: Brass, 3/4 inch NPT, 3-1/2 inch long.
 - 4. Accuracy: 1 percent.
 - 5. Calibration: Degrees F.
- 2.16 CPVC Piping Expansion Compensation
 - A. Manufacturers:
 - 1. Spears
 - 2. Substitutions: Section 01 60 00 Product Requirements
 - B. Construction: Expansion Joints shall be telescoping design with triple (3) O-ring seals, including center pressure seal and outer debris seals, and internal support piston. Maximum joint travel length shall be All Expansion Joints shall be pressure rated according to the manufacturer's specifications for water at 73° F to 235 psig for piping 2" and smaller and 150 psig for piping 2-1/2" and larger. All Expansion Joints shall be fabricated from PVC or CPVC material conforming to ASTM D 1784. All sockets shall meet the dimensional requirements of ASTM D2467.
 - 1. Maximum Joint Travel length: 6".
 - 2. O-ring seal material: EPDM.
- 2.17 Steel or Copper Piping Expansion Compensation
 - A. Manufacturers:
 - 1. Hyspan
 - 2. Substitutions: Section 01 60 00 Product Requirements
 - B. Construction: Expansion Joints
 - 1. Maximum Joint Travel length: 6".
 - 2. Maximum Axial Compression: 1".

2.18 CIRCUIT SETTER (MANUAL BALANCE VALVE)

- A. Manufacturers:
 - 1. Bell & Gossett Model "Circuit Setter Plus"
 - 2. Taco

- 3. Armstrong
- 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Valves to be designed to allow installing contractor to pre-set balance points for proportional system balance prior to system start-up in accordance with pre-set balance schedule.
- C. Valve NSF certified with less than 0.25% zero lead content for use in all domestic water systems.
- D. Construction:
 - 1. Valve to be of Lead-Free Brass body/SS ball construction with glass and carbon filled TFE seat rings.
 - 2. Valves to have differential pressure read-out ports across valve seat area. Readout ports to be fitted with internal EPT inserts/check valves. Valve bodies to have 1/4" NPT tapped drain/purge port.
 - 3. Valves to have memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position.
 - 4. All valves to have calibrated nameplates to assure specific valve settings.
 - 5. Valves shall be designed for positive shut-off.

2.19 CIRCUIT SETTER (AUTOMATIC BALANCE VALVE)

- A. Manufacturers:
 - 1. ThermOmega Model "Circuit Solver"
 - 2. Substitutions: Section 01 60 00 Product Requirements. Manual type balancing valves are not acceptable.
- B. Valve shall be self-contained and fully automatic without additional piping or control mechanisms.
- C. Valve shall be ANSI/AWWA C800 compliant and shall be NSF-61 certified with zero lead content for use in all domestic water systems.
- D. Operation:
 - 1. Valve shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.
 - 2. When fully closed Circuit Solver shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
 - 3. Valve shall be factory adjustable from 105F (40.5C) to 140F (60C) as required by project conditions. (other setpoint available, consult factory).
- E. Construction:
 - 1. Body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
 - 2. Rated to 200 PSIG maximum working pressure and 300 degrees F working temperature.

- 3. All Circuit Solvers shall be standard tapered female pipe thread, NPT.
- 4. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits. Actuator shall be rated for a minimum 200,000 cycles.

2.20 THERMOSTATIC MIXING VALVES (UNDERCOUNTER LAVATORIES)

- A. Manufacturers:
 - 1. Sloan Model: MIX-135-A
 - 2. Powers
 - 3. Acorn
 - 4. Symmons
 - 5. Leonard
 - 6. Lawyer
 - 7. Substitutions: Not allowed.
- B. Specifically designed for under-the-lavatory application. Locate tempering valve undercounter or sink bowl as high as possible to limit visibility.
- C. Valve:
 - 1. ASSE 1070 approved.
 - 2. Solid brass body, corrosion resistant internal components.
 - 3. Water temperature adjustment stem with lock nut.
 - 4. Integral check valves at hot and cold inlets.
 - 5. Mixing valve shall provide water at 105EF to lavatory faucet "hot water" supply.

2.21 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type as specified in Section 31 23 17.
- B. Cover: Fill Type as specified in Section 31 23 23.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Inserts: 1. See Section 22 05 29.
- B. Pipe Hangers and Supports:1. See Section 22 05 29.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than 6 inches below local frost line.
- C. Establish minimum separation of 18 inches from other services or in accordance with local water authority requirements, whichever is greater.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Section 31 23 16 and 31 23 17.
- F. Install pipe to elevation as indicated on Drawings.
- G. Install pipe on prepared bedding.
- H. Route pipe in straight line.
- I. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- J. Install shutoff and drain valves at locations indicated on Drawings in accordance with this Section. Coordinate with division 08 31 13.
- K. Install plastic ribbon tape continuous over top of pipe. Coordinate with Section 22 05 53.
- L. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 31 23 23.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 inches compacted layers to 12 inches minimum cover over top of jacket. Compact in accordance with Section 31 23 23 or to local water authority standard, whichever is more stringent.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.
 - 6. Establish elevations of buried piping outside the building to obtain minimum depth of 6 inches below local frost line.
 - 7. Excavate and backfill in accordance with Section 31 23 17.

3.5 INSTALLATION - ABOVE GROUND PIPING

- A. Install Work in accordance with International Plumbing Code or local plumbing authority standards, whichever is more stringent.
- B. Install non-conducting dielectric connections wherever jointing dissimilar metals. Provide and install plastic isolating grommets on all metal pipe that penetrates and routes through steel/metal framing.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.
- E. Group piping whenever practical at common elevations.
- F. Slope water piping minimum 0.25 percent and arrange to drain at low points.
- G. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- H. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 05 29.
- I. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.
- J. Establish elevations of buried piping outside the building to obtain minimum depth of 6 inches below local frost line.
- K. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- L. Provide support for utility meters in accordance with requirements of utility companies.
- M. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- N. Install water piping in accordance with ASME B31.9.
- O. Sleeve pipes passing through partitions, walls and floors. Refer to Section 22 05 29.
- P. Install unions downstream of valves and at equipment or apparatus connections.
- Q. Install valves with stems upright or horizontal, not inverted.
- R. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

- S. Install globe or balancing valves for throttling, bypass, or manual flow control services.
- T. Provide ball or lug end butterfly valves adjacent to equipment when functioning to isolate equipment.
- U. Provide spring loaded check valves on discharge of water pumps.
- V. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.
- W. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.
- X. Install water hammer arresters complete with accessible isolation valve on hot and cold water supply piping to washing machine outlets and other listed quick-closing fixtures.
- Y. Install lavatory trap primers in the same accessible cavity as lavatory shutoff. Where lavatory shutoff is exposed primer may be exposed. All non-chrome plated piping and parts downstream of shutoff shall be painted to match adjacent wall.
- Z. Install multiple trap primers a minimum of 12" above floor for every 20' of water line between trap primer and furthest floor drain. Install distribution unit level with clear plastic cover, in accessible location. Connection to water supply shall be from above such that dirt and debris in trap primer supply are minimized.
- AA. Contractor shall coordinate all core drilled, saw cut or otherwise created holes including but not limited to water risers and runouts with precast concrete plank supplier. Holes shall be coordinated with Division 034113-Precast Concrete Hollow Core Planks and located on shop drawings.
- BB. CPVC shall not be threaded with male threads. Fittings may utilize Female threads where CPVC is reinforced using factory installed permanent stainless steel bands.
- CC. PEX Pipe Joint Construction: PEX-a Connections: Install per manufacturer's recommendations. Use manufacturer-recommended cold-expansion tool for ASTM F 1960 connections.

3.6 INSTALLATION – SERVICE CONNECTIONS

- A. Provide new water service complete with approved water meter.
- B. Provide 18 gage galvanized sheet metal sleeve around service main to 6 inch above floor and 6 inches minimum below grade. Size for minimum of 2 inches of loose batt.

3.7 CLEANING

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.

- B. Disinfecting of Domestic Water.
- C. Prior to starting work, verify system is complete, flushed and clean.
- D. Verify pH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).
- E. Inject disinfectant, free chlorine in liquid, powder and tablet or gas form, throughout system to obtain residual from 50 to 80 mg/L.
- F. Bleed water from outlets to obtain distribution and test for disinfectant residual at minimum 15 percent of outlets.
- G. Maintain disinfectant in system for 24 hours.
- H. When final disinfectant residual tests less than 25 mg/L, repeat treatment.
- I. Flush disinfectant from system until residual concentration is equal to incoming water or 1.0 mg/L.
- J. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.8 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements and 01 70 00 Execution and Closeout Requirements; Field inspecting, testing, adjusting, and balancing
- B. Test piping system in accordance with National Standard Plumbing Code.

END OF SECTION

SECTION 22 13 00

FACILITY SANITARY SEWERAGE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Buried Sanitary Sewer Piping
- 2. Sanitary sewer piping above grade.
- 3. Cooling Coil Condensate Pipe
- 4. Floor drains.
- 5. Trap Guards.
- 6. Cleanouts.
- 7. Sumps.
- B. Related Sections:
 - 1. Section 03 30 00 Cast-In-Place Concrete: Execution requirements for placement of concrete specified by this section.
 - 2. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
 - 3. Section 08 31 13 Access Doors and Frames: Product requirements for access doors for placement by this section.
 - 4. Section 09 90 00 Painting and Coating: Product and execution requirements for painting specified by this section.
 - 5. Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports for placement by this section.
 - 6. Section 22 05 53 Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
 - 7. Section 22 07 00 Plumbing Insulation: Product and execution requirements for pipe insulation.
 - 8. Section 31 05 13 Soils for Earthwork: Soils for backfill in trenches.
 - 9. Section 31 05 16 Aggregates for Earthwork: Aggregate for backfill in trenches.
 - 10. Section 31 23 16 Excavation: Product and execution requirements for excavation and backfill required by this section.
 - 11. Section 31 23 17 Trenching: Execution requirements for trenching required by this section.
 - 12. Section 31 23 23 Fill: Requirements for backfill to be placed by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME A112.21.1 Floor Drains.
 - 2. ASME A112.14.1 Backwater Valves.
 - 3. ASME A112.14.3 Grease Interceptors.
 - 4. ASME A112.14.4 Grease Removal Devices.

- 5. ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings.
- 6. ASME B16.3 Malleable Iron Threaded Fittings.
- 7. ASME B16.4 Gray Iron Threaded Fittings.
- 8. ASME B16.23 Cast Copper Alloy Solder Joint Drainage Fittings (DWV).
- 9. ASME B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings DWV.
- 10. ASME B31.9 Building Services Piping.
- B. American Society for Testing and Materials:
 - 1. ASTM B88 Standard Specification for Seamless Copper Water Tube.
 - 2. ASTM B32 Standard Specification for Solder Metal.
 - 3. ASTM B42 Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - 4. ASTM B43 Standard Specification for Seamless Red Brass Pipe, Standard Sizes.
 - 5. ASTM B75 Standard Specification for Seamless Copper Tube.
 - 6. ASTM B88 Standard Specification for Seamless Copper Water Tube.
 - 7. ASTM B251 Standard Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
 - 8. ASTM B302 Standard Specification for Threadless Copper Pipe.
 - 9. ASTM B306 Standard Specification for Copper Drainage Tube (DWV).
 - 10. ASTM B584 Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 11. ASTM D1785 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.ASTM D2241 - Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - 12. ASTM D2466 Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - 13. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
 - 14. ASTM D2665 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
 - 15. ASTM D2729 Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 16. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
 - 17. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 18. ASTM F679 Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - 19. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. Cast Iron Soil Pipe Institute:
 - 1. CISPI 301 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 2. CISPI 310 Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.

- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
- E. Plumbing and Drainage Institute:
 - 1. PDI G101 Standard Testing and Rating Procedure for Grease Interceptors.

1.3 SUBMITTALS

- A. Section 01330 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sewage-ejectors, and manholes.
- C. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 3. Sanitary Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and clean-outs.
- C. Operation and Maintenance Data: Submit frequency of treatment required for interceptors. Include, spare parts lists, exploded assembly views for pumps and equipment.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with latest [International Plumbing Code][National Standard Plumbing Code] and local municipality requirements, whichever is more stringent.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Section 01 70 00 - Execution Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 BURIED SANITARY SEWER PIPING

- A. This section shall apply to all buried sanitary sewer and grease waste piping installed in any of the following locations.
 - 1. Below the building envelope and up to five feet away from the exterior of the building envelope.
 - 2. Where specifically called out on plans as part of this division's work.
 - 3. The connecting piping to an item specifically called out on plans as part of this division's work.

- 4. Below the overhang of any building element.
- B. Cast Iron Soil Pipe: ASTM A74, service weight, bell and spigot ends.
 - 1. Fittings: Cast iron, ASTM A74.
 - 2. Joints: Hub-and-spigot, CISPI HSN compression type with ASTM C564 neoprene gaskets or lead and oakum.
 - 3. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
- C. PVC Pipe: ASTM D2665 or ASTM D3034.
 - 1. Fittings: PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement, cleaner and purple primer.
 - 3. Not allowed for grease waste piping.
 - 4. Not allowed for the first 30' downstream of any kitchen waste receiving inlet. All inlets within kitchen and bar area receive kitchen waste.

2.2 SANITARY SEWER PIPING, ABOVE GRADE

- A. Cast Iron Pipe: CISPI 301, hub-less, service weight.
 - 1. Fittings: Cast iron, CISPI 301.
 - 2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
 - 3. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.
- B. PVC Pipe: ASTM D1785 Schedule 40, or ASTM 2466.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement, cleaner and purple primer.
 - 3. Reference division 220700 for insulation requirements
 - 4. Not allowed for grease waste piping.
 - 5. Not allowed for the first 30' downstream of any kitchen waste receiving inlet. All inlets within kitchen and bar area receive kitchen waste.

2.3 COOLING COIL CONDENSATE PIPE

- A. Copper Tube 1-1/4"-8": ASTM B306, hard drawn Type DWV
 - 1. Fittings: ASME B16.23, cast bronze, or ASME B16.29, wrought copper, type DWV.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.
- B. Copper Tubing 3/4"-1": ASTM B88, hard drawn, Type M.
 - 1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F.

- C. PVC Pipe: ASTM D1785 Schedule 40, or ASTM 2466.
 - 1. Fittings: ASTM D2466, PVC.
 - 2. Joints: ASTM D2855, solvent weld with ASTM D2564 Solvent cement, cleaner and colored primer.
 - 3. Reference division 220700 for insulation requirements

2.4 PIPE HANGERS AND SUPPORTS

A. Provide and install per Section 22 05 29 of this specification.

2.5 FLOOR DRAINS

- A. Manufacturers:
 - 1. Zurn Industries.
 - 2. Mifab
 - 3. Wade
 - 4. Watts
 - 5. JR Smith
 - 6. Substitutions: Not allowed.
- B. Floor Drain (FD-1): ASME A112.21.1; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and square, adjustable nickel-bronze strainer. Zurn Model Z-415-B, type "B" 6 inch diameter strainer, outlet diameter to match sanitary piping as indicated on drawings.

2.6 SANITARY SEWER TRAP PRIMER TAIL PIECE

- A. Manufacturers:
 - 1. Sioux Chief
 - 2. Substitutions: Section 01600 Product Requirements.
- B. Sanitary Sewer Trap Primers (TPS-1): Trap primer tailpiece with inverted wye type trap primer connection. Trap primer tailpiece shall be supplied in place of standard lavatory tailpiece where indicated on plans. Trap primer tailpiece shall have a ¹/₂" trap primer connection and through size of 1-1/2" or 1-1/4" as indicated on plans. Tailpiece shall have a chrome finish. The tubular connection shall be as required. Provide ¹/₂" copper tubing from tailpiece ¹/₂" outlet to floor drain trap primer connection. Trap primer tail piece shall be Sioux Chief "Trap-Ease" model 200-092 or 213-092.

2.7 TRAP GUARD

- A. Manufacture:
 - 1. ProVent Systems
 - 2. Substitutions: Section 01600 Product Requirements
- B. Alternative manufacture shall provide an ICC-ES PMG Listing compliance certificate.

2.8 CLEANOUTS

- A. Manufacturers:
 - 1. Zurn Industries.
 - 2. Mifab
 - 3. Wade
 - 4. Watts
 - 5. JR Smith
 - 6. Substitutions: Not Allowed.
- B. Exterior Surfaced Areas (YCO): Round cast nickel bronze access frame and non-skid cover. Zurn Model Z-1400-HD heavy duty.
- C. Exterior Unsurfaced Areas (YCO): Line type with lacquered cast iron body and round epoxy coated cover with gasket. Zurn Model Z-1402-HD heavy duty.
- D. Interior Finished Floor Areas (FCO): Lacquered cast iron body with anchor flange, threaded top assembly, and round scored cover with gasket in areas with no finish floor and square depressed cover with gasket to accept floor finish in finished floor areas. Top to be Nickel-Bronze. Zurn Model Z-1400-KC.
- E. Interior Finished Wall Areas (WCO): Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless steel access cover secured with machine screw. Cover is to be flat type, dimpled is not allowed, provide recessed clean out plug where cleanout fitting is exceptionally close to finished wall. Provide firestopping material behind cover in rated walls. Zurn Model Z-1441-VP.
- F. Interior Unfinished Accessible Areas (CO): Caulked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders. Zurn Model Z-1449.

2.9 FLOOR SINKS

- A. Manufacturers:
 - 1. Zurn Industries.
 - 2. Mifab
 - 3. Wade
 - 4. Watts
 - 5. JR Smith
 - 6. Substitutions: Not Allowed.
- B. Floor Sink (FS-1): 12 x 12 x 8 inch deep cast iron body and square slotted medium duty grate, with white acid resisting porcelain enamel interior and top, complete with white ABS anti-splash interior bottom dome strainer, ¹/₂ grate, and anchor flange with seepage holes and clamp collar. Zurn Model Z-1901[-KC].

2.10 BEDDING AND COVER MATERIALS

A. Bedding: Fill Type as specified in Section 31 23 17.

B. Cover: Fill Type as specified in Section 31 23 23.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Apply cleaner.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges, couplings or unions.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Inserts: 1. See Section 22 05 29.
- B. Pipe Hangers and Supports:1. See Section 22 05 29.

3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Verify connection size, location, and invert are as indicated on Drawings.
- B. Establish elevations of buried piping with not less than one ft of cover.
- C. Establish minimum separation of 18 inches from other services piping in accordance with local plumbing code.
- D. Remove scale and dirt on inside of piping before assembly.
- E. Excavate pipe trench in accordance with Section 31 23 16 and 31 23 17.
- F. Install pipe to elevation as indicated on Drawings.
- G. Install pipe on prepared bedding.
- H. Route pipe in straight line.
- I. Pipe Cover and Backfilling:1. Backfill trench in accordance with Section 31 23 23.

- 2. Maintain optimum moisture content of fill material to attain required compaction density.
- 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 inches compacted layers to 12 inches minimum cover over top of jacket. Compact in accordance with Section 31 23 17 or to local water authority standard, whichever is more stringent.
- 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
- 5. Do not use wheeled or tracked vehicles for tamping.
- 6. Establish elevations of buried piping outside the building to obtain minimum depth of 6 inches below local frost line.
- 7. Excavate and backfill in accordance with Section 31 2 317.
- J. Encase exterior cleanouts in concrete flush with grade.
- K. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum for piping 3" 6", 1/4 inch per foot for piping 2" 2-1/2", 1/16 inch per foot for piping larger than 6". Maintain gradients.
- L. Install floor cleanouts at elevation to accommodate finished floor.

3.5 INSTALLATION - ABOVE GROUND PIPING

- A. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
- D. Install piping to maintain headroom. Do not spread piping, conserve space.
- E. Group piping whenever practical at common elevations.
- F. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 05 29.
- G. Provide access where valves and fittings are not accessible. Coordinate size and location of access doors with Section 08 31 13.
- H. Install piping penetrating roofed areas to maintain integrity of roof assembly.
- I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

- J. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 90 00.
- K. Install bell and spigot pipe with bell end upstream.
- L. Sleeve pipes passing through partitions, walls and floors.
- M. Support cast iron drainage piping at every joint.
- N. Establish invert elevations, slopes for drainage to 1/8 inch per foot minimum for piping 3" 6", 1/4 inch per foot for piping 1-1/4" 2-1/2", 1/16 inch per foot for piping larger than 6". Maintain gradients. Clear waste from cooling coils or category II, III and IV gas fire appliances may be run at 1/8" per foot slope for any pipe size.
- O. All cooling and refrigeration coils are to have condensate waste piped to dump on grade with a 6" air gap or piped to another approved place of disposal. Where condensate piping is indicated on plans install as indicated.
- P. Condensate piping is to be trapped. Each trap is to be provided with a cleanout cap.
- Q. Condensate piping is to be a minimum size of 3/4" above ground.
- R. Category II, III and IV gas fired appliances which require condensate piping per manufacturers installation instructions shall be provided with an acid neutralization kit and shall be piped to a floor drain connected to the sanitary sewer system or another approved place of disposal. Where condensate piping is indicated on plans install as indicated.
- S. Air handling equipment (including but not limited to air handlers, fan coils, furnaces and cooling coils) located in attic spaces producing condensate of any kind shall have a secondary drain pan located underneath. The secondary drain pan shall be routed to a separate and easily visible location. Emergency kill switches may be omitted where a secondary drain pan and secondary piping is supplied.
- T. Contractor shall coordinate all core drilled, saw cut or otherwise created holes including but not limited to lavatory waste pipes, floor drains, tub/shower drains, and water closet waste lines with precast concrete plank supplier. Holes shall be coordinated with Division 034113-Precast Concrete Hollow Core Planks and located on shop drawings.
- U. Provide sheet metal drain pans below all waste piping located above food warming, food preparation, food display or food storage areas. Drain pans shall be a minimum of 24 gauge galvanized sheet metal and shall be a minimum of 1-1/2" deep. Drain pan shall be located under the piping (and pipe supports) and shall extend 2" beyond the footprint of pipe. Footprint of pipe shall include any support or device connected and hanging below pipe where dripping could follow support or device. Drain pans shall also extend 2" beyond the footprint of primary drain pans of equipment producing condensate located above food warming, food preparation, food display or food storage areas and shall serve as secondary drain pans for such equipment. Drain pans shall be provided with ³/₄"

indirect waste pipe which will be piped to nearest floor sink or floor drain and terminate with 2" air gap using a 90 degree elbow turned down. Indirect waste pipe is to be sloped at 1/8" per foot slope.

3.6 SCHEDULES

Plumbing System	Material
Condensate	PVC
Sanitary Waste Below Ground	PVC
Sanitary Waste Above Ground	PVC
Sanitary Vent Above Ground	PVC

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements and 01 70 00 Execution and Closeout Requirements field inspecting, testing, adjusting, and balancing.
- B. Test piping system in accordance with International Plumbing Code.

END OF SECTION

SECTION 22 14 00

FACILITY STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Downspout Boots.

B. Cleanouts Related Sections:

- 1. Section 09 90 00 Painting and Coating: Execution requirements for painting material specified by this section.
- 2. Section 22 05 29 Hangers and Supports for Plumbing Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
- 3. Section 22 05 53 Identification for Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
- 4. Section 22 07 00 Plumbing Insulation: Product and execution requirements for pipe insulation.
- 5. Section 31 05 13 Soils for Earthwork: Soils for backfill in trenches.
- 6. Section 31 05 16 Aggregates for Earthwork: Aggregate for backfill in trenches.
- 7. Section 31 23 16 Excavation: Product and execution requirements for excavation and backfill required by this section.
- 8. Section 31 23 17 Trenching: Execution requirements for trenching required by this section.
- 9. Section 31 23 23 Fill: Requirements for backfill to be placed by this section.

1.2 **REFERENCES**

- A. American Society of Mechanical Engineers:
 - 1. ASME A112.21.1M Floor Drains.
 - 2. ASME A112.21.2M Roof Drains.
 - 3. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - 1. ASTM A74 Standard Specification for Cast Iron Soil Pipe and Fittings.
 - 2. ASTM C564 Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - 3. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
 - 4. ASTM D2464 Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 5. ASTM D2564 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

- 6. ASTM D2665 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings.
- 7. ASTM D2680 Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping.
- 8. ASTM D2729 Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- 9. ASTM D2855 Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
- 10. ASTM D3034 Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- 11. ASTM F477 Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
- 12. ASTM F679 Standard Specification for Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
- 13. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. Cast Iron Soil Pipe Institute:
 - 1. CISPI 301 Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 2. CISPI 310 Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
- D. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP 70 Cast Iron Gate Valves, Flanged and Threaded Ends.
 - 4. MSS SP 71 Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - 5. MSS SP 80 Bronze Gate, Globe, Angle and Check Valves.
 - 6. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
 - 7. MSS SP 110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

- A. Section 013300 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes for sump-pumps, catch basins and manholes.
- C. Product Data:
 - 1. Storm Drainage Specialties: Submit manufacturers catalog information, component sizes, rough-in requirements, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and clean-outs.
- C. Operation and Maintenance Data: Submit spare parts lists, exploded assembly views for pumps and equipment.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with latest International Plumbing Code or local plumbing authority standard, whichever is more stringent.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 013000 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 Product Requirements: Product storage and handling requirements.
- B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 016000 - Product Requirements.

1.10 FIELD MEASUREMENT

A. Verify field measurements prior to fabrication.

- 1.11 WARRANTY
 - A. Section 017000 Execution Requirements: Product warranties and product bonds.
- 1.12 EXTRA MATERIALS
 - A. Section 017000 Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 DOWNSPOUT BOOT

- A. Manufacturers:
 - 1. Gutterworks
 - 2. Substitutions: Section 016000 Product Requirements.
- B. Construction: SDR35 PVC
- C. Inlet and outlet sizes to match drawings. Provide offset as needed.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Section 013000 Administrative Requirements: Coordination and project conditions.
 - B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements and 01 70 00 Execution and Closeout Requirements field inspecting, testing, adjusting, and balancing.
- B. Test piping system in accordance with International Plumbing Code.

END OF SECTION

SECTION 22 14 29

SUMP PUMPS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sump pumps.
- B. Related Sections:
 - 1. Section 22 13 00 Facility Sanitary Sewerage: Execution requirements for placement of hangers and supports specified by this section.
 - 2. Section 22 14 00 Facility Storm Drainage: Execution requirements for placement of hangers and supports specified by this section.

1.2 DESIGN REQUIREMENTS

- A. Design Criteria:
 - 1. Refer to schedule at end of this section.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
 - 1. Submit installation details for pumps, piping, controls and accessories including wiring schematics.
- C. Product Data: Submit data for specified Products.
- D. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with state standards.

1.6 QUALIFICATIONS

- A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.
- 1.7 DELIVERY, STORAGE AND HANDLING
 - A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
 - B. Prepare pumps and accessories for shipment to prevent entry of foreign matter into product body.
 - C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate work with other trades and utilities within construction area.

PART 2 PRODUCTS

2.1 SUMP PUMPS

A. BASIN MOUNTED SUBMERSIBLE SUMP PUMPS

- 1. Manufacturers:
 - a) Little Giant
 - b) Stancor
 - c) Zoeller
 - d) Weil
 - e) Grundfos
 - f) Myers

- g) Substitutions: Not permitted.
- 2. Type: Completely submersible, vertical, centrifugal.
- 3. Casing: Themoplastic or Cast Iron
- 4. Impeller: Vortex.
- 5. Bearings: upper and lower ball bearings.
- 6. Sump: Fiberglass or Polypropylene 22" deep basin with non-standard diamond pattern steel cover plate rated for pedestrian traffic.
- 7. Switch type: Float shall be electronic type with no moving parts
- 8. Accessories: Oil resistant 10 foot cord and plug with three-prong connector for plug in connection. 22" deep basin, high level alarm and discharge kit with check valve shall also be included.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify connections, size, and location are as indicated on Drawings.

3.2 INSTALLATION

- A. Install sump pumps in accordance with Drawings and manufacturer's instructions.
- B. Provide necessary piping, fittings, and valves as indicated on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Upon completion of installation, examine, adjust and test each pump for proper operation.
- C. Test each pump with clean water through minimum of four complete cycles. Test oil sensing ability during two of four cycles (where oil sensing is specified).

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

END OF SECTION

SECTION 22 14 30

WATER PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Recirculation Pumps

B. Related Sections:

- 1. Section 03 30 00 Cast-In-Place Concrete: Execution requirements for placement of concrete house keeping pads specified by this section.
- 2. Section 22 07 00 Plumbing Insulation: Product and execution requirements for pipe insulation.
- 3. Section: 22 11 00 Facility Water Distribution: Supply connections to domestic water heaters.
- 4. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections to equipment specified by this section.

1.2 REFERENCES

A. Underwriters Laboratories Inc.: UL 778 – Motor Operated Water Pumps

1.3 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

- 1. Submit installation details for pumps, piping, controls and accessories including wiring schematics. Indicate operating temperatures, head curves, efficiency curves and NPSH curves. Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and construction materials.
- C. Product Data: Submit data for specified Products.
- D. Manufacturer's Certificates: Certify Products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with state standards.

1.6 QUALIFICATIONS

- A. Manufacturer: company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing and protecting products.
- B. Prepare pumps and accessories for shipment to prevent entry of foreign matter into product body.
- C. Store products in areas protected from weather, moisture, or possible damage; do not store products directly on ground; handle products to prevent damage to interior or exterior surfaces. Protect systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Conduct operations not to interfere with, interrupt, damage, destroy, or endanger integrity of surface or subsurface structures or utilities, and landscape in immediate or adjacent areas.

1.9 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate work with other trades and utilities within construction area.

PART 2 PRODUCTS

- 2.1 SYSTEM LUBRICATED CIRCULATORS (Recirculation)
 - A. Manufacturers:
 - 1. Bell & Gossett
 - 2. Armstrong

- 3. Grundfos
- 4. TACO
- 5. Substitutions: None permitted.
- B. Type: Horizontal shaft, single stage, direct connected wet rotor motor for in-line mounting, for 150 psig maximum working pressure, 140 degrees F maximum water temperature.
- C. Casing: Cast bronze with flanged pump connections.
- D. Impeller: Glass filled polypropylene
- E. Shaft, Rotor: Stainless Steel.
- F. Bearings: Metal Impregnated carbon (graphite) and ceramic.
- G. Motor: Impedance protected, single speed.
- H. Disconnect: Cord and plug with three position on/auto/off switch.
- I. Aquastat: Thermostatic control preset "off" at 2 degrees F below water heater setpoint and "on" at 12 degrees F below water heater setpoint (adjustable). Thermostat shall be well mounted type and shall be recommended for installation in either horizontal or vertical position.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify connections, size, and location are as indicated on Drawings.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump independent of pump casings.
- C. Install the following piping accessories for recirculation pumps. Refer to Section 22 11 00.
 - 1. On supply:
 - a. Balancing valve
 - b. Pressure gauge
 - c. Check valve

- d. Shutoff valve.
- 2. On return:
 - a. Thermometer well and thermometer.
 - b. Pressure gauge
 - c. Shutoff valve
- D. Lubricate pumps before start-up.
- E. In-line circulators shall be installed with shaft in horizontal position.

3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Upon completion of installation, examine, adjust and test each pump for proper operation.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

END OF SECTION

SECTION 22 33 00

ELECTRIC DOMESTIC WATER HEATERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Residential electric water heaters.
- B. Related Sections:
 - 1. Section 03 30 00 Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
 - 2. Section: 22 11 00 Facility Water Distribution: Supply connections to domestic water heaters.
 - 3. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 **REFERENCES**

- A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- B. American Society of Mechanical Engineers:
 - 1. ASME PTC 25 Pressure Relief Devices.
 - 2. ASME Section VIII Boiler and Pressure Vessel Code Pressure Vessels.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, taps, and drains.
- C. Product Data: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Submit electrical characteristics and connection locations.
- D. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit replacement part numbers and availability.
- 1.5 QUALITY ASSURANCE
 - A. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1.
 - B. Perform Work in accordance with state standards.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Products storage and handling requirements.
- B. Accept water heaters on site in original labeled cartons. Inspect for damage.
- C. Protect tanks with temporary inlet and outlet caps. Maintain caps in place until installation.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.1 ELECTRIC WATER HEATERS

- A. Manufacturers:
 - 1. AO Smith
 - 2. Bradford White
 - 3. Rheem
 - 4. State
 - 5. Substitutions: Not Permitted.
- B. Type: Factory-assembled and wired, electric, vertical storage.
- C. Tank: Glass lined welded steel, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish. Maximum working pressure to be 150 psig. Stainless steel lower elements.
- D. Controls: Automatic immersion water thermostats; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
- E. Accessories: Brass water connections and dip tube, drain valve, magnesium anode, and ASME rated temperature and pressure relief valve.
- F. Expansion Tank: Provide diaphragm type expansion tank sized to limit maximum pressure to 125 psig.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over water heaters.
- B. Install tank type water heaters on concrete housekeeping pad, minimum 3-1/2 inches high and 6 inches larger than water heater base on each side. Refer to Section 03 30 00. Install instantaneous water heaters serving sinks directly under sinks or lavs unless serving emergency fixtures. Install instantaneous water heaters serving emergency fixtures with bottom of unit 9' above finished floor.
- C. Connect domestic hot water, domestic cold water piping to supply and return water heater connections.
- D. Install the following piping accessories. Refer to Section 22 11 00.
 - 1. On supply:
 - a. Shutoff valve.
 - b. Thermometer well and thermometer.
 - 2. On return:

- a. Shutoff valve.
- b. Thermometer well and thermometer.
- E. Install discharge piping from relief valves and drain valves to nearest floor drain or building exterior.
- F. Install water heater trim and accessories furnished loose for field mounting.
- G. Install electrical devices furnished loose for field mounting.

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water closets.
 - 2. Lavatories.
 - 3. Sinks.
 - 4. Electric water coolers.
- B. Related Sections:
 - 1. Section 07 90 00 Joint Protection: Product requirements for calking between fixtures and building components for placement by this section.
 - 2. Section 22 11 00 Facility Water Distribution: Supply connections to plumbing fixtures.
 - 3. Section 22 13 00 Facility Sanitary Sewerage: Waste connections to plumbing fixtures.
 - 4. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI A117.1 Accessible and Usable Buildings and Facilities.
 - 2. ANSI Z124.1 Plastic Bathtub Units.
 - 3. ANSI Z124.2 Plastic Shower Units.
 - 4. ANSI Z358.1 Emergency Eyewash and Shower Equipment.
- B. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 1010 Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.
- C. American Society of Mechanical Engineers:
 - 1. ASME A112.6.1 Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
 - 2. ASME A112.18.1 Plumbing Fixture Fittings.
 - 3. ASME A112.19.1M Enameled Cast Iron Plumbing Fixtures.
 - 4. ASME A112.19.2M Vitreous China Plumbing Fixtures.
 - 5. ASME A112.19.3 Stainless Steel Plumbing Fixtures (Designed for Residential Use).
 - 6. ASME A112.19.4 Porcelain Enameled Formed Steel Plumbing Fixtures.
 - 7. ASME A112.19.5 Trim for Water-Closet Bowls, Tanks and Urinals.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
- C. Samples: Submit one finish chip from each manufacturer of bathroom fixtures or accessories for the purpose of color coordinating finishes ie. (brushed chrome shall look the same from all manufacturers). Lavatory samples supplied by contractor will be evaluated against modular bathroom supplied lavatories by architect for compliance.
- D. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with [International Plumbing Code][National Standard Plumbing code], and local standards.
- B. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc., suitable for purpose specified and indicated.
- C. Provide plumbing fixture fittings in accordance with ASME A112.18.1 that prevent backflow from fixture into water distribution system.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 MOCKUP

A. Sample preassembled modular bathroom rough in shall be made available for inspection by Architect. Preassembled bathroom shall be furnished by modular bathroom supplier.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.
- D. Preassembled bathrooms shall be locked at all times and shall not be unlocked except while plumber installs toilet and when sprinkler installer installs sprinkler head.

1.10 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for plumbing fixtures except those supplied by modular bathroom manufacturer.

1.11 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of faucet washers for each type of faucet, two lavatory supply fittings, one flush valve service kit, and two toilet seats of each type.

PART 2 PRODUCTS

2.1 ADA FLOOR MOUNT TANK TYPE WATER CLOSETS (WC-1)

- A. Manufacturers:
 - 1. American Standard Model 215AA.104 "Cadet PRO"
 - 2. Kohler
 - 3. Toto
 - 4. Substitutions: Section 01600 Product Requirements.
- B. Bowl: ASME A112.19.2M; floor mounted, siphon jet, 100% rim flush, 2-1/8" fully glazed trapway, vitreous china, 16-1/2 inches high close-coupled closet combination with

elongated rim, insulated vitreous china closet tank with fittings and lever flushing valve, bolt caps. Flushing valve shall be polished chrome type.

- C. Flush shall be 1.28 gallons
- D. Seat: Solid white plastic, open front, extended back, self-sustaining hinge covered, brass bolts, with seat cover. Church 2155CTJ.
- E. Tank type water closets shall be gravity type or vacuum assist type. Power or pressure assisted tank type water closets are not acceptable. All tank type toilets shall flush a minimum of 1,000 grams of waste when tested in accordance with MaP testing methods as established by Veritec Consulting (in conjunction with the California Urban Water Conservation Council and Canadian Water and Wastewater Association). Compliance shall be demonstrated and published in the 9th (or later) Edition of the "Maximum Performance (MaP) Testing of Popular Toilet Models" report. A 2" flapper valve may be substituted for 3" flapper valve where tank is equipped with vacuum assist.
- F. Accessories:
 - 1. Wheel handle stop.
 - 2. Flexible supply.
 - 3. Escutcheon.
 - 4. Wax toilet ring.

2.2 LAVATORY (L-1) ADA WALL MOUNTED

- A. Manufacturers
 - 1. Kohler Model: K-1728 "Chesapeake"
 - 2. Toto
 - 3. American Standard
 - 4. Eljer
 - 5. Substitutions: Section 01600 Product Requirements.
- B. Bowl: ASME A112.19.2M; ADA compliant, oval shape, wall mount installation, front overflow, 19-1/4"x17-1/4" nominal dimensions.
- C. Provide Supply Fitting: ASME A112.18.1; ADA compliant, brushed chrome plated supply fitting with water economy aerator with maximum 2.0 gpm flow, single handle, red and blue indicators. American Standard Model: 7385.003.
- D. Accessories:
 - 1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 - 2. Grid strainer waste assembly.
 - 3. Wheel handle stops.
 - 4. Flexible supplies.
 - 5. Supplies, trap and waste insulated and offset to meet ADA regulations.
 - 6. Provide undercounter thermostatic mixing valve. Refer to speficiation section 22 11 00. Mixing valve shall provide water at 105F to lavatory faucet "hot water"
supply. Mixing valves with hand dial or wheel handle adjustment will not be accepted. Locate tempering valve undercounter or sink bowl as high as possible to limit visibility.

2.3 ELECTRIC WATER COOLERS (EWC-1)

- A. Manufacturers:
 - 1. Elkay Model EZSTL8SC.
 - 2. Halse Taylor
 - 3. Substitutions: Section 01600 Product Requirements
- B. Fountain:
 - 1. ARI 1010; Two station wall mounted high-low electric water cooler with stainless steel top, stainless steel shrouds, on steel body, elevated anti-squirt bubbler with stream guard, automatic stream regulator, front and side push rail, mounting bracket, refrigerated with integral air cooled condenser and stainless steel grille.
 - 2. Capacity: 8.8 GPH at 80 degrees F room temperature.
 - 3. Electrical: Maximum ¹/₂ hp compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.
- 2.4 MOP SINK (MS-1)
 - A. Manufacturers:
 - 1. Mustee Model: 62M
 - 2. Mustee
 - 3. Substitutions: Section 01600 Product Requirements.
 - B. Bowl: 24 x 24 x 8-1/4 inch high white molded stone, floor mounted, with one inch wide shoulders, stainless steel strainer, and stainless steel 3" drain body.
 - C. Trims: ASME A112.18.1 exposed wall type supply with lever handles, spout wall brace, vacuum breaker, hose end spout, strainers, eccentric adjustable inlets, integral screwdriver stops with covering caps and adjustable threaded wall flanges. Mustee 63.600A.
 - D. Accessories:
 - 1. 4 feet of $\frac{1}{2}$ inch diameter plain end reinforced rubber hose.
 - 2. Hose clamp hanger.
 - 3. 3 slot mop hanger.

2.5 SINK (SK-1)

- A. Manufacturers:
 - 1. Elkay Model LRAD172060
 - 2. Moen
 - 3. Sterling
 - 4. Substitutions: Section 01600 Product Requirements.

- B. Bowl: ADA compliant, Single compartment bar sink 14"x14"x5-7/8" inside, 18 gauge, type 304 stainless steel, rear center drain, drop in, fully under coated, single hole centered.
- C. Supply Faucet: ASME A112.18.1; brushed chrome plated brass gooseneck supply fitting with water economy aerator with maximum 2.2 gpm flow, 11" tall 6-7/8" reach spout, single ADA compliant handle. Symmons model SPB-3510.
- D. Accessories:
 - 1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 - 2. Wheel handle stops.
 - 3. Flexible supplies.

2.6 SINK (SK-2)

- A. Manufacturers:
 - 1. Elkay Model GECR3321.
 - 2. Moen
 - 3. Sterling
 - 4. Substitutions: Section 01600 Product Requirements.
- B. Bowl: Two Compartment 33"x21-1/4"x5-3/8", with two bowls 14"x15-3/4"x5-1/4" inside, 20 gauge, type 304 stainless steel, rear centered drain, self-rimming, fully under coated, single centered hole. Provide with badger 1 garbage disposal with dishwasher connection.
- C. Supply Faucet: ASME A112.18.1; brushed chrome plated brass gooseneck supply fitting with water economy aerator with maximum 2.2 gpm flow, 15-7/8" tall 8" reach spout, single ADA compliant handle with pull down hand spray spout and retractable hose. Hand spray to have 2 modes, standard steam and wide stream. Symmons model S-2302-PD.
- D. Accessories:
 - 1. Chrome plated 17 gage brass P-trap with clean-out plug and arm with escutcheon.
 - 2. Wheel handle stops.
 - 3. Flexible supplies.

2.7 LAVATORY INSULATION KIT

- A. Manufacturers:
 - 1. Truebro Soft Guard Plus
 - 2. Substitutions: Section 01600 Product Requirements.
- B. Product Description: Where Lavatories are noted to be insulated for ADA compliance, furnish the following: Safety Covers conforming to ANSI A177, ASTM E84, and consisting of insulation kit of molded closed cell vinyl construction, 3/16 inch thick,

white color, for insulating tailpiece, P-trap, valves, and supply piping. Furnish with weep hole and angle valve access covers.

2.8 ALTERNATE FAUCET MANUFACTURERS

- A. Alternate Manual Faucet Manufacturers
 - 1. Kohler
 - 2. American Standard
 - 3. Delta
 - 4. Moen
 - 5. Substitutions: Section 01600 Product Requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install Work in accordance with state standards.
- B. Install each fixture with trap, easily removable for servicing and cleaning.
- C. Provide chrome plated rigid or flexible supplies to fixtures with screwdriver stops, reducers, and escutcheons.
- D. Install components level and plumb.
- E. Install and secure fixtures in place with wall carriers and bolts.
- F. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 00, color to match fixture.

- G. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- H. For ADA accessible water closets, install flush valve with handle to wide side of stall.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit use of fixtures before final acceptance.

END OF SECTION

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe hangers and supports.
 - 2. Hanger rods.
 - 3. Inserts.
 - 4. Flashing.
 - 5. Equipment curbs.
 - 6. Exterior pipe supports.
 - 7. Exterior duct supports.
 - 8. Sleeves.
 - 9. Mechanical sleeve seals.
 - 10. Formed steel channel.
 - 11. Firestopping relating to HVAC work.
 - 12. Firestopping accessories.

B. Related Sections:

- 1. Section 03 10 00 Concrete Forming and Accessories: Execution requirements for placement of sleeves in concrete forms specified by this section.
- 2. Section 03 30 00 Cast-In-Place Concrete: Execution requirements for placement of concrete housekeeping pads specified by this section.
- 3. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
- 4. Section 07 90 00 Joint Protection: Product requirements for sealant materials for placement by this section.
- 5. Section 09 90 00 Painting and Coating: Product and execution requirements for painting specified by this section.
- 6. Section 23 05 48 Vibration Controls for HVAC Piping and Equipment.
- 7. Section 23 11 23 Facility Natural-Gas Piping: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.1 Power Piping.
 - 2. ASME B31.5 Refrigeration Piping.
 - 3. ASME B31.9 Building Services Piping.
- B. ASTM International:
 - 1. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.

- 2. ASTM E814 Standard Test Method for Fire Tests of Through Penetration Fire Stops.
- 3. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
- 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- C. American Welding Society: 1. AWS D1.1 - Structural Welding Code - Steel.
- D. FM Global:
 - 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 3. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.
- G. Intertek Testing Services (Warnock Hersey Listed):
 - 1. WH Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, and pipe hanger and support locations and detail of trapeze hangers.

- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with local authority and listed references.
- B. Perform work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- C. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- D. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- E. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- F. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.

- G. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.
- H. Perform Work in accordance with state standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.
 - 5. Michigan Hanger Co.
 - 6. Superior Valve Co.
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Hydronic Piping:
 - 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
 - 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Cold Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
 - 4. Hangers for Hot Pipe Sizes 2 to 4 inches: Carbon steel, adjustable, clevis.
 - 5. Hangers for Hot Pipe Sizes 6 inches and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 - 6. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches and Larger: Steel channels with welded spacers and hanger rods, cast iron roll.
 - 8. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hooks.
 - 9. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
 - 10. Wall Support for Hot Pipe Sizes 6 inches and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 - 11. Vertical Support: Steel riser clamp.
 - 12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 13. Floor Support for Hot Pipe Sizes 4 Inches and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 14. Floor Support for Hot Pipe Sizes 6 inches and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
 - 15. Copper Pipe Support: Copper-plated, carbon steel ring.
- C. Refrigerant Piping:
 - 1. Conform to ASME B31.9, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.

- 2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- 3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- 5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
- 6. Wall Support for Pipe Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp.
- 7. Vertical Support: Steel riser clamp.
- 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- 9. Copper Pipe Support: Copper-plated carbon-steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

- A. Manufacturers:
 - 1. Grinnel.
 - 2. Tolco.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

- A. Metal Flashing: 26 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 EXTERIOR PIPE SUPPORTS

- A. Manufacturers:
 - 1. MIRO
 - 2. ERICO CADDY
 - 3. Eberl Iron Works
 - 4. Substitutions: Section 01600 Product Requirements
- B. Pipes up to 3"

- 1. MIRO model: 3-RAH
- 2. A "roller-bearing" pipe support used to support roof mounted gas pipes, electrical conduit, solar piping and other mechanical piping. Unique design absorbs thermal expansion and contraction of pipes thus preventing damage to the roof membrane. Pipes rest on a self-lubricating roller which is a 304 stainless steel rod and a polycarbonate resin roller. The pipe support base is made of sturdy MIRON TPCTM or polycarbonate resin, the roller is polycarbonate and all metal parts are made of stainless steel.
- 3. The "U" shaped roller serves to keep the pipestand roller system directly beneath the pipe without binding and allows for some lateral expansion of the piping system.
- 4. The pipestand consists of two major components: (1) A one-piece polycarbonate resin roof deck base, (2) A roller made of polycarbonate resin and a stainless steel rod which rests in an adjustable height roller housing connected with 1/2" diameter stainless steel all thread on the base. Carbon black is added to the MIRON TPCTM and polycarbonate resin for UV resistance and protection.

2.6 EXTERIOR DUCT SUPPORTS

- A. Manufacturers:
 - 1. ERICO CADDY H-Frame Series
 - 2. MIRO Industries
 - 3. Eberl Iron Works
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Construction:
 - 1. Unit shall be manufactured from UV stabilized polypropylene and polyethylene.
 - 2. Bottom of base shall provided with a foam pad that offers low abrasion interface.
 - 3. Unit shall be constructed in a manor to evenly distribute the weight across the entire footprint go the HVAC unit.
 - 4. Provide all channel and hardware required for complete installation. All channel and hardware shall be hot-dip galvanized.

2.7 SLEEVES

- A. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sleeves for Rectangular Ductwork: Galvanized steel.
- E. Sealant for non-rated penetrations: Acrylic refer to Section 07 90 00.

2.8 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.9 FORMED STEEL CHANNEL

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Galvanized 12 gage) thick steel. With holes 1-1/2 inches on center.

2.10 FIRESTOPPING

- A. Manufacturers:
 - 1. 3M Fire Protection Products.
 - 2. Nelson Firestop Products.
 - 3. Johns Manville
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Materials:
 - 1. Caulk: CP25 (must be brick red)
 - 2. Wrap/Strip: FS-195
 - 3. Collar: RC-1
 - 4. Composite Sheet: CS-195
 - 5. Fire Barrier Moldable putty.
 - 6. Fire Dam Spray
- C. Provide details per Section 07 84 00 of this specification.

2.11 FIRESAFING

- A. Manufacturer
 - 1. USG Acoustical Products
- B. Materials
 - 1. 4 inch mineral fiber stuffing insulation

- 2. Density: 4 lb/cu ft.
- C. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Single component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- D. Color: Brick Red as selected from manufacturer's full range of colors.

2.12 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where piping is exposed.
 - 2. For exterior wall openings below grade, furnish mechanical sealing device to continuously fill annular space between piping and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - INSERTS

- A. Install inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted, drill through concrete slab from below and provide throughbolt with recessed square steel plate and nut above, flush with top of or recessed into and grouted flush with slab. Obtain permission from Architect before determining method of installing support when inserts are omitted.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with manufacturers' recommendation and this specification.
- B. Support horizontal piping as scheduled.

- C. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Use hangers with 1-1/2 inch minimum vertical adjustment.
- F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.
- G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- H. Support riser piping independently of connected horizontal piping.
- I. Provide copper plated hangers and supports for copper piping.
- J. Design hangers for pipe movement without disengagement of supported pipe.
- K. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- L. Provide clearance in hangers and from structure and other equipment for installation of insulation. Refer to Section 22 07 00.

3.5 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Flash vent and soil pipes projecting 6 inches minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inches minimum clear on sides with 24 x 24 inches sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.
- C. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
- D. Seal floor, shower, and mop sink drains watertight to adjacent materials.
- E. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach Counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.
- F. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Set sleeves in position in forms. Provide reinforcing around sleeves.
- C. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- D. Extend sleeves through floors 2 inches above finished floor level. Caulk sleeves.
- E. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with approved firestopping system. Provide close fittings metal collar are escutcheon at both sides of penetration.
- F. Install chrome plated steel escutcheons at finished surfaces.

3.7 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating to uniform density and texture.
- D. Compress fibered material to maximum 40 percent of its uncompressed size.
- E. Place intumescent coating in sufficient coats to achieve rating required.
- F. Dam material to remain if non-combustible. Dam material to remove if combustible.
- G. Fire Rated Surface:

1.

- Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- H. Non-Rated Surfaces:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

- b. Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - Install type of firestopping material recommended by manufacturer.
- 2. Install escutcheons floor plates or ceiling plate where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
- 3. Exterior wall openings below grade: Assemble rubber links of mechanical sealing device to size of piping and tighten in place, in accordance with manufacturer's instructions.
- 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.8 FIELD QUALITY CONTROL

c.

- A. Section 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.9 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.10 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 23 05 48

VIBRATION CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vibration isolators.

B. Related Sections:

- 1. Section 03 30 00 Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
- 2. Section 07 90 00 Joint Protection: Product requirements for joint sealers specified for placement by this section.
- 3. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports.
- 4. Section 23 05 93 Testing, Adjusting, and Balancing for HVAC: Requirements for sound and vibration measurements performed independent of this section.
- 5. Section 23 33 00 Air Duct Accessories: Product requirements for both solid and flexible duct connectors for duct sound attenuators specified for placement by this section.

1.2 INTENT

- A. All mechanical equipment, piping and ductwork as noted on the equipment schedule or in the specification shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections.
- B. All isolators and isolation materials shall be of the same manufacturer and shall be certified by the manufacturer.
- C. It is the intent of the seismic portion of this specification to keep all mechanical and electrical building system components in place during a seismic event.
- D. All such systems must be installed in strict accordance with seismic codes, component manufacturers and building construction standards. Whenever a conflict occurs between the manufacturers or construction standards, the most stringent shall apply.
- E. This specification is considered to be minimum requirements for seismic consideration and is not intended as a substitute for legislated, more stringent, national, state or local construction requirements.

1.3 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI S1.13 Methods for the Measurement of Sound Pressure Levels in Air.
 - 2. ANSI S12.36 Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- B. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 575 Method of Measuring Machinery Sound within Equipment Space.
- C. American Society of Heating, Refrigerating and:
 - 1. ASHRAE 68 Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - 2. ASHRAE Handbook HVAC Applications.
- D. ASTM International:
 - 1. ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - 2. ASTM E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
 - 3. ASTM E596 Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.
- E. Sheet Metal and Air Conditioning Contractors Association:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.4 DEFINITIONS

- A. Life Safety:
 - 1. All systems involved with fire protection including sprinkler piping, fire pumps, jockey pumps, fire pump control panels, service water supply piping, water tanks, fire dampers and smoke exhaust systems.
 - 2. All systems involved with and/or connected to emergency power supply including all generators, transfer switches, transformers and all flow paths to fire protection and/or emergency lighting systems.
 - 3. All medical and life support systems.
 - 4. Fresh air relief systems on emergency control sequence including air handlers, conduit, duct, dampers, etc.

1.5 PERFORMANCE REQUIREMENTS

- A. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.
- B. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by ASHRAE Handbook., HVAC Applications:
 - 1. Offices
 - a. Executive: 30

- b. Conference rooms: 30
- c. Private: 30
- d. Open-plan areas: 35
- e. Computer/business machine areas: 40
- f. Public circulation: 40

1.6 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data, pressure losses, and acoustical performance for standard sound attenuation products.
 - 2. Detailed schedules of flexible and rigidly mounted equipment, piping, duct and conduit showing vibration isolators and seismic restraints by referencing numbered descriptive drawings.
- C. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.
- D. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

1.7 MANUFACTURER'S RESPSONSBILITY

- A. Manufacturer of vibration isolation and seismic control equipment shall have the following responsibilities as a minimum:
 - 1. Determine vibration isolation and seismic restraint sizes and locations.
 - 2. Provide vibration isolation and seismic restraints as scheduled or specified.
 - 3. Provide calculations and materials if required for restraint of un-isolated equipment.
 - 4. Provide installation instructions, drawings and trained field supervision to insure proper installation and performance.

1.8 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

1.9 QUALITY ASSURANCE

A. Perform Work in accordance with ANSI and ASHRAE standards.

1.10 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.
- C. Design application of seismic restraints under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State of the Project.

1.11 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

1.12 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.13 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

- 2.1 GENERAL
 - A. All vibration isolators described in this section shall be the product of a single manufacturer.
 - B. For the purposes of this project, failure is defined as the discontinuance of any attachment point between equipment or structure, vertical permanent deformation greater than 1/8" (3mm) and/or horizontal permanent deformation greater than 1/4" (6mm).
 - C. Manufacturers:
 - 1. Mason Industries
 - 2. Kinetics Noise
 - 3. Amber/Booth
 - 4. Vibration Mountings and Controls
 - 5. Substitutions: No substitutions allowed.

2.2 VIBRATION ISOLATORS

- A. Curb Mounted Vibration Isolation Rail:
 - 1. Curb-Mounted Spring Rail: Full-perimeter rail type isolator, spring components shall be 2"/51 mm deflection, free-standing, un-housed, laterally stable steel springs. Springs shall have a lateral stiffness greater than 1.0 times the rated vertical stiffness and shall be designed for 50% overload to solid. The spring element shall meet all the specified characteristics described in Section 2.01/E.1 paragraph. Springs shall be color coded to indicate load capacity.

- 2. Rails shall provide continuous support for the rooftop equipment and shall be designed to provide isolation against casing-radiated vibration in the rooftop equipment housing and structure-borne vibration from rotating and mechanical equipment in the rooftop package. Rail assembly shall consist of extruded aluminum top and bottom members connected by spring isolators and a continuous air- and water-tight seal.
- 3. Rail assemblies shall incorporate means for attachment to the building and the supported equipment and shall incorporate additional stiffening members if necessary to assure stability. Rails shall be fitted with wind restraint devices suitable for prevailing wind conditions that will <u>not</u> impose loads on the curb walls at 90 degrees to their long axis. Vibration isolators shall be selected by the manufacturer for each specific application to comply with deflection requirements as indicated on the project documents.
- 4. The seal shall be a beaded elastomeric material retained in a keyway along the top extrusion. The weather strip shall be sealed along the bottom with an aluminum fascia strip.
- 5. Vibration Isolation Rail be Model KSR as manufactured by Kinetics Noise Control.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
 - B. Verify equipment, ductwork and piping is installed before work in this section is started.

3.2 INSTALLATION

- A. Contractor shall supply supplementary support steel for all equipment, piping, ductwork, etc. including roof mounted equipment, as required and/or specified to provide a complete code compliant system.
- B. Install isolation for motor driven equipment.
- C. Install spring hangers without binding.
- D. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.
- E. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- F. All vibration isolator systems must be installed in strict accordance with the manufacturers written instructions and all certified submittal data.

- G. Installation of vibration isolators must not cause any change of position of equipment, piping or ductwork resulting in stresses or misalignment.
- H. No rigid connections between equipment and the building structure shall be made that degrades the noise and vibration control system herein specified.
- I. The contractor shall not install any equipment, piping, duct or conduit which makes rigid connections with the building unless isolation is not specified. ABuilding@ includes, but is not limited to, slabs, beams, columns, studs and walls.
- J. Coordinate work with other trades to avoid rigid contact with the building.
- K. Any conflicts with other trades which will result in rigid contact with equipment or piping due to inadequate space or other unforeseen conditions should be brought to the architects/engineers attention prior to installation. Corrective work necessitated by conflicts after installation shall be at the responsible contractor's expense.
- L. Bring to the architects/engineers attention any discrepancies between the specifications and the field conditions or changes required due to specific equipment selection, prior to installation. Corrective work necessitated by discrepancies after installation shall be at the responsible contractor's expense.
- M. Correct, at no additional cost, all installations which are deemed defective in workmanship and materials at the contractor's expense.
- N. Air handling equipment and centrifugal fans shall be protected against excessive displacement which results from high air thrust in relation to the equipment weight.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements and 01 70 00 Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect isolated equipment after installation and submit report. Include static deflections.

END OF SECTION

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Tags.
 - 3. Stencils.
 - 4. Pipe markers.
 - 5. Labels.
 - 6. Lockout devices.
- B. Related Sections:
 - 1. Section 09 90 00 Painting and Coating: Execution requirements for painting specified by this section.

1.2 **REFERENCES**

- A. American Society of Mechanical Engineers:
 - 1. ASME A13.1 Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification and valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of tagged valves; include valve tag numbers.

1.5 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

- 2.1 NAMEPLATES
 - A. Manufacturers:
 - 1. Craftmark Identification Systems
 - 2. Brimar
 - 3. Safety Sign Co.
 - 4. Seton Identification Products
 - 5. Substitutions: Section 01 60 00 Product Requirements
 - B. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color. Where specific color scheme is required by local code the local color scheme shall be followed.
 - C. Nameplates identifying equipment shall match tag in equipment schedule and shall also contain a description of equipment such as "P-1" "110°F HW Recirculation Pump". The tag shall be in 1-3/4" high letters and the description shall be in $\frac{1}{2}$ " letters.

2.2 TAGS

A. Metal Tags:

- 1. Manufacturers:
 - a. Same as Nameplates
- 2. Brass or Aluminum with stamped letters; tag size minimum 1-1/2 inches diameter/square with finished edges. Hot water to have square tags, all others to be round.
- B. Information Tags:

1.

- Manufacturers:
 - a. Same as Nameplates
- 2. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches with grommet and self-locking nylon ties.
- C. Tag Chart: Typewritten letter size list of applied tag numbers, valve size, fluid conveyed, room numbers served (if water) and valve location in anodized aluminum frame plastic laminated. Locate valve list in mechanical room directly above or adjacent to water entry.

2.3 STENCILS

- A. Manufacturers:
 - 1. Same as Nameplates.
- B. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches Outside Diameter of Insulation or Pipe: 1/2 inch high letters.
 - 2. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1-inch high letters.
 - 3. Over 6 inches Outside Diameter of Insulation or Pipe: 1-3/4 inches high letters.
 - 4. Equipment (where not labeled with plastic tags): 1-3/4 inches high letters.
- C. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

- A. Color and Lettering: Conform to ASME A13.1.
- B. Plastic Pipe Markers:
 - 1. Manufacturers:
 - a. Same as Nameplates.
 - 2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.
- C. Plastic Tape Pipe Markers:
 - 1. Manufacturers:
 - a. Same as Nameplates.
 - 2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
- D. Underground Pipe Markers:
 - 1. Manufacturers:

- a. Same as Nameplates.
- 2. Bright colored continuously printed plastic ribbon tape with aluminum foil core, minimum 6 inches wide by 4.5 mil thick, manufactured for direct burial service.
- 3. Tape shall be colored to APWA color code.
- 4. Tape shall be detectable to a depth of 10'.
- Taper marker shall comply with DOT Office of Pipeline Safety USAS B31.8, NTSB PSS-73-1, API RP1109, GSA Public Buildings Service Guide, American Gas Association 72-D-56, OSHA 1926.956 (c)(1) and Federal Gas Safety Regulation S 192-321 (e)

2.5 LABELS

- A. Manufacturers:
 - 1. Same as Nameplates.
- B. Description: Aluminum, size 1.9 x 0.75 inches, adhesive backed with printed identification.

2.6 LOCKOUT DEVICES

- A. Lockout Hasps:
 - 1. Manufacturers:
 - a. Idesco
 - b. Brady
 - c. Reese Safety Products
 - d. Substitutions: Section 01 60 00 Product Requirements
 - 2. Anodized aluminum hasp with erasable label surface; size minimum $7-1/4 \ge 3$ inches.
- B. Valve Lockout Devices:
 - 1. Manufacturers:
 - a. Same as Lockout Hasps
 - 2. Steel device preventing access to valve operator, accepting lock shackle.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 INSTALLATION

- A. Apply stencil painting in accordance with Section 09 90 00.
- B. Install identifying devices after completion of coverings and painting.

- C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.
- D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.
- E. Install tags using corrosion resistant chain. Number tags consecutively by location.
- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe. All underground pipes shall be marked using underground pipe marker tape, there shall be no exceptions for marking underground pipe except irrigation piping under 1" in nominal size. Installation of pipe markers shall extend to the limits of the site. Reference Civil plans for the extent of site and site piping. Coordinate with site contractor for location of site piping.
- G. Identify air handlers, heat exchangers, fan coils, rooftop units, condensing units, condensers and boilers with plastic nameplates. Small pumps or mixing valves may have labels adjacent item with an arrow pointing toward item or may have a large brass tag with identifying information "including description" stamped into it and affixed to item with a chain.
- H. Identify valves in main and branch piping with tags. All shutoff valves unless they are within 5' of equipment they serve shall have a tag.
- I. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service and flow direction for all pipes. For fuel gas piping identify nominal pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each floor penetration.
- J. Tag automatic controls, instruments, and relays. Key to control schematic.
- K. Identify ductwork with stenciled painting. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.
- L. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.
- M. Identify air terminal units and radiator valves with numbered tags.
- N. All exposed fuel gas pipe and pipe fittings (elbows, tees, weld-o-lets, etc.) shall be painted yellow unless otherwise directed by local code. Paint shall not cover any gauges or pressure ports nor shall paint effect the operation of the fuel gas delivery system. Painting of fuel gas piping is not required in boiler rooms, electrical rooms, elevator machinery rooms nor sprinkler rooms. Hangers and supports of gas pipe shall be painted the color of the element being used for support. Apply paint in compliance with Section 09 90 00.

- O. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe. All underground pipes shall be marked using underground pipe marker tape, there shall be no exceptions for marking underground pipe except hydronic piping cast into slabs as part of a snow melting system. Installation of pipe markers shall extend to the limits of the site. Reference Civil plans for the extent of site and site piping. Coordinate with site contractor for location of site piping.
- P. Gas Piping serving a fuel gas generator shall be labeled "Emergency Generator Fuel Line" in place of standard fuel gas labeling.
- Q. Where a natural gas fired emergency generator is supplied by a dedicated fuel line there shall be nameplate in yellow with black lettering labeling the pipe "NATURAL GAS FOR EMERGENCY GENERATOR" visible from meter. Also visible from the meter shall be a nameplate in yellow with black lettering labeling any other pipes from the meter "NATURAL GAS FOR GENERAL USE". All lettering is to be 1-3/4" tall.

END OF SECTION

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Testing, adjusting, and balancing of air systems.
 - 2. Measurement of final operating condition of HVAC systems.
- B. Related Sections:
 - 1. Section 23 05 48 Vibration Controls for HVAC Piping and Equipment.
 - 2. Section 23 09 93 Sequence of Operations for HVAC Controls: Sequences of operation for HVAC equipment.

1.2 REFERENCES

- A. Associated Air Balance Council:
 - 1. AABC MN-1 National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 111 Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. Natural Environmental Balancing Bureau:
 - 1. NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Prior to commencing Work, submit proof of latest calibration date of each instrument.
- C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms or forms prepared following ASHRAE 111 or NEBB Report. Results of "light tests" shall be written up as a letter to the Architect/Engineer on company letterhead with the signatures of the code official who witnessed tests as well as the individual who conducted test.
- D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

- E. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty or Copy of NEBB Certificate of Conformance Certification
- F. Submit draft copies of report for review prior to final acceptance of Project.
- G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of flow measuring stations and balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with state standards.
- B. Perform Work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance or ASHRAE 111 or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems.

1.6 QUALIFICATIONS

- A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum three years documented experience by certified by AABC or Certified by NEBB.
- B. Agency shall be 100% independent of any affiliations with general or installing contractors, manufactures, or design engineers.
- C. Perform Work under supervision of AABC Certified Test and Balance Engineer or NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 SEQUENCING

- A. Section 01 10 00 Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.9 SCHEDULING

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Schedule and provide assistance in final adjustment and test of life safety systems with Fire Authority.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01300 Administrative Requirements: Coordination and project conditions.
- B. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper T&B of systems and equipment.
- C. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Note the locations of devices that are not accessible for testing and balancing.
- D. Examine the approved submittals for HVAC systems and equipment.
- E. Examine ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that are properly separated from adjacent areas. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
- G. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, clean permanent filters are installed, and equipment with functioning controls is ready for operation.

- H. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected, configured by the controls contractor, and functioning.
- I. Examine strainers to verify that mechanical contractor has replaced startup screens with permanent screens and that all strainers have been cleaned.
- J. Examine two-way valves for proper installation and function.
- K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- M. Examine air vents to verify that mechanical contractor has removed all air from all hydronic systems.

3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Prepare a T&B plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- C. Prepare system-readiness checklists for use by systems installers in verifying system readiness for T&B. These shall include, at a minimum, the following:
 - 1. Airside:
 - a. Ductwork is complete with terminals installed.
 - b. Air terminals are installed.
 - c. Volume, smoke and fire dampers are open and functional.
 - d. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - e. Fans are operating, free of vibration, and rotating in correct direction.
 - f. Variable-frequency controllers' start-up is complete and safeties are verified.
 - g. Fire, smoke and volume dampers are in place, open and functional.
 - h. Air coil fins are cleaned and combed.
 - i. Access doors are closed and duct end caps are in place.
 - j. Automatic temperature control systems are operational.
 - k. Ceilings are installed.
 - 1. Windows and doors are installed.
 - m. Suitable access to balancing devices and equipment is provided.
 - n. Proper thermal overload protection is in place for electrical equipment.
 - o. Duct system leakage is minimized.

- 2. Hydronics:
 - a. Piping is complete with terminals installed.
 - b. Water treatment is complete.
 - c. Systems are flushed, filled and air purged.
 - d. Strainers are pulled and cleaned.
 - e. Control valves are functioning per the sequence of operation.
 - f. Shutoff and balance valves have been verified to be 100 percent open.
 - g. Pumps are started and proper rotation is verified.
 - h. Pump gage connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - i. Variable -frequency controllers' start-up is complete and safeties are verified.
 - j. Suitable access to balancing devices and equipment is provided.
- D. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems (Supply, return and exhaust): Adjust to within plus or minus 10 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
- C. Minimum outside air: Adjust to within zero to plus 10 percent of design.
- D. Maintaining pressure relationships as designed shall have priority over the tolerances above.
- E. Hydronic Systems (Heating and cooling): Adjust to within plus or minus 10 percent of design.
- F. Flows through finned tube boiler must be between manufacturers' minimum and maximum values and 10% of design.
- G. Water temperatures are to be at or within 2 degrees Fahrenheit under indicated temperatures.
- H. Duct leakage: Air leakage shall not exceed limits below when tested in accordance with Chapter 5 of the AABC National Standard Manual. Duct shall not be pressure tested greater than their pressure class. Where testing indicated below exceeds the pressure class of ductwork, the leakage test shall be conducted at the pressure for which the duct is rated.
 - 1. Duct serving HVAC equipment with fans of less than one half horsepower: 2 percent at 0.5" WC.
 - 2. Duct serving HVAC equipment with fans of one half horsepower or greater but less than one horsepower: 2 percent at 1.0" WC.

- 3. Duct serving HVAC equipment with fans of 1 horsepower or greater: 1 percent at 1.0" WC.
- 4. Duct serving inlet side of VAV Box: 1 percent at 4"WC.
- 5. HVAC duct within fire rated chases or ceilings: 1 percent at 3"WC.
- 6. HVAC duct concealed by drywall or masonry walls or ceilings: 1 percent at 3"WC.
- 7. HVAC duct routed through an attic space or other unconditioned space: 1 percent at 3"WC.

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner or Engineer.

3.5 AIR SYSTEM PROCEDURE

- A. Perform an air leakage test on all architectural chases used to convey air prior to the installation of wall finishes.
- B. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.
- C. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross sectional area of duct.
- D. Measure air quantities at air inlets and outlets.
- E. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.
- F. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- G. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- H. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- I. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- J. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- K. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- L. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.
- M. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure in Hotel lobby.
- N. Check multi-zone units for motorized damper leakage. Adjust air quantities with mixing dampers set first for cooling, then heating, then modulating.
- O. For variable air volume system powered units set volume controller to airflow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable-air-volume temperature control.
- P. On fan powered VAV boxes, adjust airflow switches for proper operation.
- Q. Exhaust ductwork serving Type I hoods shall be tested for leakage using a "light test" as described by the latest edition of International Mechanical Codes. The mechanical code official having jurisdiction shall witness light test. Ductwork tested using "light test" is not required to be leakage tested in accordance with Chapter 5 of the AABC National Standard Manual.

3.6 SCHEDULES

- A. Equipment Requiring Testing, Adjusting, and Balancing:
 - 1. Packaged Roof Top Heating/Cooling Units.
 - 2. Fans.

- 3. Air Filters.
- 4. Air Inlets and Outlets.
- B. Report Forms

1.

- Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect
 - g. Project Engineer
 - h. Project Contractor
 - i. Report date
- 2. Summary Comments:
 - a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
- 3. Instrument List:
 - a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
- 4. Electric Motors:
 - a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP and kW
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Sheave Make/Size/Bore
- 5. V-Belt Drive:
 - a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity
 - e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
- 6. Combustion Test:
 - a. Manufacturer
 - b. Model number

- c. Gas pressure at meter outlet
- d. Gas flow rate
- e. Burner manifold gas pressure
- f. Percent carbon monoxide (CO)
- g. Percent carbon dioxide (CO2)
- h. Percent oxygen (O2)
- i. Percent excess air
- j. Flue gas temperature at outlet
- k. Ambient temperature
- 7. Air Cooled Condenser:
 - a. Identification/number
 - b. Location
 - c. Manufacturer
 - d. Model number
 - e. Entering DB air temperature, design and actual
 - f. Leaving DB air temperature, design and actual
- 8. Heat Exchanger:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Primary water entering temperature, design and actual
 - h. Primary water leaving temperature, design and actual
 - i. Primary water flow, design and actual
 - j. Primary water pressure drop, design and actual
 - k. Secondary water leaving temperature, design and actual
 - 1. Secondary water leaving temperature, design and actual
 - m. Secondary water flow, design and actual
 - n. Secondary water pressure drop, design and actual
- 9. Cooling Coil Data:
 - a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Saturated suction temperature, design and actual
 - k. Air pressure drop, design and actual
- 10. Air Moving Equipment:
 - a. Location
 - b. Manufacturer
 - c. Model number

- d. Arrangement
- e. Air flow, specified and actual
- f. Return air flow, specified and actual
- g. Outside air flow, specified and actual
- h. Total static pressure (total external), specified and actual
- i. Inlet pressure
- j. Discharge pressure
- k. Sheave Make/Size/Bore
- l. Number of Belts/Make/Size
- m. Fan RPM
- 11. Return Air/Outside Air Data:
 - a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
- 12. Exhaust Fan Data:
 - a. Location
 - b. Manufacturer
 - c. Model number
 - d. Air flow, specified and actual
 - e. Total static pressure (total external), specified and actual
 - f. Number of Belts/Make/Size
 - g. Fan RPM
- 13. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
- 14. Duct Leak Test:
 - a. Description of ductwork under test
 - b. Duct design operating pressure
 - c. Duct design test static pressure
 - d. Duct capacity, air flow
 - e. Maximum allowable leakage duct capacity times leak factor
 - f. Test apparatus
 - 1) Blower
 - 2) Orifice, tube size
 - 3) Orifice size
 - 4) Calibrated
 - g. Test static pressure

- h. Test orifice differential pressure
- i. Leakage
- 15. Air Distribution Test Sheet:
 - a. Air terminal number
 - b. Room number/location
 - c. Terminal type
 - d. Terminal size
 - e. Design air flow
 - f. Test (final) air flow
 - g. Percent of design air flow

END OF SECTION

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. HVAC ductwork insulation, jackets, and accessories.
- B. Related Sections:
 - 1. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
 - 2. Section 09 90 00 Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 2. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 3. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement.
 - 5. ASTM C449/C449M Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - 6. ASTM C450 Standard Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging.
 - 7. ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 8. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation.
 - 9. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 10. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - 11. ASTM C585 Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
 - 12. ASTM C591 Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
 - 13. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

- 14. ASTM C795 Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
- 15. ASTM C921 Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- 16. ASTM C1071 Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
- 17. ASTM C1136 Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
- 18. ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
- 19. ASTM D1785 Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- 20. ASTM D4637 Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
- 21. ASTM E96/E96M Standard Test Methods for Water Vapor Transmission of Materials.
- 22. ASTM E162 Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
- B. Sheet Metal and Air Conditioning Contractors':
 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- C. Underwriters Laboratories Inc.:
 - 1. UL 1978 Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

D. Duct insulation, Coverings, and Linings: Maximum 25/50 flame spread/smoke developed index, when tested in accordance with ASTM E84, using specimen procedures and mounting procedures of ASTM E 2231.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.6 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- 1.7 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
 - B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
 - C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.
 - D. Insulation or lined ductwork found by architect's construction administrator to be moist or to have been exposed to wet conditions shall be removed from job site and disposed of regardless of whether insulation/lined ductwork has been installed.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

- 2.1 GLASS FIBER, FLEXIBLE WRAP (DUCTWORK)
 - A. Manufacturers:
 - 1. Knauf Fiber Glass
 - 2. CertainTeed
 - 3. Owens Corning
 - 4. Substitutions: Section 016000 Product Requirements.
 - B. Insulation: ASTM C553 Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications, Type II, 1 ¹/₂ lb/ft³ Density.
 - C. Vapor Retarder Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film
 - 2. Moisture vapor transmission: ASTM E96; 0.02 perm
 - 3. Secure with pressure sensitive tape.
 - D. Vapor Retarder Tape:
 - 1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
 - E. Outdoor Vapor Retarder Mastic:
 - 1. Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
 - F. Tie Wire: Annealed steel, 16 gage.
 - G. Flexible wrap insulation shall have a flame spread index of 25 or less and a developed smoke index of 50 or less when tested in accordance with ASTM E 84.

2.2 GLASS FIBER, RIGID

- A. Manufacturers:
 - 1. Knauf Fiber Glass
 - 2. CertainTeed
 - 3. Owens Corning
 - 4. Substitutions: Section 016000 Product Requirements.
- B. Insulation: ASTM C612; rigid, noncombustible;
 - 1. 'K' factor: ASTM C177 or ASTM C518, 0.24 at 75 degrees F.

- 2. Maximum Service Temperature: 250 degrees F.
- 3. Maximum Moisture Absorption: 0.1 percent by volume.
- 4. Density: 6 lb/cu ft.
- C. Facing: Foil-Scrim-Kraft (FSK).
- D. Rigid glass fiber shall have a flame spread index of 25 or less and a developed smoke index of 50 or less when tested in accordance with ASTM E 84.

2.3 GLASS FIBER DUCT LINER

- A. Manufacturers:
 - 1. Knauf Fiber Glass.
 - 2. CertainTeed.
 - 3. Owens Corning.
 - 4. Substitutions: Section 016000 Product Requirements.
- B. Insulation: ASTM C1071 Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material), Type I.
 - 1. Poly-vinyl-acetate polymer impregnated surface and edge coat.
 - 2. Minimum Density: 3 lb/ft³.
 - 3. Minimum Service Temperature: -40 deg. F.
 - 4. Maximum Service Temperature: 220 deg F.
 - 5. Rated Velocity: 5,000 fpm.
- C. Duct liner shall have a flame spread index of 25 or less and a developed smoke index of 50 or less when tested in accordance with ASTM E 84.

2.4 EXTERIOR WEATHERPROOFING MEMBRANE

- A. Manufacturers:
 - 1. VentureClad 1577CW-BM.
 - 2. Substitutions: Section 016000 Product Requirements.
- B. Multi-layered laminate with Acrylic adhesive, 8.0 mils thick with a minimum puncture value of 30 pounds.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 Administrative Requirements: Coordination and project conditions.
- B. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- C. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

- A. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 078400 for penetrations of assemblies with fire resistance rating.
- B. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers. Finish with aluminum jacket and fitting covers where mechanical equipment rooms are used as a return, supply, exhaust or transfer air plenum.
- C. Factory Insulated Equipment: Do not insulate.
- D. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- E. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- F. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- G. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- H. Cellular glass fiber insulated equipment containing fluids below ambient temperature: Provide vapor retarder jackets, factory-applied or field-applied. Finish with glass-cloth and vapor barrier adhesive.
- I. Cellular glass fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.
- J. Finish insulation at supports, protrusions, and interruptions.
- K. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- L. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.
- M. Insulated ductwork conveying air below ambient temperature:
 - 1. Provide insulation with vapor retarder jackets.
 - 2. Finish with tape and vapor retarder jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints. Where service access is required, bevel and seal ends of insulation.
- N. Insulated ductwork conveying air above ambient temperature:
 - 1. Provide with or without standard vapor retarder jacket.

- 2. Finish with tape and vapor retarder jacket.
- 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
- 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints. Where service access is required, bevel and seal ends of insulation.
- O. External Duct Insulation Application:
 - 1. Secure insulation with vapor retarder with wires and seal jacket joints with vapor retarder adhesive or tape to match jacket.
 - 2. Secure insulation without vapor retarder with staples, tape, or wires.
 - 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 - 4. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
 - 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
 - 6. Coordinate installation of insulation with EPDM or VentureClad weather membrane and Division 7 installer.
- P. Duct and Plenum Liner Application:
 - 1. Adhere insulation with adhesive for 100 percent coverage.
 - 2. Secure insulation with mechanical liner fasteners. SMACNA Standards for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

- A. Supply and Return Ducts Exposed to Outdoors:
 - 1. Glass Fiber, Rigid insulation: 2 inch thick (Minimum R-8)
 - 2. Include VentureClad jacketing system or EPDM covering
- B. Supply and Return Ducts (located inside the building insulation envelope):
 1. Glass Fiber, Flexible Wrap insulation: 2 inch thick.
- C. Supply and Return Ducts (exposed in conditioned space): 1. Glass Fiber, Duct Liner: 1 inch thick.
- D. Supply and Return Ducts (first 10 feet from connection to unit):1. Glass fiber duct liner: 1 inch thick
- E. Outside Air Intake Ducts:1. Glass Fiber, Flexible Wrap insulation: 2 inch thick.
- F. Exhaust Ducts (first 10 feet from exterior openings):

1. Glass Fiber, Flexible Wrap insulation: 1 inch thick.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. De-Humidistats.
 - 2. Programmable Thermostats
 - 3. Zone Damper Sensors.
 - 4. Non-Programmable Room Thermostats
 - 5. Thermostat Accessories
 - 6. Carbon Dioxide Sensors
 - 7. Actuators
 - 8. Panels
 - 9. Transformers

B. Related Sections:

- 1. Section 23 09 93 Sequence of Operations for HVAC Controls: Sequences of operation implemented using products specified in this section.
- 2. Section 23 33 00 Air Duct Accessories: Product requirements for duct mounted thermometers. Installation requirements for dampers and other duct mounted products furnished in this section.
- 3. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections specified by this section.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 1. ASHRAE 62 Ventilation for Acceptable Indoor Air Quality.
- C. American Society of Mechanical Engineers:
 - 1. ASME B16.18 Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASME B16.22 Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ASTM International:
 - 1. ASTM A126 Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 2. ASTM A536 Standard Specification for Ductile Iron Castings.
 - 3. ASTM B32 Standard Specification for Solder Metal.
 - 4. ASTM B88 Standard Specification for Seamless Copper Water Tube.

- 5. ASTM B280 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- 6. ASTM D2737 Standard Specification for Polyethylene (PE) Plastic Tubing.

E. American Welding Society:

- 1. AWS A5.8 Specification for Filler Metals for Brazing and Braze Welding.
- F. National Electrical Manufacturers Association:
 - 1. NEMA DC 3 Residential Controls Electrical Wall Mounted Room Thermostats.
 - 2. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- G. National Fire Protection Association:
 - 1. NFPA 72 National Fire Alarm Code.
 - 2. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. Coordinate submittals with information requested in Section 23 09 93.
- C. Product Data: Submit description and engineering data for each control system component. Include sizing as required.
- D. Design Data: Indicate data for maximum control wire distances.
- E. Manufacturer's Installation Instructions: Submit installation requirements for each control component.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors.
- C. Operation and Maintenance Data: Submit inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.

1.5 QUALITY ASSURANCE

A. Control Air Damper Performance: Test in accordance with AMCA 500.

B. Perform Work in accordance with state standards.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum of three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
- 1.8 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
 - B. Accept controls on site in original factory packaging Inspect for damage.

1.9 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of control components in piping systems with work of Section 23 21 16.
- C. Coordinate installation of control components in duct systems with work of Section 23 33 00.

1.10 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer warranty for each control system component of HVAC control system.

1.11 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one guest room thermostat.

PART 2 PRODUCTS

- 2.1 DEHUMIDISTATS (Non-Occupied Spaces)
 - A. Manufacturers
 - 1. Honeywell Model: H46C1166
 - 2. TCS Bsys Controls
 - 3. Schneider Electric
 - 4. Siemens
 - 5. Substitutions: Section 016000 Product Requirements.
 - B. Description:
 - 1. Wall mounted, proportioning type.
 - 2. Fully enclosed, dust free, snap-acting switch
 - 3. Sensing Element: Thin, moisture sensitive nylon ribbon.
 - 4. Adjustment type: Dial
 - 5. Operating range: 20 to 80 percent
 - 6. Temperature Range : 50 125 degrees F
 - 7. Cover: Impact resistant molded plastic
- 2.2 DEHUMIDISTATS (Occupied Spaces)
 - A. Manufacturers
 - 1. Honeywell Model: H8908C
 - 2. TCS Bsys Controls
 - 3. Schneider Electric
 - 4. Siemens
 - 5. Substitutions: Section 016000 Product Requirements.
 - B. Description:
 - 1. Wall mounted, proportioning type.
 - 2. Fully enclosed, dust free, snap-acting switch
 - 3. Sensing Element: Thin, moisture sensitive nylon ribbon.
 - 4. Adjustment type: Dial
 - 5. Operating range: 20 to 80 percent
 - 6. Temperature Range : 50 125 degrees F
 - 7. Cover: Impact resistant molded plastic

2.3 PROGRAMMABLE THERMOSTATS

- A. Manufacturers:
 - 1. TCS Basys Controls
 - 2. Schneider Electric
 - 3. Honeywell
 - 4. Johnson Controls
 - 5. Siemens
 - 6. Substitutions: Not allowed
- B. 24 VAC microprocessor-based room thermostats with built in keypad and display for programming and scheduling, and utilize a 7-day time clock with two setback intervals per day. TCS Basys model: SZ1020 Series.
- C. Tenant Override: Programmable from 0-255 minutes, local or remote activation.
- D. Display: 32-character LCD display.
- E. Programming by: Front panel keypad (accessible by pass code) or communication port.
- F. Memory backup: Non-volatile EEPROM.
- G. Accuracy: +/- 0.5%.
- H. Display resolution: +/- 1 degree F.
- I. Thermostat Guards: Locking transparent plastic mounted on separate base (not required when thermostat utilizes a remote sensor).
- J. Thermostat to include: Six status LEDs.
- K. Standard unit to have three heating and two cooling stages, heat pump units to have two compressor stages, two auxiliary heat stages, and a configurable reversing valve output.
- L. Thermostat shall be capable of operating remotely using a remote room sensor.

2.4 ZONE DAMPER SENSORS

A. Refer to section 23 33 00.

2.5 NON-PROGRAMMABLE WALL THERMOSTATS

- A. Manufacturers:
 - 1. Honeywell Model T4398B
 - 2. Schneider Electric
 - 3. Johnson Controls
 - 4. TCS Basys
 - 5. White Rogers

- 6. Substitutions: Not allowed
- B. 115-277 VAC mechanical thermostat.
- C. Attractive white cover to have room temperature display.
- D. Accuracy: +/- 2 degree F
- E. Display: +/- 5 degree F.
- F. Standard unit to have one stage of heating.
- G. Units shall be rated at a minimum of 22 amp at 120/208/240 VAC, 19 amp at 277 VAC.

2.6 THERMOSTAT ACCESSORIES

A. Room Thermostat Accessories:
1. Insulating Bases: For thermostats located on exterior walls.

2.7 CARBON DIOXIDE SENSORS

A. Manufacturers:

- 1. Honeywell
- 2. TCS Basys Controls (PC Series)
- 3. Schneider Electric
- 4. Johnson Controls
- 5. Siemens
- 6. Substitutions: Section 016000 Product Requirements.
- B. Refer to drawings for mounting location.
- C. Sensor is to be wall mounted with digital display.
- D. Range: 0 to 2,000 ppm factory default, adjustable to 10,000 ppm with PC1104 software kit.
- E. Accuracy: +/- 75 ppm or 7% whichever is greater.
- F. Response time: < 1 minute (0 to 90% FS).
- G. Warm up time: <2 minutes @77°F (25°C).
- H. Guarantee: 5 year calibration guarantee.
- I. Operating temperature: $60 \text{ to } 90^{\circ}\text{F}$ (15 to 32°C).
- J. Operating humidity: 0 to 95% RH, non-condensing.

- K. Storage temperature: -40 to 158° F (-40 to 70° C).
- L. Supply voltage: 18 to 30 VAC RMS, 50/60 Hz half-wave rectified; 18 to 42 VDC polarity protected 1.75 VA max. average power, 2.75 VA peak power.
- M. Analog output: 4 to 20 mA (500. max. load) 0 to 10 VDC (100. output impedance) both outputs available simultaneously.
- N. Relay output: N.O. or N.C.; Form C, 2A@24 VAC or VDC, adjustable setpoint.

2.8 DAMPER ACTUATORS

- A. Manufactures:
 - 1. Schneider Electric.
 - 2. ASI Controls.
 - 3. Honeywell.
 - 4. Johnson Controls.
 - 5. Siemens.
 - 6. The Trane Company.
 - 7. Belimo.
 - 8. Substitutions: Section 01600 Product Requirements.
- B. Power requirements: Coordinate power requirements with Division 26.
- C. Sizing: Sizing shall be done in accordance with damper and/or valve manufactures specifications.
- D. On/Off spring return actuators shall be direct coupled type which require no crank arm or linkage and shall be capable of direct mounting to a shaft up to 1/2" diameter.
- E. Modulating spring return actuators shall be direct coupled type which require no crank arm or linkage and shall be capable of direct mounting to a shaft up to 1/2" diameter. The actuator must provide proportional control and must be designed so they may be used for either clockwise or counter clockwise fail-safe operation. Actuator shall use a DC motor controller.

2.9 PANELS

A. Control panel(s) shall be fully enclosed cabinet, all steel construction and shall meet the requirements for a NEMA 1 enclosures. Cabinet shall have a hinged door with a locking latch. All cabinet locks shall use a common key. Provide means of storing control system instructions and drawings inside cabinet for future reference. Cabinet shall be finished with two coats of baked enamel paint. Panel shall be wall-mounted type and located where indicated on the mechanical drawings. All switches that are manually adjusted during routine operation of the system shall be located on the cabinet door with proper name tags. All other appurtenances shall be located within the cabinet.

2.10 TRANSFORMERS

- A. Manufactures:
 - 1. Honeywell
 - 2. Schneider Electric.
 - 3. Johnson Controls.
 - 4. Siemens.
 - 5. Substitutions: Section 01600 Product Requirements.
- B. Power requirements: Coordinate power requirements with Division 26.
- C. Line to low voltage type, totally enclosed, fuse protection on both primary and secondary windings.

2.11 TRANSFORMERS (Zone Damper System)

- A. Manufactures:
 - 1. Honeywell
 - 2. Schneider Electric.
 - 3. Johnson Controls.
 - 4. Siemens.
 - 5. Substitutions: Section 01600 Product Requirements.
- B. Electrical requirements:
 - 1. Primary Voltage: Coordinate power requirements with Division 26.
 - 2. Secondary Voltage: 24v
 - 3. Power output: 75 va
- C. Line to low voltage type, totally enclosed, fuse protection on both primary and secondary windings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 Administrative Requirements: Coordination and project conditions.
- B. Verify building systems to be controlled are ready to operate.
- C. Verify air handling units and ductwork have been accepted and air filters are in place before installing sensors in air streams.
- D. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings before installation.

3.2 INSTALLATION

- A. Install thermostats in aspirating boxes as indicated on Drawings.
- B. Install guards on thermostats as indicated on Drawings.
- C. Install control panels adjacent to associated equipment on vibration free walls or freestanding supports. Use one cabinet for more than one system in same equipment room. Install engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
- D. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- E. Install conduit and electrical wiring in accordance with Section 260503.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Testing and Inspection Services.
- B. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.4 DEMONSTRATION AND TRAINING

- A. Section 017000 Execution Requirements: Requirements for demonstration and training.
- B. Demonstrate complete operation of systems, including sequence of operation prior to Date of Substantial Completion.
- C. Demonstrate complete and operating system to owner.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes Sequence of Operation for:
 - 1. Packaged Rooftop Equipment.
 - 2. Zone Damper.
 - 3. Exhaust Fans
 - 4. Electric Unit Heaters.
 - 5. Electric Wall Heaters.
- B. Related Sections:
 - 1. Section 23 33 00 Air Duct Accessories: For equipment, devices, and system components to implement sequences of operation.
 - 2. Section 23 34 00 HVAC Fans: For equipment, devices, and system components to implement sequences of operation
 - Section 23 81 03 Packaged Rooftop Air Conditioning Units Small Capacity: For equipment, devices, and system components to implement sequences of operation

1.2 SUBMITTALS

- A. Section 01330 Submittal Procedures: Submittal procedures
- B. Shop Drawings: Indicate mechanical system controlled and control system components.
 - 1. Label with settings, adjustable range of control and limits. Submit written description of control sequence
 - 2. Submit flow diagrams for each control system, graphically depicting control logic.
 - 3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
 - 4. Coordinate submittals with information requested in Section 230900.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

3.1 GAS FIRED PACKAGED RTU

- A. Run Conditions Scheduled: The unit shall run according to a user-definable time schedule in the following modes:
 - 1. Occupied Mode: The unit shall maintain a cooling setpoint of 74°F (adj.) and a heating setpoint of 70°F (adj.).
 - 2. Unoccupied mode: The unit shall maintain a cooling setpoint of 80°F (adj.) and a heating setpoint of 55°F (adj.).
- B. Outside Air Damper:
 - 1. The damper shall open anytime the supply air fan is operating in the occupied mode. The damper shall remain closed in the unoccupied mode.
 - a. When open the damper shall open to minimum outside air setpoint unless otherwise commanded.
 - b. When open the damper shall modulate open more than minimum in response to requirements of dual enthalpy economizer.
 - c. CO2 Control: During the occupied mode, if the CO₂ level (as detected by any of the wall mounted CO₂ sensors) rises above 800 ppm, the outside damper shall open to maximum position. When the CO₂ level fall below 700 ppm, the outside air damper shall return to the minimum position. Refer to drawings for units equipped with CO2 control.
- C. Supply Fan:
 - 1. The supply fan shall run anytime the unit is in occupied mode. The fan shall run for a minimum of 5 min (adj.) and be off a minimum of 5 min (adj.) unless shutdown on safeties.
 - 2. The fan shall have the following delay:
 - a. A 2 min (adj.) delay on start only after the outside air damper has been proven open through its end switch.
- D. Cooling Stages:
 - 1. The controller shall measure the zone/OA air temperature and stage the cooling to maintain its cooling setpoint. To prevent short cycling, there shall be a 5 min (adj.) delay between stages and each stage shall run a minimum of 1 min (adj.).
 - 2. When outdoor enthalpy conditions are suitable for natural cooling, the economizer cycle shall be enabled.
 - 3. When the de-humidistat sense a rise in space humidity above setpoint the system shall operate in re-heat mode until the humidity falls below the setpoint. Refer to drawings for units equipped with dehumidification controls.
- E. Heating Stages:

- 1. The controller shall measure the zone/OA air temperature and stage the heating to maintain its heating setpoint. To prevent short cycling, there shall be a 5 min (adj.) delay between stages and each stage shall run a minimum of 1 min (adj.).
- 2. On a fall in temperature below the thermostat setpoint, the heating will be energized. On a fall in temperature the reverse shall occur.
- 3. During morning warm-up, the outdoor air damper shall be closed until the thermostat is satisfied. At this point, the outdoor air damper shall open to its minimum position.
- F. Economizer: The controller shall measure the zone temperature and modulate the economizer dampers in sequence to maintain a setpoint 2°F less than the zone cooling setpoint.
 - 1. The outside and exhaust air dampers shall close and the return air damper shall open when the unit is off.
 - 2. The economizer shall be enabled whenever:
 - a. Outside air temperature is less than 65°F (adj.).
 - b. AND the outside air enthalpy is less than 22Btu/lb (adj.)
 - c. AND the outside air temperature is less than the return air temperature.
 - d. AND the outside air enthalpy is less than the return air enthalpy.
 - e. AND the fan status is on.
 - 3. The economizer shall not be in operation (adj.) whenever:
 - a. Mixed air temperature is less than 35°F (adj.).
 - b. OR on loss of fan status
 - c. OR the freezestat is on.
- G. Emergency unit shut down for system over 2,000 CFM:
 - 1. Unit shall shut down upon detection of smoke in smoke in return or supply duct. Coordinate with fire alarm contractor.

3.2 ZONE DAMPER SYSTEM

- A. General:
 - 1. The system shall be in heating or cooling based on the majority vote from the zone sensors.
 - 2. If any zone is more than 7 degrees F (adj.) off of the zone setpoint the system shall switch to the mode necessary to bring that zone within 2 degrees (adj) of the zone setpoint. Once this is achieved the system shall return to normal operation.
- B. Zone Dampers:
 - 1. Dampers shall modulate between minimum and maximum setpoint to maintain the space temperature. Refer to drawing for minimum and maximum damper setpoints.
- C. By-Pass Damper:
 - 1. Damper shall modulate between minimum and maximum setpoint to maintain desired duct static pressure. Refer to drawing for minimum and maximum damper setpoints.

- 3.3 EXHAUST FANS (EF-1,2,3,4)
 - A. Unit shall be interlocked with room lighting controls and time delay switch.
- 3.4 EXHAUST FANS (EF-5)
 - A. Unit shall be controlled by mechanical cooling thermostat.
- 3.5 EXHAUST FANS (EF-6)
 - A. Unit shall be controlled by dehumidistat.
 - 1. Upon a rise in space relative humidity above the dehumidistat setpoint of 55% (adj.) the fan shall be energized and the associated outside air intake motorized damper shall be energized.

3.6 UNIT HEATER

A. Upon a fall in space temperature below the unit mounted thermostat setpoint the fan and heater shall be energized.

3.7 WALL HEATER

A. Upon a fall in space temperature below the unit mounted thermostat setpoint the fan and heater shall be energized.

END OF SECTION

SECTION 23 11 23

FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Natural gas piping buried within 5 feet of building.
- 2. Natural gas piping buried beyond 5 feet of building.
- 3. Natural gas piping above grade.
- 4. Flanges, unions, and couplings.
- 5. Pipe hangers and supports.
- 6. Valves.
- 7. Pressure gauges
- 8. Strainers.
- 9. Natural gas pressure regulators.
- 10. Underground pipe markers.
- 11. Bedding and cover materials
- B. Related Sections:
 - 1. Section 05 12 00 Structural Steel Framing: Product requirements for touch-up painting of structural steel.
 - 2. Section 05 21 00 Steel Joist Framing: Product requirements for touch-up painting of steel joists.
 - 3. Section 07 84 00 Firestopping: Product requirements for firestopping for placement by this section.
 - 4. Section 08 31 13 Access Doors and Frames: Access doors for concealed valves and accessories.
 - 5. Section 09 90 00 Painting and Coating: Product requirements for painting for placement by this section.
 - 6. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
 - 7. Section 23 05 48 Vibration Controls for HVAC Piping and Equipment.
 - 8. Section 23 05 53 Identification for HVAC Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.
 - 9. Section 31 05 13 Soils for Earthwork: Soils for backfill in trenches.
 - 10. Section 31 05 16 Aggregates for Earthwork: Aggregate for backfill in trenches.
 - 11. Section 31 23 16 Excavation: Product and execution requirements for excavation and backfill required by this section.
 - 12. Section 31 23 17 Trenching: Execution requirements for trenching required by this section.
 - 13. Section 31 23 23 Fill: Requirements for backfill to be placed by this section.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B16.3 Malleable Iron Threaded Fittings.
 - 2. ASME B16.26 Cast Copper Alloy Fittings for Flared Copper Tubes.
 - 3. ASME B16.33 Manually Operated Metallic Gas Valve for use in Above Ground Piping Systems up to 125 PSI
 - 4. ASME B16.44 Manually Operated Metallic Gas Valve for use in Above Ground Piping Systems up to 5 PSI
 - 5. ASME B31.9 Building Services Piping.
 - 6. ASME Section IX Boiler and Pressure Vessel Code Welding and Brazing Qualifications.
- B. American Society for Testing and Materials:
 - 1. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 2. ASTM A234/A234M Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - 3. ASTM B68 Standard Specification for Seamless Copper Tube, Bright Annealed.
 - 4. ASTM B75 Standard Specification for Seamless Copper Tube.
 - 5. ASTM B88 Standard Specification for Seamless Copper Water Tube.
 - 6. ASTM B280 Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
 - 7. ASTM B749 Standard Specification for Lead and Lead Alloy Strip, Sheet, and Plate Products.
 - 8. ASTM F708 Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. American Welding Society:
 - 1. AWS D1.1 Structural Welding Code Steel.
- D. American Water Works Association:
 - 1. AWWA C105 American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 Pipe Hangers and Supports Materials, Design and Manufacturer.
 - 2. MSS SP 67 Butterfly Valves.
 - 3. MSS SP 69 Pipe Hangers and Supports Selection and Application.
 - 4. MSS SP 78 Cast Iron Plug Valves, Flanged and Threaded Ends.
 - 5. MSS SP 89 Pipe Hangers and Supports Fabrication and Installation Practices.
 - 6. MSS SP 110 Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.
- F. National Fire Protection Association:
 - 1. NFPA 54 National Fuel Gas Code.

G. Underwriters Laboratories Inc.:

- 1. UL 842 Valves for Flammable Fluids.
- H. Underwriters Laboratories Inc.:
 - 1. ANSI Z21.15 Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves
- I. American National Standards Institute:
 - 1. ANSI Z21.15 Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.
 - 2. ANSI Z21.80 Standard for Certified Line Pressure Regulators

1.3 SYSTEM DESCRIPTION

- A. Provide new gas service including pressure regulator, and meter. Gas service distribution piping to have initial minimum pressure of 8" WC.
- B. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.
- C. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- D. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- E. Use ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

1.4 SUBMITTALS

- A. Section 013300 Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Piping: Submit data on pipe materials, fittings, and accessories.
 - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
 - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
 - 4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes for the following:
 - a. Strainers.
 - b. Natural gas pressure regulators.
 - c. Natural gas pressure relief valves.
 - d. Natural gas pressure gauges.

- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of natural gas piping system pressure test.
- E. Manufacturer's Certificate: Certify Products meet or exceed local gas provider requirements.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

1.5 CLOSEOUT SUBMITTALS

- A. Section 017000 Execution Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves and regulators, piping system, and system components.
- C. Operation and Maintenance Data: Submit for valves and gas pressure regulators installation instructions, spare parts lists, and exploded assembly views.

1.6 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54 and the International Mechanical Code.
- B. Perform LPG Work in accordance with NFPA 58 and the International Mechanical Code.
- C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- D. Perform Work in accordance with local gas supplier applicable code authority having jurisdiction and AWS D1.1 for welding hanger and support attachments to building structure.
- E. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

A. Section 013000 - Administrative Requirements: Pre-installation meeting.

B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

1.11 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.12 COORDINATION

- A. Section 013000 Administrative Requirements: Requirements for coordination.
- B. Coordinate trenching excavating bedding backfilling marking of buried piping systems with requirements of Sections 31 05 13, 31 05 16, 31 23 16, 31 23 17 and local gas provider.

1.13 WARRANTY

A. Section 017000 - Execution Requirements: Product warranties and product bonds.

1.14 EXTRA MATERIALS

A. Section 017000 - Execution Requirements: Spare parts and maintenance products.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASTM A234/A234M forged steel welding type.
 - 2. Joints: ASME B31.9, welded.
 - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil polyethylene tape.

- B. Copper Tubing (1" and smaller): ASTM B88, Type K, annealed.
 - 1. Fittings: ASME B16.22, wrought copper (cast not allowed).
 - 2. Joints: Brazed, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F. Compression fittings are allowed only at connection to above ground system

2.2 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, welded to ASME B31.9. Threaded joints shall be allowed where joint is not located in a concealed area.

2.3 NATURAL GAS VENT PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53 Schedule 40 black.
 - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
 - 2. Joints: NFPA 54, welded to ASME B31.9. Threaded joints shall be allowed where joint is not located in a concealed area.
- B. Copper Tubing: ASTM B88 Type L, drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 430 to 535 degrees F Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1190 to 1480 degrees F.

2.4 FLANGES, UNIONS, AND COUPLINGS

- A. 2 inches and Smaller:
 - 1. Ferrous pipe: 150 psi malleable iron threaded unions.
- B. 2-1/2 inches and Larger:
 - 1. Ferrous pipe: 150 psi forged steel slip-on flanges; 1/16 inch thick preformed neoprene gaskets.
- C. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.5 PIPE HANGERS AND SUPPORTS

- A. Manufacturers:
 - 1. Carpenter & Paterson Inc.
 - 2. Creative Systems Inc.
 - 3. Flex-Weld, Inc.
 - 4. Glope Pipe Hanger Products Inc.

- 5. Michigan Hanger Co.
- 6. Superior Valve Co.
- 7. Substitutions: Section 016000 Product Requirements.
- B. Conform to NFPA 54, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- C. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
- D. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.
- E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
- F. Wall Support for Pipe 3 inches and Smaller: Cast iron hook.
- G. Vertical Support: Steel riser clamp.
- H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.6 VALVES

- A. Ball Valves:
 - 1. Manufacturers:
 - a. Milwaukee Valve Company.
 - b. Nibco, Inc.
 - c. Stockham Valves & Fittings.
 - d. Watts
 - e. Substitutions: Section 016000 Product Requirements.
 - 2. 1/4 inch to 1 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, full port.
 - 3. 1-1/4 inch to 3 inch, MSS SP 110, 250 psi, two piece, threaded ends, bronze body, reinforced teflon seats, blow-out proof stem, lever handle, UL 842 listed for flammable liquids and LPG, conventional port.
- B. Butterfly Valves:

1.

- Manufacturers:
 - a. Milwaukee Valve Company.
 - b. Nibco, Inc.
 - c. Stockham Valves & Fittings.
 - d. Watts
 - e. Substitutions: Section 016000 Product Requirements.
- 2. 2 inches and Smaller: MSS SP 67, 175 psi, bronze body, viton seals, stainless steel trim, lever handle UL listed for gas service, threaded ends, full port.
- 3. 2-1/2 inches and Larger: MSS SP 67, 125psi, cast iron body, bushing is to be dacron liner bonded to fiberglass with epoxy resin outer shell, buna-N seat, 316

stainless steel shaft, 316 stainless steel disk, standard ten position lever handle, UL listed for gas service, full lugs.

C. Plug Valves: 1. Manu

- Manufacturers:
 - a. Homestead
 - b. Substitutions: Section 016000 Product Requirements.
- 2. 2 -1/2 inches and larger: Valves are to be of the lubricated plug type, without taper, and with close tolerance between the plug and body sealing surfaces. Valves are to have a stem seal of reinforced Teflon. Valves must have a leak-proof, spring loaded ball and lubricant sealed check valve; and combination lubricant screw and button head fitting to prevent foreign matter from being forced into lubricant system. Valve plugs are to be floated on low-friction Teflon surfaces for extra ease of turning the lower surface to also act as a means of minimizing torsional stress in the spring and are to have port area equal to 100% of the area of standard pipe. Valves are to be so constructed that lubricant system has sufficient pressure to force lubricant over all seating surfaces. Extruded Lubricant around stem is to be positive indication that lubricant system is full, and that there had been a minimum contamination of line fluids.

D. Standards:

2.

- 1. Gas valves serving as equipment shutoff valves.
 - a. For low pressure (10" WC and less) gas fired appliances shall be ANSI Z21.15 listed.
 - b. For medium pressure (above 10" WC to 5 psi) gas fired appliances shall be ASME B16.44 listed.
 - c. For high pressure (above 5 psi) gas fired appliances shall be ASME B16.33 listed.
 - Gas valves serving in other valve applications.
 - a. Where valves serve gas lines conveying low or medium pressure (5 psi and less) gas the valves shall be ASME B16.44 listed.
 - b. Where valves serve gas lines conveying high pressure (above 5psi) gas the valves shall be ASME B16.33 listed.

2.7 PRESSURE GAGES

- A. Manufacturers:
 - 1. Miljoco
 - 2. Substitutions: Section 016000 Product Requirements.
- B. Gauge: ASME B40.100, UL 393 with diaphram, rotary brass movement, brass socket, black scale on white background.
 - 1. Case: Steel.
 - 2. Movement: Brass with milled teeth.
 - 3. Dial Size: 2-1/2 inch diameter.
 - 4. Full Scale Accuracy: 1-1/2 percent
 - 5. Diaphragm: Beryllium copper.
 - 6. Socket: Brass
- 7. Restrictor: 0.013" restrictor on scales over 10"H2O.
- 8. Scale: Where gas company delivery pressure downstream of meter is less than 10"WC or where gauge is installed downstream of a secondary regulator the scale shall be 0 to 15"WC. Where gas company delivery pressure downstream of meter is greater than 10"WC and less than 4 psi the scale shall be 0 to 5 psi. Where gas company delivery pressure downstream of meter is greater than 4 psi the scale shall be 0 to 10 psi.
- 9. Ambient Temperature Range: -40E to 140EF
- 10. Needle Valve: Brass, 1/4 inch NPT for minimum 300 psi.

2.8 STRAINERS

- A. Manufacturers:
 - 1. Mueller Steam Specialty.
 - 2. O.C. Keckley Company.
 - 3. Spirax Sarco, Inc.
 - 4. Substitutions: Section 016000 Product Requirements.
- B. 2 inch and Smaller: Screwed brass or iron body for 175 psig working pressure, Y pattern with 1/32 inch stainless steel perforated screen.
- C. 2-1/2 inch to 4 inch: Flanged iron body for 175 psig working pressure, Y pattern with 3/64 inch stainless steel perforated screen.
- D. 5 inch and Larger: Flanged iron body for 175 psig working pressure, basket pattern with 1/8 inch stainless steel perforated screen.

2.9 NATURAL GAS PRESSURE REGULATORS

- A. Furnish materials in accordance with International Fuel Gas Code and the International Mechanical Code.
- B. Manufacturers:
 - 1. Fisher
 - 2. Schlumberger.
 - 3. Maxitrol.
 - 4. Substitutions: Section 016000 Product Requirements.
- C. Product Description: Spring loaded, general purpose, self-operating service regulator including internal relief type diaphragm assembly and vent valve. Diaphragm case can be rotated 360 degrees in relation to body.
 - 1. Temperatures: minus 20 degrees F to 150 degrees F.
 - 2. Body: Cast iron Steel.
 - 3. Spring case, lower diaphragm casing, union ring, seat ring and disk holder: Aluminum.
 - 4. Disk, diaphragm, and O-ring: Fluoroelastomer.
 - 5. Maximum inlet pressure: 150 psig

- 6. Furnish sizes 2 inches and smaller with threaded ends. Furnish sizes 2-1/2 inches and larger with flanged ends.
- 7. Regulator shall be positive shutoff type and shall not allow downstream pressure to exceed setpoint during periods of not flow.
- 8. Provide a manufacturer provided vent screen fitting with screen faced downward where regulator is located indoors and is vented to the exterior.

2.10 UNDERGROUND PIPE MARKERS

A. Provide as per Division 23 05 53.

2.11 BEDDING AND COVER MATERIALS

- A. Bedding: Fill Type as specified in Section 31 05 17 and local gas provider.
- B. Cover: Fill Type as specified in Section 31 23 23 and local gas provider.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. 013000 Administrative Requirements: Coordination and project conditions.
 - B. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION - INSERTS

- A. Provide inserts for placement in concrete forms.
- B. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide throughbolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.9 ASTM F708 and MSS SP 89.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
- H. Provide copper plated hangers and supports for copper piping sheet lead packing between hanger or support and piping.
- I. Prime coat exposed steel hangers and supports in accordance with Section 099000. Finish paint exposed steel hangers and supports in accordance with Section 099000. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- K. All regulators and overpressure protection devices shall have the vent connection piped to the exterior of the building. Vent limiters are not acceptable.
- L. Verify gas company shall guarantee maximum surge pressure of 14"WC (or lowest maximum inlet pressure allowed on any gas burning appliance) on systems where gas company supplies a nominal 5"WC-10"WC downstream of meter. If gas company cannot guarantee gas pressure downstream of meter (maximum surge pressure) will not exceed maximum allowed pressure, provide gas pressure relief valve. Gas pressure relief valve shall connect directly downstream of meter and upstream of building penetration. Locate relief outlet 10' horizontally from any air intake or flue, or 2' above any intake or flue. Terminate using rain cap. Set valve to open at lowest maximum inlet pressure allowed on any gas appliance.

3.5 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Verify connection size, location, and invert are as indicated on Drawings.
- C. Establish elevations of buried piping with not less than 2-1/2 ft of cover.
- D. Establish minimum separation of 18 inches from other services piping in accordance with local gas provider code.
- E. Remove scale and dirt on inside of piping before assembly.
- F. Excavate pipe trench in accordance with Section 31 23 17.
- G. Install pipe to elevation as dictated by local gas provider.
- H. Install pipe on prepared bedding.
- I. Route pipe in straight line.
- J. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- K. Pipe Cover and Backfilling:
 - 1. Backfill trench in accordance with Section 31 23 17.
 - 2. Maintain optimum moisture content of fill material to attain required compaction density.
 - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 4 inches compacted layers to 12 inches minimum cover over top of jacket. Compact in accordance with Section 31 23 17 or to local gas company standard, whichever is more stringent.
 - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
 - 5. Do not use wheeled or tracked vehicles for tamping.
 - 6. Establish elevations of buried piping outside the building to obtain minimum depth of 6 inches below local frost line.
 - 7. Excavate and backfill in accordance with Section 31 23 17.

3.6 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54, and the International Mechanical Code.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Install piping to conserve building space and not interfere with use of space.

- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- H. Provide clearance for installation of insulation and access to valves and fittings.
- I. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- J. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer. Refer to Section 05 12 00.
- K. Provide support for utility meters in accordance with requirements of utility company.
- L. Install vent piping from gas pressure reducing valves to outdoors and terminate in weatherproof hood.
- M. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. All above grade gas piping downstream of meter shall be painted. Paint color shall be safety yellow unless otherwise directed by local code or call outs on plans. Refer to Section 099000.
- N. Install identification on piping systems including underground piping. Refer to Section 23 05 53.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.
- Q. Provide shutoff, pressure regulator and drip leg on each gas fired piece of equipment or appliance.

3.7 FIELD QUALITY CONTROL

- A. Section 014000 Quality Requirements: Testing and Inspection.
- B. Section 01 40 00 Quality Requirements and 01 70 00 Execution and Closeout Requirements field inspecting, testing, adjusting, and balancing.
- C. Test piping system in accordance with International Fuel Gas Code.

END OF SECTION

SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Duct Materials.
 - 2. Insulated flexible ducts.
 - 3. Single wall spiral round ducts.
 - 4. Ductwork fabrication.
 - 5. Duct cleaning.

B. Related Sections:

- 1. Section 03 30 00 Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
- 2. Section 09 90 00 Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
- 3. Section 23 05 29 Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
- 4. Section 23 05 48 Vibration Controls for HVAC Piping and Equipment.
- 5. Section 23 33 00 Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM A36/A36M Standard Specification for Carbon Structural Steel.
 - 2. ASTM A90/A90M Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - 3. ASTM A240/A240M Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - 4. ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - 5. ASTM A568/A568M Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
 - 6. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 7. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

- 8. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
- 9. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- 10. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA Fibrous Glass Duct Construction Standards.
 - 2. SMACNA HVAC Air Duct Leakage Test Manual.
 - 3. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- D. Underwriters Laboratories Inc.:
 - 1. UL 181 Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:
 - 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 duct systems, indicate classification of 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 walls.
 - 7. Terminal unit, coil, and humidifier installations.
 - 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.

- C. Product Data: Submit data for duct materials, duct liner/insulation and duct connectors.
- D. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA HVAC Duct Construction Standards Metal and flexible.
- B. Construct ductwork to NFPA 90A and NFPA 96 standards.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements.
- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

- 2.1 DUCT MATERIALS
 - A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90/A90M.
 - B. Stainless Steel Ducts: ASTM A240/A240M or ASTM A666, Type 304.
 - C. Sheet aluminum Soft temper, satin finish.
 - D. Fasteners: Rivets, bolts, or sheet metal screws.
 - E. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 INSULATED FLEXIBLE DUCTS

- A. Manufacturers:
 - 1. Acme Manufacturing.
 - 2. Master-Fit.
 - 3. ATCO.
 - 4. Genflex.
 - 5. Hart & Cooley.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
 - 1. Pressure Rating: 10 inches wg positive and 1.0 inches wg negative.
 - 2. Maximum Velocity: 4000 fpm.
 - 3. Temperature Range: -10 degrees F to 160 degrees F.
 - 4. Thermal Resistance: 6.0 square feet-hour-degree F per BTU.

2.3 SINGLE WALL SPIRAL ROUND DUCTS

- A. Manufacturers:
 - 1. McGill AirFlow Corporation.
 - 2. Semco Incorporated.
 - 3. Tangent Air Corp.
 - 4. Spiral Mfg. Co., Inc.
 - 5. Hamilin Sheet Metal Inc.
 - 6. Substitutions: Section 01 60 00 Product Requirements

- B. Product Description: UL 181, Class 1, round spiral lockseam duct constructed of galvanized steel; rated for 10 inches wg pressure when underground.
- C. Duct Coating: Polyvinyl chloride plastic, 4 mil thick on outside and 4 mil thick on inside. Temperature range: minus 30 degrees F to 200 degrees F.
- D. Construct duct with the following minimum gages when aboveground:

Diameter	Gauge
3 inches to 14 inches	26
15 inches to 26 inches	24
28 inches to 36 inches	22
38 inches to 50 inches	20
52 inches to 84 inches	18

E. Construct fittings with the following minimum gages when aboveground:

Diameter	Gauge
3 inches to 14 inches	24
15 inches to 26 inches	22
28 inches to 36 inches	20
38 inches to 50 inches	20
52 inches to 60 inches	18
62 inches to 84 inches	16

2.4 DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible (Round Duct Construction Standards), and as indicated on Drawings. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated. Duct sealing for supply, return, transfer and general exhaust shall be accomplished using liquid type sealant by McGill Airflow or equal. Sealing using tape is prohibited. Exterior ductwork shall be sealed using exterior type sealant whether exposed or covered by weatherproofing. Sealant shall be of low VOC type.
- C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass

fiber insulation. Provide 4" turning vanes for duct elbows 18" (nominal) in any direction and larger. Provide 2" turning vanes for duct smaller than 18" (nominal) in any direction down to 8"x6" (nominal) duct. Turning vanes are not required for duct smaller than 8"x6" (nominal).

- D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- G. If any walls at any location in the building are fire rated then no metal duct shall be installed which is constructed of lighter than 26 gauge sheet metal.
- H. Seal joints between duct sections and duct seams with welds, gaskets, or mastic adhesives.
 - 1. Sealants, and Mastics: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.
 - 3. Do not seal exposed ductwork.
 - 4. Do not use tape to seal duct.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
 - B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION ABOVE GROUND DUCTWORK

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use crimp joints with or without bead or beaded sleeve couplings for joining round duct sizes 8 inch and smaller.
- D. Install duct hangers and supports in accordance with Section 23 05 29.

- E. Use double nuts and lock washers on threaded rod supports.
- F. Connect flexible ducts to metal ducts with draw bands.
- G. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.
- H. Casings: Install floor mounted casings on 4 inch high concrete curbs. Refer to Section 03 30 00. At floor, rivet panels on 8 inch centers to angles. Where floors are acoustically insulated, furnish liner of 18 gage galvanized expanded metal mesh supported at 12 inch centers, turned up 12 inches at sides with sheet metal shields.
- I. Install residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.
- J. Install Work in accordance with state standards.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

3.4 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.5 SCHEDULES

AIR SYSTEM	MATERIAL
Supply (System with Cooling Coils)	Steel
Return and Relief	Steel
General Exhaust	Steel
Outside Air Intake	Steel

A. Ductwork Material Schedule:

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	2 inch wg regardless of velocity
Supply (System with Cooling Coils)	2 inch wg
Return and Relief	2 inch wg
General Exhaust	2 inch wg

END OF SECTION

SECTION 23 33 00

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

- 1. Duct access doors.
- 2. Volume control dampers.
- 3. Motorized control dampers.
- 4. Zone dampers.
- 5. Flexible duct connections.
- 6. Duct test holes.
- B. Related Sections:
 - 1. Section 23 09 00 Instrumentation and Control for HVAC.
 - 2. Section 23 31 00 HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.
 - 3. Section 23 09 93 Sequence of Operations.
 - 4. Section 23 81 03 Packaged Rooftop Air Conditioning Units Small Capacity.
 - 5. Section 26 05 03 Equipment Wiring Connections.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. ASTM International:
 - 1. ASTM E1 Standard Specification for ASTM Thermometers.
- C. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
 - 2. NFPA 92A Recommended Practice for Smoke-Control Systems.
- D. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.
- E. Underwriters Laboratories Inc.:
 - 1. UL 555 Standard for Safety for Fire Dampers.
 - 2. UL 555C Standard for Safety for Ceiling Dampers.
 - 3. UL 555S Standard for Safety for Smoke Dampers.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
 - 1. Fire dampers including locations and ratings.
 - 2. Smoke dampers including locations and ratings.
 - 3. Backdraft dampers.
 - 4. Flexible duct connections.
 - 5. Volume control dampers.
 - 6. Duct access doors.
 - 7. Duct test holes.
- E. Product Data: For fire dampers, smoke dampers, combination fire and smoke dampers, motorized control dampers, and, manual volume control dampers submit the following:
 - 1. Include UL ratings, dynamic ratings, leakage, pressure drop and maximum pressure data.
 - 2. Indicate materials, construction, dimensions, and installation details.
 - 3. Damper pressure drop ratings and air leakage ratings based on tests and procedures performed in accordance with AMCA 500.
- F. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access doors, test holes
- C. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.5 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.

1.9 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.10 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

1.12 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one of each size of fusible link.

PART 2 PRODUCTS

- 2.1 DUCT ACCESS DOORS
 - A. Manufacturers:
 - 1. Greenheck.
 - 2. Ruskin.
 - 3. Prefco.

- 4. Substitutions: Section 01 60 00 Product Requirements
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.
- C. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch thick insulation with sheet metal cover.
 - 1. Less than 12 inches square, secure with sash locks.
 - 2. Up to 18 inches Square: Furnish two hinges and two sash locks.
 - 3. Up to 24 x 48 inches: Three hinges and two compression latches with outside and inside handles.
 - 4. Larger Sizes: Furnish additional hinge.
 - 5. Access panels with sheet metal screw fasteners are not acceptable.

2.2 MANUAL VOLUME CONTROL DAMPERS (12" IN HEIGHT & LESS)

- A. Manufacturers:
 - 1. Greenheck Model: MBD-10
 - 2. Ruskin.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Velocity: Dampers shall have a maximum velocity rating of 2,000 fpm.
- C. Construction:
 - 1. Frame: 22 gauge galvanized steel.
 - 2. Blade: 20 gauge galvanized steel.
 - 3. Axle: Minimum $\frac{1}{2}$ inch dia. plated steel.
 - 4. Bearings: Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame. Provide end bearings.
- D. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.

2.3 MANUAL VOLUME CONTROL DAMPERS (GREATER THAN 12" IN HEIGHT)

- A. Manufacturers:
 - 1. Greenheck Model: MBD-15
 - 2. Ruskin.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Velocity: Dampers shall have a maximum velocity rating of 2,000 fpm.
- C. Construction:

- 1. Frame: 16 gauge galvanized steel hat channel with 5" depth.
- 2. Blades: 16 gauge galvanized steel "V" type blades.
- 3. Axle: Minimum $\frac{1}{2}$ inch dia. plated steel.
- 4. Bearings: Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame. Provide end bearings.
- 5. Linkage: External plated steel, blade-to-blade.
- D. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
 - 3. Where rod lengths exceed 30 inches furnish regulator at both ends.
- E. Multi-Blade Damper: Fabricate of opposed blade pattern with minimum blade height of 6 inch. Assemble center and edge crimped blades in galvanized frame channel with suitable hardware.

2.4 MANUAL VOLUME CONTROL DAMPERS (ROUND)

- A. Manufacturers:
 - 1. Greenheck Model: MBDR-50
 - 2. Ruskin.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible, and as indicated on Drawings.
- C. Velocity: Dampers shall have a maximum velocity rating of 3,000 fpm.
- D. Construction:
 - 1. Frame: 20 gauge galvanized steel.
 - 2. Blades: 20 gauge galvanized steel.
 - 3. Axle: Minimum ¹/₂ inch dia. plated steel. Outboard shaft support bracket for field mounted actuator.
 - 4. Bearings: Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame.
- E. Quadrants:
 - 1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
 - 2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.

2.5 MOTORIZED CONTROL DAMPERS (RECTANUGALR)

- A. Manufacturers:
 - 1. Greenheck Model: VCD-23

- 2. Ruskin
- 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Leakage:
 - 1. Damper shall be low leakage type suitable for outside air applications.
 - 2. Damper shall have a maximum leakage of Class 1 @ 4 in. wg as defined by AMCA (Leakage class 1 is defined as 8 cfm/ sq. ft. @ 4 in. wg). Tested in accordance with AMCA standard 500-D.
- C. Velocity: Dampers shall have a maximum velocity rating of 3000 fpm.
- D. Maximum Pressure Drop: As tested in accordance with AMCA 5.3 setup:
 - 1. 12"x"12" damper:
 - a. 500 FPM = 0.01 in wg
 - b. 1,000 FPM = 0.03 in wg
 - c. 1,500 FPM = 0.08 in wg
 - 2. 24"x24" damper
 - a. 500 FPM = 0.01 in wg
 - b. 1,000 FPM = 0.02 in wg
 - c. 1,500 FPM = 0.04 in wg
- E. Construction:
 - 1. Frame: Damper frame shall be 16 ga. galvanized steel formed into a 5" x 1" structural hat channel. Top and bottom frame members on dampers less than 17" high shall be low profile design to maximize the free area of these smaller dampers. Frame shall be 4-piece construction with 1 ½" (minimum) integral overlapping gusset reinforcements in each corner to assure square corners and provide maximum resistance to racking.
 - 2. Blades: Damper blades shall be 16 ga. galvanized steel strengthened by three longitudinal 1" deep Vee grooves running the entire length of each blade. Each blade shall be symmetrical relative to its axle pivot point, presenting identical performance characteristics with air flowing in either direction through the damper. Provide symmetrical blades of varying size as required to completely fill the damper opening.
 - 3. Blade Stops: Each blade stop (at top and bottom of damper frame) shall occupy no more than $\frac{1}{2}$ " of the damper opening area to allow for maximum free area and to minimize pressure loss across the damper.
 - 4. Seals:
 - a. Blade Edge: Blade seals shall be TPE comes standard which are mechanically fastened to each blade. Silicone blade is optional.
 - b. Jamb: Flexible stainless steel compression type
 - 5. Linkage: Concealed in jamb, plated steel metal.
 - 6. Axles: Minimum ¹/₂ inch dia. plated steel. Outboard shaft support bracket for field mounted actuator.
 - 7. Bearings: Axle bearings shall be synthetic (acetal) sleeve rotating in polished extruded holes in the damper frame.
 - 8. Finish: Mill galvanized finish is standard.

F. Actuator:

- 1. Type: Refer to specification section 230900.
- 2. Mounting: External.
- G. Type:
 - 1. Modulating dampers shall have opposed-action blades.
 - 2. Two-position dampers shall have parallel action blades.

2.6 ZONE DAMPER SYSTEM (WATTMASTER)

- A. Manufacturers:
 - 1. WattMaster: Auto-Zone Plus.
 - 2. Train: Varitrac
 - 3. Honeywell
 - 4. Substitutions: Substitutions not permitted.
- B. System Description:
 - 1. The control system shall be a microprocessor based, stand alone system capable of controlling up to 30 zoned HVAC units. Each HVAC unit shall support up to 16 individual zones. In addition to zone control, system shall be capable of controlling up to 390 single zone constant volume units all connected to the same communications network. A central operator's interface panel with a keypad and display shall allow the programming of all setpoint parameters and time scheduling for all controllers without the use of a personal computer. All devices shall be powered by 24 volts AC. All field wiring shall be NEC Class II.
- C. Communications:
 - 1. The control systems communication shall be RS-485/9,200 baud, HSI Open Protocol, Token passing network. Manufacturer must be able to provide a copy of communications protocol if requested without additional cost.
- D. Operator Interface Panel:
 - 1. A central operator's panel shall be provided. All controllers connected to the network shall be accessed from one operator's panel. All system values and setpoints shall be accessible for viewing and modification through this interface panel. The interface shall consist of a membrane keypad for the purpose of data entry. The operator interface shall have a 4 line by 20 character, backlighted, LCD display for the purpose of displaying system status, values, setpoints, alarms, and error messages. The display must show data with English descriptors. Special code or cryptic messages will not be acceptable. Interface must provide password protection to protect data from non-authorized users.
- E. Zoned HVAC Unit Controller:
 - 1. Zoned HVAC central units shall be controlled by a master controller. The master controller will be responsible for monitoring each zone via information received from the zone controllers and in turn control the HVAC unit to satisfy the requirements for each individual zone. The master controller shall be powered with 24 vac and shall utilize quick-disconnect terminal blocks for all wiring

2.

connections. In case of power failure, the master controller shall be capable of storing system values and setpoints for up to ten days utilizing a non-battery memory back-up. Each master controller shall support up to 16 zone controllers.

- The master controller shall provide Inputs for the following:
 - a. Outside Air Temperature Sensor
 - b. Supply Air Temperature Sensor
 - c. Return Air Temperature Sensor
 - d. Static Pressure Sensor for Bypass Control
 - e. Bypass Damper Actuator Feedback
 - f. Economizer Disable
 - g. Force Occupied Modes
 - h. Change Filter Status
- 3. Controller shall provide Outputs for the following:
 - a. Fan
 - b. Heating 2 Stages (Expandable to 6)
 - c. Cooling 2 Stages (Expandable to 6)
 - d. Bypass Actuator (Modulating)
 - e. Exhaust Fan/Relief Damper
 - f. Modulating Economizer Damper (0-10 vdc)
- 4. The master controller will provide the following control functions:
 - a. 7 Time of Day Scheduling
 - b. 365 Day holiday Scheduling
 - c. Fan Control Continuous or Cycling
 - d. Static Pressure Control
 - e. Zone Voting Status
 - f. Minimum Heating/Cooling Lockouts
 - g. Minimum Heating/Cooling Runtime
 - h. Minimum Heating/Cooling Off Time
 - i. Heating/Cooling Change Over Delay
 - j. Supply Air Setpoint for Economizer Control
 - k. Modulating Economizer Control
 - 1. Economizer Enable Setpoint
 - m. Minimum Economizer Position
 - n. Automatic Daylight Savings Time Adjustment Automatic or Manual
- 5. The following status values from the master controller shall be accessible from the operators interface panel:
 - a. Supply, Return, & Outside Air Temperatures
 - b. Static Pressure
 - c. Bypass & Economizer Position Feedback
 - d. Total System Heating and Cooling Demand
 - e. Heating/Cooling Priorities
 - f. Mode Status
 - g. Heating/Cooling Lockout Status
 - h. Alarm Status
 - i. Software Version Installed
- 6. The following alarm values from the master controller shall be accessible from the operators interface:

- a. Bad Supply Air Sensor
- b. Supply Air Temperature Alarm
- c. Static Pressure Failure
- d. Damper Failure
- e. Missing Zone
- f. Zone out of Setpoint Range for over 1 Hour
- g. Change Filter alarm
- h. Bad Zone Sensor
- i. Zone Damper Failure
- 7. The master controller shall be capable of storing trend logs for all input points. External storage devices will not be acceptable. These logs shall be accessible locally or remotely using a Windows based software package which shall be provided with the system.
- F. Zone Controllers
 - 1. All zone controller shall be microprocessor based and monitor space temperature to allocate proper air flow into its zone to achieve the desired comfort and ventilation levels. Both pressure dependent and independent control shall be possible from the same controller. The zone controller shall be powered by 24 vac and shall utilize quick-disconnect terminal blocks for all wiring connections. Zone damper, air flow sensor (Pressure Independent only), and auxiliary relay board wiring, shall be provided if control of base board heat, box heat, series fan, or parallel fan control is required.
 - 2. Zone Controller shall provide inputs for the following:
 - a. Room Sensor
 - b. Room Sensor Setpoint Adjustment
 - c. Zone Damper Actuator Feedback Signal
 - d. Air Flow Sensor (Pressure Independent Only)
 - 3. Zone Controller shall provide outputs for the following:
 - a. Zone Damper Actuator (Modulating)
 - b. Auxiliary Relay Board Expansion:
 - 1) Baseboard Heat
 - 2) Box Heat
 - 3) Series Fan
 - 4) Parallel Fan
 - 4. The zone controller will provide the following control functions:
 - a. Occupied/Unoccupied Heating/Cooling Setpoints
 - b. Min/Max Zone Damper Position (Pressure Dependent)
 - c. Min/Max Zone Damper CFM (Pressure Independent)
 - d. Override Operation
 - e. Room Sensor Setpoint Adjustment Range
 - f. Voting/Nonvoting Status
 - g. Room Sensor Calibration Offset
 - h. Auxiliary Heat Setpoint
 - i. Trend Logging Interval

- 5. The following status values from the zone controller shall be accessible from the operators interface panel:
 - a. Room Temperature
 - b. Cooling & Heating Setpoint
 - c. Room Sensor Setpoint Adjustment Value
 - d. Heating/Cooling Demand
 - e. Zone Damper Position (True Feedback)
 - f. Airflow (Pressure Independent Only)
 - g. Current Damper Min/Max Position/Airflow Setpoints
 - h. Current Duct Supply Temperature
 - i. Current HVAC unit Mode of Operation
 - j. Relay Expansion Board Status (If connected)
 - k. Voting Status
 - 1. Force Mode Status
 - m. Calibration Status
 - n. Override Status
 - o. Alarm Status
 - p. Software Version Installed
- 6. The following alarm values from the zone controller shall be accessible from the operators interface panel:
 - a. Damper Calibration Failure
 - b. Damper Drive Open Failure
 - c. Damper Drive Close Failure
 - d. Zone Sensor Failure
 - e. Missing Zone
 - f. Zone out of Setpoint Range for over 1 Hour
- G. Zone And Bypass Dampers
 - 1. Round dampers shall be provided with factory mounted controls. Controls and actuator shall be mounted inside a general purpose, galvanized steel enclosure mounted to the damper assembly. The enclosure shall have a removable cover.
 - 2. Dampers shall be constructed from galvanized steel with damper mechanically fastened to a shaft and isolated from the casing to eliminate the possibility of damper binding due to shipping or handling damage. The damper shaft is to rotate in oil impregnated sintered bronze bearings. The unit casing shall be constructed of 22 gauge galvanized steel. The damper shaft shall have a mechanical position indicator of the damper position.
 - 3. The damper blade shall be a sandwich construction incorporating a solid sheet of Volara, type A gasket material, sandwiched between two halves of reinforced galvanized steel. The average valve leakage of all units shall not exceed 1% at 3" inlet static pressure.
 - 4. Zone Dampers for Pressure Independent operation must come with a factory mounted, averaging flow probe mounted at the inlet of the damper and solid state air flow sensor.
 - 5. Each round damper shall be factory insulated. The insulation shall surround the outside of the damper. The insulation shall be a minimum of 1/2" thick, dual

density fiberglass with a .001" aluminum foil face. The insulation must be UL listed and meet NFPA 90A requirements.

- 6. All performance data shall be ARI certified and rated in accordance with standard 880-89.
- H. Zone & Bypass Actuators.
 - 1. All zone and bypass damper actuators shall be direct coupled type with a minimum running torque of 35 in-lb. Actuators shall be a tristate/floating type with true position resistance feedback. Actuators shall be rated for a minimum of two million cycles. Rotation shall be 90 degrees with a running time of one minute. Actuators shall be powered by 24 vac. All wiring terminations, power, control, & feedback, shall be made through a single modular plug connector. Actuator shall include a override clutch mechanism for manual adjustment.
- I. Zone Sensors
 - 1. Zone sensors shall be a flush mount using an industry standard, Type III, 10K thermistor. Sensor accuracy shall be plus or minus 0.4 degrees Fahrenheit. Sensor shall be protected in such a way that internal wall temperature variances will not affect the sensor reading. Sensor shall be housed in an off-white, plastic enclosure. Sensor shall be provided in the following configurations:
 - a. Sensor with Override & Setpoint Adjustment
 - 2. If setpoint adjustment option is used, a user programmable value of plus or minus 0-5 degrees Fahrenheit can be entered for each individual controller. System shall be able to use any combination of the four sensor configurations.
- J. Duct & Outside Air Sensors
 - Duct and Outside Air sensors shall be industry standard, Type III, 10K thermistor. Sensor accuracy shall be plus or minus 0.4 degrees Fahrenheit. Duct sensors shall be a probe type with a minimum 8" length. Outside Air sensors shall be mounted in a weather protective enclosure and shall be mounted outside in a location where the sensor will not be affected by direct sun light. Roof mounting will not be acceptable.
- K. Software
 - 1. A Windows based, color graphics software package shall be provided to the end user, even if local or remote communications with a PC is not implemented with the initial installation of this system. Software shall be compatible with Microsoft Windows. A full functioning licensed copy of the software with a user manual shall be included along with a copy of the software. The software shall not be copy protected as to restrict its installation on multiple computers. The software shall provide the following features and functions
 - a. Preprogrammed Status Screens for:
 - 1) Master Controller
 - 2) Zone Controller
 - 3) Constant Volume Controller
 - 4) Wet-bulb/Economizer Module
 - 5) System Summary

- b. Menu Driven, Fill in the blank Programming for all system values & setpoints
- c. User definable, English language descriptors for all controller locations
- d. User friendly setup for on site or remote communications
- e. Multiple Levels of Password Protection
- f. Alarm Auto-dial out to a pager
- g. Alarm Auto-dial out to a remote PC
- h. Remote connection setup for multiple building sites
- i. Custom Graphics Editor
- j. Trend Log Setup
- k. Automatic Trend Log Retrieval
- 1. Download of Trend Logs to Excel Format Spreadsheets
- m. Fill in the Blank Schedule Programming
- n. Point & Click Programming of Holiday Schedules
- o. Automatic Air Balance Force Modes
- p. Diagnostic Counters
- q. Alarm Logging
- r. User Access Logging
- L. Wet-bulb/Economizer Control
 - 1. System shall be capable of adding a wet-bulb/economizer module to the controller communications loop. This device will be used to enhance economizer performance. The module will broadcast an outside air wet-bulb value to all controllers utilizing economizer control. The module shall accept a signal from a dry bulb outside air temperature sensor and a relative humidity transmitter. In turn the module will perform necessary calculations to determine the proper wet-bulb value. The relative humidity transmitter must be a solid state device with a minimum accuracy of plus or minus 3%.

2.7 FLEXIBLE DUCT CONNECTIONS

- A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards Metal and Flexible.
- B. Connector: Fabric crimped into metal edging strip.
 - 1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
 - 2. Net Fabric Width: Approximately 3 inches wide.
 - 3. Metal: 3 wide, 24 gage galvanized steel.

2.8 DUCT TEST HOLES

A. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify rated walls are ready for fire damper installation.
- C. Verify ducts and equipment installation are ready for accessories.
- D. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.2 INSTALLATION.

- A. Install Work in accordance with manufacturer's instructions.
- B. Install back-draft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated on Drawings.
- C. Access Doors: Install access doors at the following locations and as required by code for access.
 - 1. Upstream of each reheat coil.
 - 2. Before and after each duct mounted filter.
 - 3. Before and after each duct mounted coil.
 - 4. Before or after each automatic control damper.
 - 5. Before or after each fire damper, smoke damper, combination fire and smoke damper. Access must allow for removal of damper and access to wiring connections.
 - 6. Install at locations for cleaning kitchen exhaust ductwork in accordance with NFPA 96.
- D. Access Door Sizes: Install minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as indicated on Drawings. Install 4 x 4 inch for balancing dampers only. Review locations prior to fabrication.
 - 1. Mark access doors for fire and smoke dampers on outside surface, with minimum 1/2 inch high letters reading: FIRE/SMOKE DAMPER, SMOKE DAMPER, OR FIRE DAMPER.
- E. Install temporary duct test holes where required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- F. Zone Dampers
 - 1. The contractor shall furnish and install the control system, all materials, and programming for full operation in accordance with the manufacturer's recommended requirements and procedures. The installation shall be in

compliance with the National Electric Code, Occupational safety and Health Act, and all applicable state and local building codes.

- 2. Contractor shall have successfully completed the factory approved course for the zone damper system. Contractor shall submit course completion certificate prior to submitting zone damper submittal.
- 3. Startup and Testing shall be provided by a factory trained service personnel.
- 4. Wiring;
 - a. All wiring shall be low voltage and shall be in accordance with the National Electrical Code and local electrical codes.
 - b. All communications wire shall be 18 gauge twisted pair with foil shield and tinned drain wire. All control wire to zone thermostats shall be 18 gauge solid thermostat wire. All power wire shall be 18 gauge minimum to all damper control modules with 16 gauge minimum for all trunk lines. All wire will be sized to deliver 22 VAC minimum at all components at maximum system current rating.
 - c. Power to all components within a single system shall be controlled by a single power on/off switch.
 - d. All exposed wire shall be installed in EMT.
- 5. Owners Instructions:
 - a. Upon completion of the work and acceptance by the Owner, factory representatives under direct employ of the temperature control subcontractor shall provide one (1) 4-hour (minimum) period of instruction to the Owner's operating personnel who have responsibility for the mechanical system. After the instruction period the contractor shall submit a log-in sheet with the name, company and job title of all persons in attendance. The log-in sheet shall also have the date, start time and stop time of the instructional period. A system instruction manual shall be provided to the building operating personnel.

3.3 DEMONSTRATION

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

SECTION 23 34 00

HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceiling fans.

B. Related Sections:

- 1. Section 07 62 00 Roof curb flashing.
- 2. Section 23 05 29 Roof curbs.
- 3. Section 23 05 48 Vibration Controls for HVAC Piping and Equipment.
- 4. Section 23 07 00 HVAC Insulation: Product requirements for power ventilators for placement by this section.
- 5. Section 23 09 00 Instrumentation and Control for HVAC: Product requirements for control components to interface with fans.
- 6. Section 23 31 00 HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
- 7. Section 23 33 00 Air Duct Accessories: Product requirements for duct accessories for placement by this section.
- 8. Section 26 05 03 Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 Load Ratings and Fatigue Life for Roller Bearings.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 99 Standards Handbook.
 - 2. AMCA 204 Balance Quality and Vibration Levels for Fans.
 - 3. AMCA 210 Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
 - 4. AMCA 300 Reverberant Room Method for Sound Testing of Fans.
 - 5. AMCA 301 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- C. American Refrigeration Institute:
 - 1. ARI 1060 Air-to-Air Energy Recovery Ventilation Equipment Certification Equipment Program.
- D. ASTM International:

- 1. ASTM E1996 Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.
- E. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 Motors and Generators.
 - 2. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- F. Underwriters Laboratories Inc.:
 - 1. UL 705 Power Ventilators.
 - 2. UL 94V Vertical Burn Test

1.3 PERFORMANCE REQUIREMENTS

A. Wind-Borne Debris Loads: Design louvers located within 30 feet of grade to withstand ASTM E1996; large missile impact test.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturers instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.

- D. Balance Quality: Conform to AMCA 204.
- E. Energy Recovery Unit Wheel Energy Transfer Rating: Meet ARI 1060.
- F. Perform Work in accordance with state standards.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect motors, shafts, and bearings from weather and construction dust.

1.10 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer's warranty for fans.

1.12 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance service.

1.13 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of belts for each size of fan belt required.

PART 2 PRODUCTS

- 2.1 CEILING FANS
 - A. Manufacturers:
 - 1. Greenheck Corp
 - 2. Loren Cook Company
 - 3. Acme Engineering and Manufacturing Corp
 - 4. Greenheck Corp
 - 5. Penn Ventilation
 - 6. Twin City Fan & Blowers
 - 7. Substitutions: Not permitted.
 - B. Centrifugal Fan Unit: Direct driven with galvanized steel housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge opening, integral outlet duct collar. Discharge position convertible by moving interchangeable panels.
 - C. Disconnect Switch: Fan mounted toggle switch for thermal overload protected motor.
 - D. Grille: Molded plastic with white finish.
 - E. Wheel: Centrifugal forward curved type constructed of galvanized steel.
 - F. Motor: Open drip proof type with permanently lubricated sealed bearings and thermal overload protection.
 - G. Accessories:
 - 1. Rubber-in-shear vibration isolator.
 - 2. Ceiling radiation damper. Install radiation damper where fan is installed in fire rated membrane such as drywall encapsulated joist spaces.
 - 3. Fan speed controller.
 - 4. Time delay relay (where plans indicate fan is to be switched "on" with lights).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as shown on plans.

3.2 PREPARATION

A. Furnish roof curbs to Section 23 05 29for installation.

3.3 INSTALLATION

- A. Secure roof wall fans and gravity ventilators with cadmium plated steel aluminum stainless steel lag screws to roof curb structure.
- B. Suspended Cabinet Fans: Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- C. Install backdraft dampers on inlet to roof and wall exhaust fans and gravity ventilators which are not continuous running.
- D. Provide backdraft dampers on outlet from cabinet and ceiling fans which are not continuous running. Install safety screen where inlet or outlet is exposed.
- E. Install backdraft dampers on discharge of exhaust fans and as indicated on Drawings. Refer to Section 23 33 00.
- F. Provide sheaves required for final air balance.
- G. Install computer cabinetry exhaust fans in the computer cabinetry as located on the architectural plans.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01 40 00 - Quality Requirements: Requirements for manufacturer's field services.

3.5 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of fan cabinet.

3.6 DEMONSTRATION

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate fan operation and maintenance procedures.

3.7 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION

SECTION 23 36 01

ELECTRIC HEATERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electric Wall Heaters
 - 2. Electric Unit Heaters
- B. Related Sections:
 - 1. Section 23 09 00 Instrumentation and Control for HVAC: Product requirements for control components to interface with air terminal units.
 - 2. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electrical connections to air terminal units specified by this section.

1.2 REFERENCES

- A. American Refrigeration Institute:
 - 1. ARI 410 Forced-Circulation Air-Cooling and Air-Heating Coils
- B. National Electrical Manufacturers Association:
 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. National Fire Protection Association:
 - 1. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
- D. Underwriters Laboratories Inc.:
 - 1. UL 181 Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

- A. Section 013300 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations. Indicate schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers
- C. Product Data: Submit coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions. Submit mechanical and electrical service locations, capacities and accessories or optional items.

- D. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 017000 Execution Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 Product Requirements: Product storage and handling requirements.
- B. Accept units on site in factory packing. Inspect for damage. Store under roof.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WARRANTY

- A. Section 017000 Execution Requirements: Product warranties and product bonds.
- B. Furnish one year manufacturer's warranty unless longer is indicated.

PART 2 PRODUCTS

2.1 ELECTRIC WALL HEATERS

- A. Manufacturers:
 - 1. Qmark
 - 2. Indeeco
 - 3. Substitutions: Section 016000 Product Requirements.
- B. Assembly: UL listed and labeled assembly with terminal box and cover, and cabinet mounted controls.
- C. Heating Elements: The heating element shall be of non-glowing design consisting of an 80/20 nickel-chrome resistance wire enclosed in a steel sheath to which plate fins are copper brazed. Heating element shall have 5 year warranty.
- D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- E. Fan: Direct-drive propeller type with aluminum blades, statically and dynamically balanced, with fan guard. Fan shall have fan delay switch to ensure fan operation until heating elements have cooled.
- F. Heavy duty 16 gauge steel bar grille with bronze brown baked enamel finish and satin finished aluminum frame.
- G. Motor: Permanently lubricated totally enclosed motor.
- H. Control: Tamper resistant thermostat (adjustable only by inserting a narrow blade screwdriver through front bar grille of heater). Range shall be 40-90 degrees F. Heater shall have thermal cutout to prevent overheating. Double pole single throw disconnect shall be provided.

2.2 ELECTRIC UNIT HEATERS

- A. Manufacturers:
 - 1. Qmark
 - 2. Indeeco
 - 3. Substitutions: Section 016000 Product Requirements.
- B. Assembly: UL listed and labeled with terminal box controls. Unit shall be able to be mounted with horizontal or vertical.
- C. Enclosure shall be constructed of heavy gauge steel, phosphatized and finished with a heavy-duty baked enamel. The heater shall be factory-assembled as scheduled.
- D. The electric coil shall be of aluminum finned, copper clad steel sheathed type with buildit automatic reset linear thermal cut-out.
- E. The fan shall be direct driven propeller type. Fan shall be statically and dynamically balanced at the factory.
- F. Fan motor shall be completely enclosed, continuous fan duty sleeve bearing type, equipped with built-in thermal overload protection and combination fan guard/motor support resiliently mounted at four points to absorb any motor vibration.
- G. Unit shall be provide wall/ceiling mounting bracket and thermostat. Thermostat shall be wall or unit mounted as indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 013000 Administrative Requirements: Coordination and project conditions.
- B. For recessed units, verify recess dimensions are correct size.
- C. Verify wall construction is ready for installation.
- D. Verify concealed blocking and supports are in place and connections are correctly located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- C. Wire electric coils. Refer to Section 26 05 03.
- D. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
- E. Protection: Install finished cabinet units with protective covers during remainder of construction.
- F. Electric Wall Heaters: Coordinate to assure correct recess size for recessed units. Do not penetrate rated walls will recessed wall heaters.
- G. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Section 26 05 03.
- H. Mount wall electric heater at factory recommended minimum height above floor. Coordinate with Division 9 for mounting height.

3.3 CLEANING

- A. Section 01700 Execution Requirements: Final cleaning.
- B. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.
- C. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

END OF SECTION

SECTION 23 37 00

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Diffusers.
 - 2. Grilles.
 - 3. Louvers.
 - 4. Roof cap.
- B. Related Sections:
 - 1. Section 08 91 00 Louvers: Wall Louvers.
 - 2. Section 09 90 00 Painting and Coating: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
 - 3. Section 23 09 00 Instrumentation and Control for HVAC: Operators for adjustable louvers.
 - 4. Section 23 33 00 Air Duct Accessories: Volume dampers for inlets and outlets.

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 70 Method of Testing for Rating the Performance of Air Outlets and Inlets.
- C. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA HVAC Duct Construction Standard Metal and Flexible.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Test Reports: Rating of air outlet and inlet performance.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of air outlets and inlets.

1.5 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70.
- B. Test and rate louver performance in accordance with AMCA 500.
- C. Perform Work in accordance with International Mechanical Code.
- D. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 PRODUCTS

2.1 CEILING DIFFUSERS

- A. Manufacturers:
 - 1. E. H Price Company.
 - 2. Titus.
 - 3. Carnes.
 - 4. Krueger.
 - 5. Substitutions: Section 01 60 00 Product Requirements
- B. Type: Refer to drawings.

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2.2 CEILING RETURN GRILLES

- A. Manufacturers:
 - 1. E. H Price Company.
 - 2. Titus.
 - 3. Carnes.
 - 4. Krueger.
 - 5. Substitutions: Section 01 60 00 Product Requirements
- B. Type: Refer to drawings.

2.3 WALL SUPPLY GRILLES

- A. Manufacturers:
 - 1. E. H Price Company.
 - 2. Titus.
 - 3. Carnes.
 - 4. Krueger.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Type: Refer to drawings.

2.4 WALL RETURN GRILLES

- A. Manufacturers:
 - 1. E. H Price Company.
 - 2. Titus.
 - 3. Carnes.
 - 4. Krueger.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Type: refer to drawings.

2.5 LOUVERS (6" Deep)

- A. Manufacturers:
 - 1. Ruskin Manufacturing
 - 2. Greenheck Corp.
 - 3. Louvers and Dampers.
 - 4. American Warming and Ventilating.
 - 5. United Enertech.
 - 6. NCA.
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Stationary and Adjustable Drainable.
- C. Type: 6 inch deep with drainable blades on 37.5 degree slope with drain gutters in each blade and downspouts in jambs and mullions.

- D. Fabrication: Fully welded extruded aluminum assembly, with factory prime coat.
- E. Mounting: Furnish with screw holes in jambs for installation.
- F. Bird Screen: Bird screen with 1/2 inch square mesh for exhaust and 3/4 inch for intake.
- G. Insect Screen: Aluminum Steel mesh, set in aluminum steel frame.
- H. Finish: Color selected by Architect.

2.6 ROOF CAP

A. Manufacturers:

- 1. Greenheck Corp.
- 2. Acme Engineering and Manufacturing Corp.
- 3. Loren Cook Company.
- 4. Penn Ventilation.
- 5. Soler & Palau.
- 6. Substitutions: Not permitted.
- B. Product Description: Ventilator is low silhouette suitable for intake and exhaust applications.
- C. Fabrication: Heavy gauge aluminum assembly windband with a rolled edge and includes a one-piece spun venturi. Curb cap shall be pre-punched for mounting.
- D. Bird Screen: 1/2 inch square aluminum mesh shall be mounted horizontally across the hood.
- E. Insect Screen: Fine Aluminum Steel mesh fitted to the top of the hood throat.
- F. Roof Curb: 14 inch high self-flashing of galvanized steel construction with continuously welded seams, slope to match roof slope, 1 inch insulation and curb bottom, and factory installed nailer strip.
- G. Finish: Color selected by Architect.

2.7 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

2.8 INSTALLATION

A. Install diffusers to ductwork with airtight connection.

- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Section 23 33 00.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Section 09 90 00.

2.9 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION

SECTION 23 40 00

HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. MERV 7 Filters
- B. Related Sections:
 - 1. Section 23 81 03 Packaged Rooftop Air Conditioning Units Small Capacity: Execution requirements for equipment utilizing items specified by this section.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 850 Commercial and Industrial Air Filter Equipment.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 2. ASHRAE 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size
- C. Underwriters Laboratories Inc.:
 - 1. UL 586 High-Efficiency. Particulate, Air Filter Units.
 - 2. UL 867 Electrostatic Air Cleaners.
 - 3. UL 900 Air Filter Units.

1.3 PERFORMANCE REQUIREMENTS

- A. Conform to ARI 850, Section 7.4.
- B. Dust Spot Efficiency: Plus or minus 5 percent.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
- C. Product Data: Submit data on filter media, filter performance data, dimensions, and electrical characteristics.

- D. Samples: Submit two samples of replacement filter media of each type and each filter frame type.
- E. Manufacturer's Installation Instructions: Submit assembly and change-out procedures.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for operation, changing, and periodic cleaning.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of disposable panel filters for each piece of equipment. Provide not more than five (5) spare filters of the type used for VTAC units.

PART 2 PRODUCTS

- 2.1 MERV 7 FILTERS
 - A. Manufacturers:
 - 1. Air Technology Industries (ATI)
 - 2. Freundenberg Filtration Technologies
 - 3. Substitutions: Section 01 60 00 Product Requirements
 - B. Media: UL 900 Class 2, 3-ply multi-denier polyester media.

- 1. Upstream media is stratified, dual layer pad made with two distinct layers of polyester fibers for greater depth loading.
- 2. Downstream media pad is to be a denser needled media. A dry tack adhesive applied on downstream side holds dirt and prevents particles from breaking loose eliminating particle migration downstream.
- 3. To inhibit microbial growth on the filters media shall be treated with EPA registered antimicrobial agent.
- C. Frame: Frame shall be heavy duty 9 gauge internal wire frame. Cross wire supports welded to the frame provide additional structural strength and hold the media in placed to prevent billowing or fluttering while in operation. Panel filter is to have no perimeter frame or supporting grids to obstruct air flow and block off media. The entire face of filter is to be exposed to airstream.
- D. Nominal size: as recommended by equipment manufacturer.
- E. Nominal thickness: 1 inch.
- F. General: Filter shall not allow microbial growth when wetted.
- G. Rating, ASHRAE 52.2-2007:
 - 1. Dust spot efficiency: 25-30 percent.
 - 2. Weight arrestance: greater than 90 percent.
 - 3. Initial resistance at 500 fpm face velocity: 0.39 inch wg
 - 4. Recommended final resistance: 1.0 inch wg.
 - 5. Continuous Operating Temperature Limit: 200 degrees Fahrenheit.

PART 3 EXECUTION

- 3.1 INSTALLATION
 - A. Install filters with felt, rubber, or neoprene gaskets to prevent passage of unfiltered air around filters where tackified adhesive is not integral to filter.
 - B. Do not operate fan system until filters are in place. Replace temporary filters used during construction and testing, with clean set.

3.2 SCHEDULES

A. Provide filters to be used as filters and prefilters as scheduled by this section. Equipment which is supplied by the manufacturer with non-standard sized washable filters such as wall mounted exposed fan coils, ceiling cassette fan coils and PTAC units shall not be supplied with filters as scheduled by this section and shall instead utilize factory supplied filters.

END OF SECTION

SECTION 23 81 03

PACKAGED ROOFTOP AIR CONDITIONING UNITS - SMALL CAPACITY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Gas fired packaged rooftop air conditioning unit.

B. Related Sections:

- 1. Section 07 62 00 Roof curb flashing.
- 2. Section 23 05 48 Vibration Controls for HVAC Piping and Equipment.
- 3. Section 23 05 53 Identification for Piping and HVAC Equipment: Rooftop unit labeling.
- 4. Section 23 09 00 Instrumentation and Control for HVAC: Equipment required for RTU control.
- 5. Section 23 09 93 Sequence of Operations for HVAC Controls: Sequences of operation applying to units in this section.
- 6. Section 23 11 23 Facility Natural-Gas Piping: Natural gas piping connections.
- 7. Section 23 33 00 Air Duct Accessories: Flexible connections.
- 8. Section 26 05 03 Equipment Wiring Connections: Electrical connection to units.

1.2 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 210/240 Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
 - 2. ARI 270 Sound Rating of Outdoor Unitary Equipment.
 - 3. ARI 340/360 Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment.
- B. Air Movement and Control Association International, Inc.:
 - 1. AMCA 500 Test Methods for Louvers, Dampers, and Shutters.
- C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 52.1 Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
 - 2. ASHRAE 62 Ventilation for Acceptable Indoor Air Quality.
 - 3. ASHRAE 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings.
- D. ASTM International:
 - 1. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
- E. National Fire Protection Association:

- 1. NFPA 54 National Fuel Gas Code.
- 2. NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems.
- F. VISCMA (*The Vibration Isolation and Seismic Control Manufacturers Association*) has developed Testing and Rating Standards for Vibration Components that comply with Code and ASHRAE based requirements.

1.3 DEFINITIONS

- A. Energy Efficiency Ratio (EER) Ratio of net cooling capacity in Btuh to total rate of electric input in watts under designated operating conditions.
- B. Seasonal Energy Efficiency Ratio (SEER) Total cooling output of an air conditioner during its normal annual usage period for cooling (in Btu) divided by total electric energy input during the same period (in Wh).

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit data indicating:
 - 1. Cooling and heating capacities.
 - 2. Dimensions.
 - 3. Weights.
 - 4. Rough-in connections and connection requirements.
 - 5. Duct connections.
 - 6. Electrical requirements with electrical characteristics and connection requirements.
 - 7. Controls.
 - 8. Accessories.
- C. Test Reports: Submit results of factory test at time of unit shipment.
- D. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Manufacturer's Field Reports: Submit start-up report for each unit.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

1.6 QUALITY ASSURANCE

- A. Cooling Capacity: Rate in accordance with ARI 210/240 ARI 340/360.
- B. Sound Rating: Measure in accordance with ARI 270.
- C. Insulation and adhesives: Meet requirements of NFPA 90A.
- D. Perform Work in accordance with latest edition of International Mechanical Code.
- E. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Accept units on site. Inspect for damage.
- C. Protect units from damage by storing off roof until roof mounting curbs are in place.

1.10 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

1.11 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

- B. Furnish five year manufacturer's warranty for compressors.
- C. Furnish five year manufacturer's warranty for heat exchangers.

1.12 MAINTENANCE SERVICE

- A. Section 01 70 00 Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of equipment for one year from Date of Substantial Completion. Include maintenance items as shown in manufacturer's operating and maintenance data, including filter replacements, fan belt replacement, and controls checkout and adjustments.
- C. Furnish 24-hour emergency service on breakdowns and malfunctions for this maintenance period.

1.13 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one set of filters and fan belts for each unit.

PART 2 PRODUCTS

2.1 GAS FIRED PACKAGED ROOFTOP AIR CONDITIONING UNITS

- A. Manufacturers:
 - 1. York
 - 2. Carrier
 - 3. Lennox
 - 4. Trane
 - 5. Substitutions: No substitutions permitted.
- B. Product Description: Self-contained, packaged, factory assembled and wired, consisting of curb, cabinet, supply fan, refrigerant cooling coil, compressor, refrigeration circuit, condenser, gas-fired heating section, air filters, mixed air casing, controls, and accessories.
- C. Configuration: As indicated on Drawings.
- D. Curb Mounted Vibration Isolation Rail:1. Refer to section 23 05 48.
- E. Cabinet:
 - 1. Designed for outdoor installation with weatherproof construction.

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- 2. Panels: Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1000 hour salt spray test per ASTM-B117 standards. Cabinet doors shall be hinged with tool-less access for easy servicing and maintenance. Full perimeter base rails shall be provided to assure reliable transit of equipment, overhead rigging, fork truck access and proper sealing on roof curb applications. Filters shall be accessible through hinged access door. Fan performance measuring ports shall be provided on the outside of the cabinet to allow accurate air measurements of evaporator fan performance without removing panels or creating bypass of the coils.
- 3. Condensate pan shall be slide out design, constructed of a non-corrosive material, internally sloped and conforming to ASHRAE 62-B9 standards. Condensate connection shall be a minimum of $\frac{3}{4}$ " I.D. female and be rigid mount connection.
- 4. Insulation: Indoor blower sections shall be insulated with up to 1" thick insulation coated on the airside. Either aluminum foil faced or elastomeric rubber insulation shall be used in the unit's compartments and be fastened to prevent insulation from entering the air stream.
- F. Supply Fan: Fan shall be a belt drive assembly and include an adjustable pitch motor pulley. Job site selected brake horsepower shall not exceed the motors nameplate horsepower rating plus the service factor. Units shall be designed to operate within the service factor. Fan wheel shall be double inlet type with forward curve blades, dynamically balanced to operate smoothly throughout the entire range of operation. Airflow design shall be constant volume. Bearings shall be sealed and permanently lubricated for longer life and no maintenance. Entire blower assembly and motor shall be slide out design.
- G. Evaporator Coil: Coil shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option. Coil shall be of the direct expansion, draw-thru design.
- H. Re-heat Coil: Coil shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed. Special Phenolic coating shall be available as a factory option. Coil shall be of the direct expansion, draw-thru design. Refer to drawings for units that require re-heat coils.
- I. Compressor: Shall be fully hermetic type, direct drive, internally protected with internal high-pressure relief and over temperature protection. The hermetic motor shall be suction gas cooled and have a voltage range of + or 10% of the unit nameplate voltage. Shall have internal spring isolation and sound muffling to minimize vibration and noise, and be externally isolated on a dedicated, independent mounting.
- J. Refrigeration circuit: Independent fixed-orifice or thermally operated expansion devices. Solid core filter drier/strainer to eliminate any moisture or foreign matter.

Accessible service gage connections on both suction and discharge lines to charge, evacuate, and measure refrigerant pressure during any necessary servicing or troubleshooting, without losing charge. The 6.5 through 12.5 ton unit shall have two independent refrigerant circuits, equally split in 50% capacity increments.

- K. Condenser coil: Coil shall have aluminum plate fins mechanically bonded to seamless internally enhanced copper tubes with all joints brazed or Micro-Channel aluminum tube, aluminum fins. Condenser coils shall be of the draw-thru design.
- L. Condenser fan: The outdoor fans shall be of the direct drive type, discharge air vertically, have aluminum blades riveted to corrosion resistant steel spider brackets and shall be dynamically balanced for smooth operation. The outdoor fan motors shall have permanently lubricated bearings internally protected against overload conditions and staged independently. A cleaning window shall be provided on two sides of the units for coil cleaning.
- M. Gas-Fired Heating Section:
 - 1. Heat exchanger and exhaust system shall be constructed of aluminized steel, and be designed with induced draft combustion with post purge logic, energy saving direct spark ignition, and redundant main gas valve.
 - 2. The heat exchanger shall be of the tubular type, constructed of T1-40 aluminized steel. Burners shall be of the in-shot type, constructed of aluminum-coated steel. All gas piping shall enter the unit cabinet at a single location, through either the side or bottom, without any field modifications.
 - 3. An integrated control board shall provide timed control of evaporator fan functioning and burner ignition.
 - 4. Heating section shall be provided with the following minimum protection: Primary and auxiliary high-temperature limit switches. Induced draft pressure sensor. Flame roll out switch (manual reset). Flame proving controls. All two stage gas units shall have two independent stages.
 - 5. Require unit fan operation before allowing gas valve to open.
- N. Air Filters
 - 1. Refer to section 23 40 00.
- O. Outside Air:
 - 1. Damper shall open to a minimum set-point while unit is in occupied mode.
 - 2. Refer to drawings for units that require demand control ventilation.
 - 3. Shall be a fully modulating 0%-100%, dual enthalpy controlled economizer with multistage integrated economizer and compressor operation for maximum benefit. The economizer shall consist of a motor operated outdoor air damper and

return air damper assembly constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals.

- P. Power Exhaust Fans:
 - 1. Refer to drawings for units that require power exhaust.
 - 2. Controls shall be factory installed.
 - 3. The control shall be on-off.
 - 4. The exhaust fan shall be backward inclined type. Fan(s) and motor(s) shall be dynamically balanced. A back draft damper shall be included with the exhaust fan.
 - 5. Exhaust air fan shall be sized for 70% relief.
- Q. Unit 2,000 cfm or greater shall be provided with a smoke detector(s) connections unit, for unit shutdown upon a detection of smoke.
- R. Controls:
 - 1. Refer to the Specification 23 09 93 Sequence of Operations for HVAC Controls
 - 2. Unit shall be complete with self-contained low-voltage control circuit protected by a resettable circuit breaker on the 24-volt transformer side.
 - 3. Unit shall incorporate a lockout circuit which provides reset capability at the space thermostat or base unit, should any of the following standard safety devices trip and shut off compressor.
 - 4. Loss-of-charge/Low-pressure switch.
 - 5. High-pressure switch.
 - 6. Freeze condition sensor on evaporator coil. If any of these safety devices trip, the LCD screen will display the alarm message.
 - 7. Unit shall incorporate "AUTO RESET" compressor over temperature, over current protection.
 - 8. Unit shall operate with conventional thermostat designs and have a low voltage terminal strip for easy hook-up.
 - 9. Unit control board shall have on-board diagnostics and fault message display.
 - 10. Standard controls shall include anti-short cycle and low voltage protection, and permit cooling operation down to a selectable value as low as 0 °F.
- S. Accessories:
 - 1. Roof Curb Adaptor Package: Furnish duct support hardware to adapt unit to existing roof curb. Refer to drawings for units that require adaptor curbs.
 - 2. Side discharge plenum curb. Refer to drawings for units that require side discharge plenum curbs.
 - 3. Electrical disconnect.
 - 4. GFCI receptacle powered when disconnect is in open position.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

B. Verify roof curbs are installed and dimensions are as instructed by manufacturer and coordinated with roof openings.

3.2 PREPARATION

A. Furnish roof curbs to Division 7 for installation.

3.3 INSTALLATION

A. Roof Curb:

- 1. Assemble roof curb.
- 2. Install roof curb level.
- 3. Coordinate curb installation and flashing.
- 4. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
- 5. Install gasket material between unit base and roof curb.
- B. Curb Mounted Vibration Isolation Rail:
 - 1. Installation of all vibration isolation rails shall be accomplished as per the manufacturer's written instructions and adjust mountings to level equipment.
- C. Connect units to supply and return ductwork with flexible connections. Refer to Section 23 33 00.
- D. Install condensate piping with trap and route from drain pan to roof drain.
- E. Install components furnished loose for field mounting.
- F. Install electrical devices furnished loose for field mounting.
- G. Install control wiring between unit and field installed accessories.
- H. Remove from roof and dispose off-site panels removed from units during installation of economizer and dampers.
- I. Locate remote panels as indicated on Drawings.

3.4 INSTALLATION - NATURAL GAS HEATING SECTION

- A. Connect natural gas piping in accordance with NFPA 54.
- B. Connect natural gas piping to unit, full size of unit gas train inlet. Arrange piping with clearances for burner service.
- C. Install the following piping accessories on natural gas piping connections. Refer to Section 23 11 23.
 - 1. Pressure gage (required only at RTU furthest from gas motor).
 - 2. Shutoff valve.

D. Install natural gas piping accessories above roof.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish initial start-up and shutdown during first year of operation, including routine servicing and checkout.

3.6 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Vacuum clean coils and inside of unit cabinet.
- C. Install new throwaway filters in units at Substantial Completion and 30 days after substantial completion.

3.7 DEMONSTRATION

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate unit operation and maintenance.
- C. Furnish services of manufacturer's technical representative for one 8 hour day to instruct Owner's personnel in operation and maintenance of units. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

3.8 SCHEDULES

A. As per drawings.

END OF SECTION

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SECTION 26 05 03

EQUIPMENT WIRING CONNECTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.
- B. Related Sections:
 - 1. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 - 2. Section 26 05 33 Raceway and Boxes for Electrical Systems.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 General Requirements for Wiring Devices.
 - 2. NEMA WD 6 Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Submittal procedures.
- B. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and requirements.
- D. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- E. Sequence electrical connections to coordinate with start-up of equipment.

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PART 2 PRODUCTS

- 2.1 CORD AND PLUGS
 - A. Attachment Plug Construction: Conform to NEMA WD 1.
 - B. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.
 - C. Cord Construction: Type SO multi-conductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit over-current protection.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods compatible with existing electrical installations, or as specified.

3.3 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.

- E. Install cord and cap for field-supplied attachment plug.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

3.5 EQUIPMENT CONNECTION SCHEDULE

- A. Make all final electrical connections to equipment supplied by others. This equipment shall include but not be limited to: Kitchen Equipment, Pool Equipment, Laundry Equipment, and Owner Supplied Equipment.
- B. It is not the responsibility of the Electrical Contractor to "plug in" equipment supplied with a cord and plug, for example: Televisions, Microwaves, Refrigerators, Residential Washing Machines, and Residential Dryers.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; nonmetallic-sheathed cable; direct burial cable; service entrance cable; armored cable; metal clad cable; and wiring connectors and connections.
- B. Related Sections:
 - 1. Section 26 05 53 Identification for Electrical Systems: Product requirements for wire identification.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
 - 1. UL 1277 Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
 - 1. Solid conductor for feeders and branch circuits 10 AWG and smaller.
 - 2. Stranded conductors for control circuits.
 - 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 - 4. Conductor not smaller than 14 AWG for control circuits.
 - 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
- B. Wiring Methods: Provide the following wiring methods:
 - 1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway or metal clad cable.
 - 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.

- 3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN insulation, in raceway or metal clad cable.
- 4. Wet or Damp Interior Locations: Use only building wire Type THWN insulation, in raceway.
- 5. Exterior Locations: Use only building wire, Type THHN/THWN insulation, in raceway.
- 6. Underground Locations: Use only building wire Type XHHW insulation, in raceway

1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit for building wire and each cable assembly type.
- C. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- D. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.9 FIELD MEASUREMENTS

A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- C. Wire and cable routing indicated is approximate unless dimensioned. Include wire and cable lengths within 10 ft (3000 mm) of length shown.

PART 2 PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. AETNA.
 - 2. American Insulated Wire Corp.
 - 3. Colonial Wire.
 - 4. Encore Wire.
 - 5. General Cable Co.
 - 6. Republic Wire.
 - 7. Rome Cable.
 - 8. Service Wire Co.
 - 9. Southwire.
 - 10. Superior Essex.
 - 11. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Single conductor insulated wire.
- C. Conductor: Copper.
- D. Insulation Voltage Rating: 600 volts.
- E. Insulation Temperature Rating: 90 degrees C.
- F. Insulation Material: Thermoplastic.

2.2 SERVICE ENTRANCE CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.

- 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: Type XHHW-2.

2.3 DIRECT BURIAL CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Substitutions: Section 01 60 00 Product Requirements Not Permitted.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.

2.4 METAL CLAD CABLE

- A. Manufacturers:
 - 1. Diamond Wire & Cable Co.
 - 2. Essex Group Inc.
 - 3. General Cable Co.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Armor Material: Aluminum.
- G. Armor Design: Interlocked metal tape
- H. Jacket: PVC. (where required)

2.5 TERMINATIONS

A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.

B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify interior of building has been protected from weather.
- C. Verify mechanical work likely to damage wire and cable has been completed.
- D. Verify raceway installation is complete and supported.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods [compatible with existing electrical installations, or] as specified.
- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify [and color code] wire and cable under provisions of Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:

- 1. Pull conductors into raceway at same time.
- 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips or [plastic]
 - cable ties to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques Direct Burial Cable:
 - 1. Trench and backfill for direct burial cable installation. Refer to Section 31 23 23 and Section 31 23 17. Install warning tape along entire length of direct burial cable, within 3 inches (75 mm) of grade.
 - 2. Use suitable direct burial cable fittings and connectors.
- G. Special Techniques Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
 - 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
- H. Install stranded conductors for branch circuits 10 AWG and smaller. Install crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under screws.
- I. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- J. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- K. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black and red for single phase circuits at 120/240 volts.
 - b. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - c. Orange, brown, and yellow for circuits at 277/480 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rod electrodes.
 - 2. Active electrodes.
 - 3. Wire.
 - 4. Grounding well components.
 - 5. Mechanical connectors.
 - 6. Exothermic connections.
- B. Related Sections:
 - 1. Section 03 20 00 Concrete Reinforcing: Bonding or welding bars when reinforcing steel is used for electrodes.
 - 2. Section 09 69 00 Access Flooring: Grounding systems for access flooring.
 - 3. Section 26 41 00 Facility Lightning Protection: Grounding of lightning protection system.
 - 4. Section 33 79 00 Site Grounding: Site related grounding components for buildings and facilities.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE 142 Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - 2. IEEE 1100 Recommended Practice for Powering and Grounding Electronic Equipment.
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
 - 2. NFPA 99 Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Existing Metal underground water pipe.
 - 2. Metal building frame.
 - 3. Concrete-encased electrode.

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- 4. Ground ring specified in Section 33 79 00.
- 5. Existing Metal underground gas piping system.
- 6. Rod electrode.
- 7. Plate electrode.

1.4 DESIGN REQUIREMENTS

A. Construct and test grounding systems for access flooring systems on conductive floors accordance with IEEE 1100. Refer to Section 09 69 00.

1.5 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 5 ohms maximum.

1.6 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- D. Manufacturer's Installation Instructions: Submit for active electrodes.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.7 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.8 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Maintain one copy of each document on site.

1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum years documented experience approved by manufacturer.

1.10 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- D. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.12 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 PRODUCTS

2.1 ROD ELECTRODES

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. O-Z Gedney Co.
 - 3. Thomas & Betts, Electrical
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description:
 - 1. Material: Copper-clad steel
 - 2. Diameter: 3/4 inch (19 mm)
 - 3. Length: 8 feet(2.4 m).
- C. Connector: U-bolt clamp.
- 2.2 WIRE
 - A. Material: Stranded copper.

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- B. Foundation Electrodes: 4 AWG.
- C. Grounding Electrode Conductor: Copper conductor bare.
- D. Bonding Conductor: Copper conductor bare.

2.3 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches NPS (DN200) by 24 inches (600 mm) long clay tile concrete fiberglass pipe with belled end.
- B. Well Cover: Cast iron Fiberglass with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Erico, Inc.
 - 2. ILSCO Corporation.
 - 3. O-Z Gedney Co..
 - 4. Thomas & Betts, Electrical.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

A. Remove paint, rust, mill oils, and surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.
- B. Extend existing grounding system using materials and methods compatible with existing electrical installations, or as specified.
3.4 INSTALLATION

- A. Install in accordance with IEEE 142 and 1100.
- B. Install rod electrodes at locations pre-approved by Owner and Engineer. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- E. Install 4 AWG bare copper wire in foundation footing.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Install 2 AWG bare copper bonding conductor.
- I. Install isolated grounding conductor for circuits supplying electronic cash registers, personal computers in accordance with IEEE 1100.
- J. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.
- K. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- L. Connect to site grounding system. Refer to Section 33 79 00.
- M. Bond to lightning protection system. Refer to Section 26 41 00.
- N. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- O. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- P. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- Q. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding

conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

- R. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- S. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- D. Perform ground resistance testing in accordance with IEEE 142.
- E. Perform leakage current tests in accordance with NFPA 99.
- F. Perform continuity testing in accordance with IEEE 142.
- G. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

END OF SECTION

SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 03 30 00 Cast-In-Place Concrete: Product requirements for concrete for placement by this section.
 - 2. Section 27 05 29 Hangers and Supports for Communications Systems.
 - 3. Section 28 05 29 Hangers and Supports for Electronic Safety and Security.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.

- 5. UL Fire Resistance Directory.
- E. Intertek Testing Services (Warnock Hersey Listed):1. WH Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.

F. Manufacturer's Installation Instructions:

- 1. Hangers and Supports: Submit special procedures and assembly of components.
- 2. Firestopping: Submit preparation and installation instructions.
- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgements: For conditions not covered by UL or WH listed designs, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.

B. Installer: Company specializing in performing work of this section with minimum years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company
 - 3. O-Z Gedney Co.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.
- 2.2 FORMED STEEL CHANNEL
 - A. Manufacturers:
 - 1. Unistrut Corp.
 - 2. Allied Tube & Conduit Corp.
 - 3. B-Line Systems
 - 4. Midland Ross Corporation, Electrical Products Division
 - 5. Substitutions: Section 01 60 00 Product Requirements
 - B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.
- 2.3 SPRING STEEL CLIPS
 - A. Product Description: Mounting hole and screw closure.
- 2.4 SLEEVES
 - A. Sleeves for Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.
 - B. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage (1.2 mm) thick galvanized steel.
 - C. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
 - D. Stuffing Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation
 - 3. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve,

connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products
 - 6. Specified Technology, Inc.
 - 7. Substitutions: Section 01 60 00 Product Requirements

B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.

- 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
- 2. Foam Firestopping Compounds: Multiple component foam compound.
- 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
- 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
- 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
- 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
- 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of colors.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

- 1. Furnish UL listed products or products tested by independent testing laboratory.
- 2. Select products with rating not less than rating of wall or floor being penetrated.
- E. Non-Rated Surfaces:
 - 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
 - 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing and damming materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.

- 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.
 - 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 - 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above flush with top of recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
 - 4. Support vertical conduit at every other floor.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:
 - 1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.

- b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
- c. Pack void with backing material.
- d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- 2. Where cable tray, bus, cable bus, conduit, wireway, and trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:
 - 1. Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
 - 2. Install escutcheons floor plates or ceiling plates where conduit, penetrates nonfire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
 - 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

- E. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 26 05 33

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:

- 1. Section 26 05 03 Equipment Wiring Connections.
- 2. Section 26 05 26 Grounding and Bonding for Electrical Systems.
- 3. Section 26 05 29 Hangers and Supports for Electrical Systems.
- 4. Section 26 05 53 Identification for Electrical Systems.
- 5. Section 26 27 26 Wiring Devices.
- 6. Section 27 05 33 Conduits and Backboxes for Communications Systems.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 Aluminum Rigid Conduit (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

- B. Underground More than 5 feet (1500 mm) outside Foundation Wall: Provide thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.
- C. Underground Within 5 feet (1500 mm) from Foundation Wall: Provide thickwall nonmetallic conduit and thin-wall nonmetallic conduit. Provide cast metal or nonmetallic boxes.
- D. In or Under Slab on Grade: Provide thickwall nonmetallic conduit]. Provide cast or nonmetallic metal boxes.
- E. Outdoor Locations, Above Grade: Provide rigid steel and aluminum conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- F. In Slab Above Grade: Provide thickwall nonmetallic conduit]. Provide cast boxes.
- G. Wet and Damp Locations: Provide rigid aluminum conduit and thickwall nonmetallic conduit]. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Wet Locations (Pool Rooms): Provide stainless steel conduit, approved electrical metallic tubing, and thickwall nonmetallic conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- I. Exposed Wet Locations (Pool Rooms): Provide stainless steel conduit or approved electrical metallic tubing. Provide stainless steel boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- J. Concealed Dry Locations: Provide rigid steel conduit, electrical metallic tubing and thickwall nonmetallic conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- K. Exposed Dry Locations: Provide rigid steel conduit, electrical metallic tubing and thickwall nonmetallic conduit. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch (19 mm) unless otherwise specified.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.

- 4. Flexible nonmetallic conduit.
- 5. Nonmetallic tubing.
- 6. Raceway fittings.
- 7. Conduit bodies.
- 8. Surface raceway.
- 9. Wireway.
- 10. Pull and junction boxes.
- 11. Handholes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch (DN50).
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

- 2.1 METAL CONDUIT
 - A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.

- 3. Thomas & Betts Corp.
- 4. Walker Systems Inc.
- 5. The Wiremold Co.
- 6. Substitutions: Section 01 60 00 Product Requirements
- B. Rigid Steel Conduit: ANSI C80.1.
- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.
- E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Interlocked steel construction.
- C. Fittings: NEMA FB 1.

2.3 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Interlocked aluminum construction with PVC jacket.
- C. Fittings: NEMA FB 1.

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.

- 5. The Wiremold Co.
- 6. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel or malleable iron, [compression] type.
- 2.5 NONMETALLIC CONDUIT
 - A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
 - B. Product Description: NEMA TC 2; Schedule 40 PVC.
 - C. Fittings and Conduit Bodies: NEMA TC 3.

2.6 NONMETALLIC TUBING

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: NEMA TC 2.
- C. Fittings and Conduit Bodies: NEMA TC 3.

2.7 OUTLET BOXES

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.

- 2. Concrete Ceiling Boxes: Concrete type.
- C. Nonmetallic Outlet Boxes: NEMA OS 2.
- D. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer. [Furnish threaded hubs.]
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- F. Wall Plates for Unfinished Areas: Furnish gasketed cover.

2.8 PULL AND JUNCTION BOXES

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements
- B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- C. Hinged Enclosures: As specified in Section 26 27 16.
- D. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
- E. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:
 - 1. Material: Cast aluminum.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: "ELECTRIC".
- F. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
 - 1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
 - 2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify outlet locations and routing and termination locations of raceway prior to roughin.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch (19 mm). Do not cross conduits in slab.
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.

- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet (3 m) prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.
- P. Flush mount device boxes in wall unless otherwise noted.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.
- B. Related Sections:
 - 1. Section 09 90 00 Painting and Coating: Execution requirements for painting specified by this section.
 - 2. Section 27 05 53 Identification for Communications Systems.
 - 3. Section 28 05 53 Identification for Electronic Safety and Security.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Samples:
 - 1. Submit two samples of each type of identification products applicable to project.
 - 2. Submit two nameplates, 4×4 inch (100 x 100 mm) in size illustrating materials and engraving quality.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept identification products on site in original containers. Inspect for damage.
- C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install labels nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.7 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light white contrasting background color.
- B. Letter Size:
 1. 1/8 inch (3 mm) high letters for identifying individual equipment and loads.

- 2. 1/4 inch (6 mm) high letters for identifying grouped equipment and loads.
- C. Minimum nameplate thickness: 1/8 inch (3 mm).

2.2 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background.

2.3 ARC FLASH LABELS

- A. Labels: Permanent adhesive, color printed on matte white background, laminated.
- B. Information: Label to include information required by NFPA 70E and IEEE 1584 including Personal Protective Equipment required, Flash Hazard Boundary, Shock approach distances, and event discharge energy.

2.4 WIRE MARKERS

- A. Description: Cloth tape, split sleeve, or tubing type wire markers.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number.
 - 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

2.5 CONDUIT AND RACEWAY MARKERS

A. Description: Nameplate fastened with adhesive Labels fastened with adhesive Stencils.

B. Color:

- 1. Medium Voltage System: Black lettering on white background.
- 2. 480 Volt System: Black lettering on white background.
- 3. 208 Volt System: Black lettering on white background.

C. Legend:

- 1. Medium Voltage System: HIGH VOLTAGE.
- 2. 480 Volt System: 480 VOLTS. HIGH VOLTAGE.
- 3. 208 Volt System: 208 VOLTS.

2.6 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches (50 mm) Outside Diameter of Raceway: 1/2 inch (13 mm) high letters.
 - 2. 2-1/2 to 6 inches (64 to 150 mm) Outside Diameter of Raceway: 1 inch (25 mm) high letters.

- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to the following:
 - 1. Black lettering on white background.
 - 2. White lettering on gray background.
 - 3. Red lettering on white background.
 - 4. Blue lettering on white background.

2.7 UNDERGROUND WARNING TAPE

A. Description: 4 inch (100 mm) wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates markers.
- D. Re-stencil existing equipment.

3.3 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
 - 6. Install nameplates for the following:
 - a. Switchboards.
 - b. Panelboards.
 - c. Transformers.

- d. Service Disconnects.
- C. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations.
 - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
 - 1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
 - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 - 3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.
- E. Raceway Marker Installation:
 - 1. Install raceway marker for each raceway longer than 6 feet (2000 mm).
 - 2. Raceway Marker Spacing: 20 feet (6000 mm) on center.
 - 3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
 - a. Paint colored band on each conduit longer than 6 feet (2000 mm).
 - b. Paint bands 20 feet (6000 mm) on center.
 - c. Color:
 - 1) 480 Volt System: Blue.
 - 2) 208 Volt System: Yellow.
- F. Stencil Installation:
 - 1. Apply stencil painting in accordance with Section 09 90 00.
- G. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Lighting contactors.
 - 2. Occupancy sensors.
 - 3. Photocells.
 - 4. Photocell control unit.
 - 5. Modular Dimming Controls
- B. Related Sections:
 - 1. Section 26 05 03 Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
 - 2. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables.
 - 3. Section 26 05 33 Raceway and Boxes for Electrical Systems: Product requirements for raceway and boxes for placement by this section.
 - 4. Section 26 05 53 Identification for Electrical Systems: Product requirements for electrical identification items for placement by this section.
 - 5. Section 26 24 16 Panelboards.
 - 6. Section 26 27 26 Wiring Devices: Product requirements for wiring devices for placement by this section.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 Industrial Control and Systems: Controllers, Contractors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 4 Industrial Control and Systems: Terminal Blocks.
 - 5. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 6. NEMA ICS 6 Industrial Control and Systems: Enclosures.
 - 7. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3 SYSTEM DESCRIPTION

A. Distributed switching control using self contained individually mounted lighting relays.

- B. Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting inside building larger than 5000 square feet (465 square meters). Control shutoff by method conforming to ICC IECC.
- C. Where indicated on drawings or required by applicable code, provide automatic shutoff for lighting outside building. Control shutoff by method conforming to ICC IECC.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
 - 1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
 - 2. Include typical wiring diagrams for each component.
- C. Product Data: Submit manufacturer's standard product data for each system component.
- D. Manufacturer's Installation Instructions: Submit for each system component.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record the following information:
 - 1. Actual locations of components and record circuiting and switching arrangements.
 - 2. Wiring diagrams reflecting field installed conditions with identified and numbered, system components and devices.
- C. Operation and Maintenance Data:
 - 1. Submit replacement parts numbers.
 - 2. Submit manufacturer's published installation instructions and operating instructions.
 - 3. Recommended renewal parts list.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept components on site in manufacturer's packaging. Inspect for damage.
- C. Protect components by storing in manufacturer's containers indoor protected from weather.

1.9 WARRANTY

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five year manufacturer warranty for components.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two of each switch type.
- C. Furnish two of each occupancy sensor type.
- D. Furnish two of each photocell type.

PART 2 PRODUCTS

2.1 LIGHTING CONTACTORS

- A. Manufacturers:
 - 1. Automatic Switch Co. Model.
 - 2. Cutler-Hammer Model.
 - 3. Square D Model.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: NEMA ICS 2, magnetic lighting contactor.

- C. Configuration: Mechanically held, 2 wire control.
- D. Coil Operating Voltage: 120 volts, 60 Hertz.
- E. Poles: To match circuit configuration and control function.
- F. Contact Rating: Conductor overcurrent protection, considering derating for continuous loads.
- G. Accessories:
 - 1. Cover Mounted Pilot Devices: NEMA ICS 5, standard-duty heavy-duty oiltight type with Form Z contacts, rated A150.
 - 2. Pushbutton: ON/OFF function, with unguarded configuration.
 - 3. Selector Switch: ON/OFF/AUTOMATIC function, with rotary action.
 - 4. Indicating Light: Red lens, resistor type, with led lamp.
 - 5. Auxiliary Contacts: One field convertible in addition to seal-in contact.
 - 6. Relays: NEMA ICS 2.
 - 7. Control Power Transformers: 120 volt secondary, VA minimum, in each enclosed contactor. Furnish fused primary and secondary, and bond unfused leg of secondary to enclosure.
- H. Enclosure: NEMA ICS 6, to meet conditions.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3.

2.2 OCCUPANCY SENSOR

- A. Manufacturers:
 - 1. Douglas Lighting Controls.
 - 2. Novitas.
 - 3. Watt Stopper.
 - 4. Substitutions: [Section 01 60 00 Product Requirements].
- B. Compatible with modular relay panels. Capable of being wired directly to Class 2 wiring without auxiliary components or devices.
- C. Separate sensitivity and time delay adjustments with LED indication of sensed movement. User adjustable time-delay: 30 seconds to 12 minutes.
- D. Furnish with manual override.
- E. Operation: Silent.
- F. Room Sensors: As indicated on Drawings.

G. Corridor and Hallway Sensors:

- 1. Capable of detecting motion 14 feet (4 m) wide and 80 feet (24 m) long with one sensor mounted 10 feet (3 m) above floor.
- 2. Capable of detecting motion in warehouse aisle 10 feet (3 m) wide and 60 feet (18 m) long or 100 feet (30 m) long when mounted 22 feet (7 m) above floor.
- 3. Capable of being wired in master-slave configuration to extend area of coverage.

2.3 PHOTOCELLS

- A. Manufacturers:
 - 1. Douglas Lighting Controls.
 - 2. Novitas.
 - 3. Watt Stopper.
 - 4. Substitutions: [Section 01 60 00 Product Requirements].
- B. General: Consist of sensor mounted as indicated on Drawings with separate controlcalibration module. Sensor connected to control-calibration module via single shielded conductor with maximum distance of 500 feet (150 m). Control unit powered by 24 VAC.
- C. Control-Calibration Module: Furnish with the following:
 - 1. Capable of being switched between 4 measurement ranges.
 - 2. Separate trip points for high and low response settings.
 - 3. Momentary contact device to override photocell relays.
 - 4. Three minute time delay between switching outputs to avoid nuisance tripping.
- D. Sensor Devices: Each sensor employs photo diode technology to allow linear response to daylight within illuminance range.
 - 1. Exterior Lighting: Hooded sensor, horizontally mounted, employing flat lens, and working range 1-10 footcandles (11-108 lx) in 10 percent increments. Entire sensor encased in optically clear epoxy resin.
 - 2. Indoor Lighting: Sensor with Fresnel lens providing for 60 degree cone shaped response area to monitor indoor office lighting levels.
 - 3. Atriums: Sensor with translucent dome with 180 degree field of view and respond in range of 100-1,000 footcandles (1,076-10,760 lx).
 - 4. Skylights: Sensor with translucent dome with 180 degree field of view and respond in range of 1,000-10,000 footcandles (10,760-107,640 lx).

2.4 PHOTOCELL CONTROL UNIT

- A. Manufacturers:
 - 1. Douglas Lighting Controls.
 - 2. Novitas.
 - 3. Watt Stopper.
 - 4. Substitutions: [Section 01 60 00 Product Requirements].

B. Product Description: Photodiode control unit with PHOTOCELL ENABLE and MASTER OVERRIDE inputs for remote control, 3 minute time delay, and with selectable ranges for 1-10 footcandle (11-108 lx).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Mount occupancy sensors, and photocells as indicated on Drawings.
- B. Install wiring in accordance with Section 26 05 19.
- C. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings. Install wire in conduit in accordance with Section 26 05 33.
- D. Label each low voltage wire clearly indicating connecting relay panel. Refer to Section 26 05 53.
- E. Mount relay as indicated on Drawings. Wire numbered relays in panel to control power to each load. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.
- F. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.
- G. Label each low voltage wire with relay number at each switch or sensor.

3.2 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish services for minimum of one day for check, test, and start-up. Perform the following services:
 - 1. Check installation of panelboards.
 - 2. Test operation of remote controlled devices.
 - 3. Repair or replace defective components.

3.3 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Test each system component after installation to verify proper operation.

- C. Test relays, [contactors,] and switches after installation to confirm proper operation.
- D. Confirm correct loads are recorded on directory card in each panel.

3.4 DEMONSTRATION

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate operation of the following system components:
 - 1. Operation of each type of occupancy sensors. Demonstrate for all zones.
 - 2. Operation of each type of photocell. Demonstrate for all zones.
- C. Furnish 8 hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least 7 days notice to Architect/Engineer of training date.

END OF SECTION
SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes distribution and branch circuit panelboards, electronic grade branch circuit panelboards, and load centers.
- B. Related Sections:
 - 1. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 53 Identification for Electrical Systems.

1.2 REFERENCES

- A. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
 - 1. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches.
 - 2. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 3. NEMA ICS 2 Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 - 4. NEMA ICS 5 Industrial Control and Systems: Control Circuit and Pilot Devices.
 - 5. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 6. NEMA PB 1 Panelboards.
 - 7. NEMA PB 1.1 General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- E. Underwriters Laboratories Inc.:
 - 1. UL 67 Safety for Panelboards.
 - 2. UL 1283 Electromagnetic Interference Filters.
 - 3. UL 1449 Transient Voltage Surge Suppressors.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.
- C. Product Data: Submit catalog data showing specified features of standard products.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- C. Operation and Maintenance Data: Submit spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance products.

PART 2 PRODUCTS

2.1 LIGHTING AND APPLIANCE PANELBOARD TYPE (240 Vac)

- A. Manufacturers:
 - 1. Square D (NQOD)
 - 2. Eaton
 - 3. GE Electrical
 - 4. Siemens
 - 5. Substitutions: Section 01600 Product Requirements.
- B. Interior
 - 1. Rated for 240 Vac/48 Vdc maximum. Continuous main current ratings, as indicated on associated drawings, not to exceed 600 amperes maximum.
 - 2. Minimum short circuit current rating: as indicated in rms symmetrical amperes at 240 Vac.
 - 3. Short circuit current rating: 5,000 at 48 Vdc.

- 4. Provide one (1) continuous bus bar per phase. Each bus bar shall have sequentially phased branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current ratings shall be determined by heat-rise tests conducted in accordance with UL 67. Bussing rated 100-400 amperes shall be plated aluminum. Bussing rated for 600 amperes shall be plated copper as standard construction. Bus bar plating shall run the entire length of the bus bar. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and NEC Articles 230-F and -G.
- 5. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength thermoplastic.
- 6. A solidly bonded aluminum equipment ground bar shall be provided. An additional aluminum isolated/insulated ground bar shall also be provided.
- 7. Split solid neutral shall be plated and located in the mains compartment up to 225 amperes so all incoming neutral cable may be of the same length. UL Listed panelboards with 200% rated solid neutral shall be plated copper for non-linear load applications. Panelboards shall be marked for non-linear load applications.
- 8. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trim shall have pre-formed twistouts covering unused mounting space.
- 9. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior or in a booklet format.
- 10. Interiors shall be field convertible for top or bottom incoming feed. Main circuit breakers in 100A interiors shall be vertically mounted. Main circuit breakers over 100A shall be vertically mounted. Sub-feed circuit breakers shall be vertically mounted. Main lug interiors up to 400 amperes shall be field convertible to main breaker. Interior leveling provisions shall be provided for flush mounted applications.

C. Main Circuit Breaker (As Indicated on Drawings)

- 1. Main circuit breakers shall have an overcenter, trip-free, toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have a permanent trip unit with thermal and magnetic trip elements in each pole. Each thermal element shall be true rms sensing and be factory calibrated to operate in a 40° C ambient environment. Thermal elements shall be ambient compensating above 40° C.
- 2. Two- and three-pole circuit breakers shall have common tripping of all poles. Circuit breakers frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker that allows the user to simultaneously select the desired trip level of all poles. Circuit breakers shall have a push-to-trip button for maintenance and testing purposes.
- 3. Breaker handle and faceplate shall indicate rated ampacity. Standard construction circuit breakers shall be UL Listed for reverse connection without restrictive line or load markings.

- 4. Circuit breaker escutcheon shall have international I/O markings, in addition to standard ON/OFF markings. Circuit breaker handle accessories shall provide provisions for locking handle in the ON or OFF position.
- 5. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16. Lug body shall be bolted in place; snap-in designs are not acceptable.
- 6. The circuit breakers shall be UL Listed for use with the following accessories as indicated on drawings: Shunt Trip, Under Voltage Trip, Ground Fault Shunt Trip, Auxiliary Switch, Alarm Switch, Mechanical Lug Kits, and Compression Lug Kits.
- D. Branch Circuit Breakers
 - 1. Circuit breakers shall be UL Listed with amperage ratings, interrupting ratings, and number of poles as indicated on the associated drawings.
 - 2. Molded case branch circuit breakers shall have bolt-on type bus connectors.
 - 3. Circuit breakers shall have an overcenter toggle mechanism which will provide quick-make, quick-break contact action. Circuit breakers shall have thermal and magnetic trip elements in each pole. Two- and three-pole circuit breakers shall have common tripping of all poles.
 - 4. There shall be two forms of visible trip indication. The breaker handle shall reside in a position between ON and OFF. In addition, there shall be a red VISI-TRIP7 indicator appearing in the clear window of the circuit breaker housing.
 - 5. The exposed faceplates of all branch circuit breakers shall be flush with one another.
 - 6. Lugs shall be UL Listed to accept solid or stranded copper and aluminum conductors. Lugs shall be suitable for 90° C rated wire, sized according to the 75° C temperature rating per NEC Table 310-16.
 - 7. Breakers shall be UL Listed for use with the following factory installed accessories as indicated on drawings: Shunt Trip, Auxiliary Switch, and Alarm Switch.
- E. Enclosures
 - 1. Type 1 Boxes
 - a. Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvannealed steel will not be acceptable.
 - b. Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - c. Box width shall be 26@ wide maximum 14@ wide maximum.
 - 2. Type 1 Fronts
 - a. Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. Fronts shall be hinged 1-piece with door. Mounting shall be flush or surface as indicated on associated drawings.

- c. Panelboards shall have MONO-FLAT fronts with concealed door hinges and mounted with trim screws. Front shall not be removable with the door locked. Doors on front shall have rounded corners and edges shall be free of burrs.
- d. Front shall have cylindrical tumbler type lock with catch and springloaded stainless steel door pull. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
- 3. Type 3R, 5, and 12
 - a. Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - b. All doors shall be gasketed and equipped with a tumbler type vault lock and two (2) additional quarter turn fasteners on enclosures 59 inches or more in height. All lock assemblies shall be keyed alike. One (1) key shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
 - c. Maximum enclosure dimensions shall not exceed 21@ wide and 6.5@ deep.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect abandoned panelboards and load centers. Remove abandoned panelboards and load centers.
- B. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing panelboards and load centers to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install panelboards and load centers in accordance with NEMA PB 1.1.
- B. Install panelboards and load centers plumb.
- C. Install recessed panelboards and load centers flush with wall finishes.
- D. Height: 6 feet (1800 mm) to top of panelboard and load center; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard and load center. Revise directory to reflect circuiting changes to balance phase loads.

- G. Install engraved plastic nameplates in accordance with Section 26 05 53.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: 5 empty 1 inch (DN27). Identify each as SPARE.
- I. Ground and bond panelboard enclosure according to Section 26 05 26. Connect equipment ground bars of panels in accordance with NFPA 70.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.
- D. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- E. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes wall switches; wall dimmers; receptacles; multi-outlet assembly; and device plates and decorative box covers.
- B. Related Sections:
 - 1. Section 26 05 33 Raceway and Boxes for Electrical Systems: Outlet boxes for wiring devices.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 General Requirements for Wiring Devices.
 - 2. NEMA WD 6 Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each style, size, and finish wall plate.

PART 2 PRODUCTS

- 2.1 WALL SWITCHES
 - A. Manufacturers:
 - 1. Pass & Seymour.
 - 2. Lutron.
 - 3. Cooper.
 - 4. Substitutions: Section 01 60 00 Product Requirements
 - B. Product Description: NEMA WD 1, Heavy-Duty General-Duty, AC only general-use snap switch.
 - C. Body and Handle: Light Almond plastic with toggle handle.
 - D. Indicator Light: Separate pilot strap; red color lens.
 - E. Locator Light: Lighted handle type switch; red color handle.
 - F. Ratings: Match branch circuit and load characteristics.

2.2 OCCUPANCY WALL SWITCHES

- A. Manufacturers:
 - 1. Leviton Model OSS10-IDX
 - 2. Substitutions: Section 01 60 00 Product Requirements

B. Ratings:

- 1. Voltage: 120 120-277 volts, AC.
- 2. Current: 500 W @ 120 VAC 1200 W @ 277 VAC.
- C. Sensor Type: Passive infrared.
- D. Sensor Coverage: 180-32 (adj.) Degrees, 20'x20' small motion, 30'x40' large motion. Time Delay: 30 minutes - 2 hours (adjustable).
- E. Color: Ivory.
- F. Dimensions: 4.06" x 1.75" x 1.85" (HxWxD).
- G. Warranty: 5 year.

2.3 WALL DIMMERS (INCANDESCENT LOAD)

- A. Manufacturers:
 - 1. Pass & Seymour.
 - 2. Cooper.
 - 3. Lutron.

- 4. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: NEMA WD 1, Type I II III-I III-II semiconductor dimmer for incandescent lamps.
- C. Body and Handle: Light Almond plastic with linear slide.
- D. Voltage: 120 volts.
- E. Power Rating: per load on drawings.
- F. Accessory Wall Switch: Match dimmer appearance.

2.4 WALL DIMMERS (FLUORESCENT LOAD)

- A. Manufacturers:
 - 1. Lutron. Model: "Diva"
 - 2. Cooper.
 - 3. Pass & Seymour.
 - 4. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: NEMA WD 1, Type II semiconductor dimmer for fluorescent dimming ballast and lamps.
- C. Body and Handle: Light Almond plastic with linear slide.
- D. Voltage: 120 volts.
- E. Power Rating: per load on drawings.
- F. Multiple Dimmer Wall Plate to be of one piece construction and matching in dimmer appearance.

2.5 RECEPTACLES

- A. Manufacturers:
 - 1. Pass & Seymour.
 - 2. Cooper.
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: NEMA WD 1, General-duty general use receptacle.
- C. Device Body: Light Almond plastic.
- D. Configuration: NEMA WD 6, type as indicated on Drawings.
- E. Convenience Receptacle: Type 5-15.

- F. Receptacles located in Dwelling Units, Guest Rooms, and residential areas are to be Tamper-Resistant with shutter system to prevent items other than plug ends being inserted into the receptacle.
- G. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- H. GFCI Receptacle with Integral Night Light: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements. LED Night Light to be controlled by photocell. Night light to activate when interior lights are off.
- I. USB (Universal Serial Bus) Charging Receptacle: Combination AC duplex receptacle with two 5-volt USB ports that charge USB 2.0 and 3.0 compatible devices.
- J. DP (Damp Proof) Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements, and marked "WR" for weather resistance.
- K. WP (Weather Proof) Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements, and marked "WR" for weather resistance.
- L. IG (Isolated Ground) Receptacle: Type 5-15 with orange color, and isolated ground connection.
- M. TVSS (Transient Voltage Surge Suppressor) Receptacle:
 - 1. Type 5-15
 - 2. Latest revision of UL1449 compliant
 - 3. LED indicator light
 - 4. 3 18mm dual pack MOVs

2.6 WALL PLATES

- A. Manufacturers:
 - 1. Pass & Seymour.
 - 2. Cooper.
 - 3. Lutron.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Decorative Cover Plate: Color to match device, smooth lined plastic..
- C. Jumbo Cover Plate: Color to match device, smooth lined plastic..
- D. Damp Locations Cover Plate (NEC 406.8 (A)): Stainless steel plate with hinged and gasketed device cover.
- E. Weatherproof Cover Plate (NEC 406.8 (B)(1)): While-In-Use die cast metal gasketed device cover and mounting base. Intermatic Model: WP1010MC.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Verify outlet boxes are installed at proper height.
- C. Verify wall openings are neatly cut and completely covered by wall plates.
- D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Clean debris from outlet boxes.

3.3 EXISTING WORK

- A. Disconnect and remove abandoned wiring devices.
- B. Modify installation to maintain access to existing wiring devices to remain active.
- C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.4 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Install receptacles with grounding pole on top.
- F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- G. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- H. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.

- I. Use jumbo size plates for outlets installed in masonry walls.
- J. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.5 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations of outlet boxes provided under Section 26 05 33 to obtain mounting heights as specified and as indicated on drawings.

3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect each wiring device for defects.
- C. Operate each wall switch with circuit energized and verify proper operation.
- D. Verify each receptacle device is energized.
- E. Test each receptacle device for proper polarity.
- F. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust devices and wall plates to be flush and level.

3.8 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 26 28 19

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fusible and non-fusible switches.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA FU 1 Low Voltage Cartridge Fuses.
 - 2. NEMA KS 1 Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- B. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit switch ratings and enclosure dimensions.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of enclosed switches and ratings of installed fuses.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.1 FUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square D.
 - 2. Siemens.

- 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: NEMA KS 1, Type HD, enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Fuse clips: Designed to accommodate NEMA FU 1, Class R fuses.
- D. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Industrial Locations: Type 4.
- E. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- F. Furnish switches with entirely copper current carrying parts.

2.2 ELEVATOR FUSED SHUNT TRIP SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Bussman
 - 2. Substitutions: No Substitutions.
- B. Product Description: Provide Power Module Switch in a single NEMA enclosure with all necessary relay(s), and control transformer. Handle lockable in OFF position.
- C. Specialized Codes: All work shall be performed in accordance with the latest edition of applicable standards, codes and laws.
 - 1. NFPA 70 B 1999 Section 620-51 (a)-(c), 620-62,620-918)
 - 2. ANSI/ASME A17.1 B 1996 Section 102.2 (c) (3)
 - 3. BOCA 3006.2.3
 - 4. NFPA 72 B 1999 Section 3-9.4.4
- D. Fuse clips: Designed to accommodate NEMA FU 1, Class J fuses.
- E. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Industrial Locations: Type 4
- F. Control Transformer: 100VA control power transformer with primary and secondary fuses. The primary voltage rating shall be per drawings with a 120 volt secondary.
- G. Isolation Relay: (3PDT, 10 amp, 120V). The coil of the isolation relay shall be 120 V
 AC. A normally open dry contact shall be provided by the Fire Alarm Safety System to energize the isolation relay and activate the shunt trip solenoid (140VA inrush at 120V).

- H. Furnish switches with entirely copper current carrying parts.
- I. Accessories:
 - 1. Key to Test Switch
 - 2. (ON) Pilot Light (Green)
 - 3. Isolated Full Capacity Neutral Lug
 - 4. 1P NC Mechanically Interlocked Auxiliary Contact (required for hydraulic elevators with automatic recall).
 - 5. Fire Alarm Voltage Monitoring Relay (Needed to comply with NFPA 72)

2.3 NONFUSIBLE SWITCH ASSEMBLIES

- A. Manufacturers:
 - 1. Square D.
 - 2. GE Electrical.
 - 3. Hubbell Inc.
 - 4. Siemens.
 - 5. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- C. Enclosure: NEMA KS 1, to meet conditions. Fabricate enclosure from steel finished with manufacturer's standard gray enamel.
 - 1. Interior Dry Locations: Type 1.
 - 2. Exterior Locations: Type 3R.
 - 3. Industrial Locations: Type 4.
- D. Service Entrance: Switches identified for use as service equipment are to be labeled for this application. Furnish solid neutral assembly and equipment ground bar.
- E. Furnish switches with entirely copper current carrying parts.

2.4 SWITCH RATINGS

A. Switch Rating: Horsepower rated for AC or DC as indicated on Drawings.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned enclosed switches.
- B. Maintain access to existing enclosed switches and other installations remaining active and requiring access. Modify installation or provide access panel.
- C. Clean and repair existing enclosed switches to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install enclosed switches plumb. Provide supports in accordance with Section 26 05 29.
- B. Height: 5 feet (1500 mm) to operating handle.
- C. Install fuses for fusible disconnect switches. Refer to Section 26 28 13 for product requirements.
- D. Install engraved plastic nameplates in accordance with Section 26 05 53.
- E. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.3 FIELD QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Field inspecting, testing, adjusting, and balancing.

END OF SECTION

SECTION 26 51 00

INTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes interior luminaires, lamps, ballasts, and accessories.
- B. Related Sections:
 - 1. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 Raceway and Boxes for Electrical Systems.
 - 3. Section 26 52 00 Emergency Lighting.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 x 3 inch (75 x 75 mm) in size illustrating luminaire finish color where indicated in luminaire schedule.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 MOCK-UP

- A. Section 01 40 00 Quality Requirements: Mock-up requirements.
- B. Provide luminaires in ceiling assembly mock-up specified in Section.
- C. Locate where directed by Architect/Engineer.

- D. Incorporate accepted mockup as part of Work.
- 1.6 FIELD MEASUREMENTS
 - A. Verify field measurements prior to fabrication.
- 1.7 MAINTENANCE MATERIALS
 - A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
 - B. Furnish two of each plastic lens type.
 - C. Furnish one replacement lamps for each lamp installed.
 - D. Furnish two of each ballast type.

PART 2 PRODUCTS

- 2.1 INTERIOR LUMINAIRES
 - A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.
 - B. Recessed Troffers
 - 1. Manufacturers:
 - a. Lithonia
 - b. Hubbell
 - c. Lightolier
 - d. Substitutions: Section 01 60 00 Product Requirements
 - C. Recessed Down Lights
 - Manufacturers:
 - a. Lithonia
 - b. Gotham
 - c. Lightolier
 - d. Substitutions: Section 01 60 00 Product Requirements
 - D. Wall Sconces

1.

- 1. Manufacturers:
 - a. Lithonia
 - b. Hubbell
 - c. Lightolier
 - d. Substitutions: Section 01 60 00 Product Requirements
- E. Ceiling Pendent
 - 1. Manufacturers:

- a. Lithonia
- b. Hubbell
- c. Lightolier
- d. Winona
- e. Substitutions: Section 01 60 00 Product Requirements
- F. Track Lighting

1.

- Manufacturers:
 - a. Lithonia
 - b. Hubbell
 - c. Lightolier
 - d. Substitutions: Section 01 60 00 Product Requirements
- G. High and Low Bay Lighting
 - 1. Manufacturers:
 - a. Lithonia
 - b. Hubbell
 - c. Substitutions: Section 01 60 00 Product Requirements
- H. Directional Uplighting
 - 1. Manufacturers:
 - a. Winona
 - b. Lithonia
 - c. Substitutions: Section 01 60 00 Product Requirements
- I. Refer to Section 01 60 00 Product Requirements for product options. Substitutions are not permitted.

2.2 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. Sylvania
 - 2. Cooper Industries Inc.
 - 3. Duro-Test Corp.
 - 4. General Electric Co.
 - 5. Hubbell Lighting
 - 6. Magnetek Inc.
 - 7. Philips Electronic North America.
 - 8. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Electronic ballast with less than 10 percent THD, suitable for lamps specified, with voltage to match luminaire voltage.

2.3 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers:
 - 1. Sylvania
 - 2. Duro-Test Corp.

- 3. General Electric Co.
- 4. Philips Electronics North America
- 5. Radiant Lamp Co.
- 6. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: ANSI C82.4, mercury vapor metal halide low pressure sodium and high pressure sodium lamp ballast, suitable for lamp specified, with voltage to match luminaire voltage.

2.4 FLUORESCENT DIMMING BALLASTS AND CONTROLS

- A. Manufacturers:
 - 1. Lutron
 - 2. Sylvania
 - 3. Cooper Industries.
 - 4. Duro-Test Corp.
 - 5. General Electric Co.
 - 6. Hubbell Inc.
 - 7. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Electrical assembly of control unit and ballast to furnish smooth dimming of fluorescent lamps.
- C. Ballast: Selected by dimming system manufacturer as suitable for operation with control unit and suitable for lamp type and quantity specified for luminaire.

2.5 INCANDESCENT LAMPS

- A. Manufacturers:
 - 1. Sylvania
 - 2. General Electric Co.
 - 3. Philips Electronics North America.
 - 4. Substitutions: Section 01 60 00 Product Requirements

2.6 FLUORESCENT LAMPS

- A. Manufacturers:
 - 1. Sylvania
 - 2. General Electric Co.
 - 3. Philips Electronics.
 - 4. Substitutions: Section 01 60 00 Product Requirements
- B. Color Rendering Index (CRI):
 - 1. Linear Fluorescent: 85
 - 2. Compact Fluorescent: 82
- C. Protective Sleeves:
 - 1. Provide clear protective sleeves to all exposed linear lamps.

2.7 HID LAMPS

- A. Manufacturers:
 - 1. Sylvania
 - 2. Duro-Test Corp.
 - 3. General Electric Co.
 - 4. Philips Electronic North America.
 - 5. RCS Industries North America.
 - 6. Siemens Corp.
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Color Rendering Index (CRI): 82.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, and accessories.
- B. Extend existing interior luminaire installations using materials and methods compatible with existing installations, or as specified.
- C. Clean and repair existing interior luminaires to remain or to be reinstalled.

3.2 INSTALLATION

- A. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- B. Support luminaires larger than 2 x 4 foot (600 x 1200 mm) size independent of ceiling framing.
- C. Locate recessed ceiling luminaires as indicated on Drawings.
- D. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- E. Exposed Grid Ceilings: Support surface-mounted luminaires on grid ceiling directly from building structure
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.

- I. Install wall-mounted luminaires at height as indicated on Drawings.
- J. Install accessories furnished with each luminaire.
- K. Connect luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Install specified lamps in each luminaire.
- N. Ground and bond interior luminaires in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaires as indicated on Drawings.

3.5 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Remove dirt and debris from enclosures.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Protecting finished work.
- B. Relamp luminaires having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 52 00

EMERGENCY LIGHTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes emergency lighting units and exit signs.
- B. Related Sections:
 - 1. Section 26 05 26 Grounding and Bonding for Electrical Systems.
 - 2. Section 26 05 33 Raceway and Boxes for Electrical Systems.
 - 3. Section 26 51 00 Interior Lighting: Exit signs.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 6 Wiring Devices-Dimensional Requirements.

1.3 SYSTEM DESCRIPTION

A. Emergency lighting to comply with requirements.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit dimensions, ratings, and performance data.
- C. Samples: Submit two color chips 3 x 3 inch (75 x 75 mm) in size illustrating unit finish color.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.6 MAINTENANCE MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish one replacement lamps for each lamp installed.
- C. Furnish one replacement battery for each battery type and size.

PART 2 PRODUCTS

2.1 EMERGENCY LIGHTING UNITS

- A. Manufacturers:
 - 1. Lithonia
 - 2. Cooper Industries
 - 3. General Signal Corp.
 - 4. Mule Emergency Lighting
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Self-contained LED emergency lighting unit.
- C. Battery: 12 volt, lead calcium type, with 1.5 hour capacity. High output capacity per drawings.
- D. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- E. Remote Fixtures: Match fixtures on unit.
- F. Housing: White plastic.
- G. Indicators: Lamps to indicate AC ON and RECHARGING.
- H. TEST switch: Transfers unit from external power supply to integral battery supply.

2.2 EXIT SIGNS

- A. Manufacturers:
 - 1. Lithonia
 - 2. Cooper Industries.
 - 3. General Signal Corp.
 - 4. Mule Emergency Lighting.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Edge Lit exit sign fixture.
- C. Housing: Extruded aluminum.
- D. Face:
 - 1. Single Face: Clear acrylic panel with red letters.
 - 2. Double Face: Clear acrylic panels with red letters and mirrored separator panel.
- E. Directional Arrows: As indicated on Drawings.
- F. Mounting: As indicated on Drawings

- G. Battery: 12 volt, nickel-cadmium type, with 1.5 hour capacity.
- H. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- I. Lamps: LED, 5 W per side, maximum.

2.3 EMERGENCY COMBO UNITS

- A. Manufacturers:
 - 1. Lithonia
 - 2. Cooper Industries
 - 3. General Signal Corp.
 - 4. Mule Emergency Lighting
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Self-contained LED emergency lighting unit.
- C. Battery: 12 volt, lead calcium type, with 1.5 hour capacity. High output capacity per drawings.
- D. Exit Sign:
 - 1. Face: Aluminum Steel Thermal Plastic stencil face with red green letters.
 - 2. Directional Arrows: As indicated on Drawings.
- E. Battery Charger: Dual-rate type, with sufficient capacity to recharge discharged battery to full charge within twelve hours.
- F. Remote Fixtures: Match fixtures on unit.
- G. Housing: White plastic.
- H. Indicators: Lamps to indicate AC ON and RECHARGING.
- I. TEST switch: Transfers unit from external power supply to integral battery supply.

2.4 FLUORESCENT LAMP EMERGENCY POWER SUPPLY

- A. Manufacturers:
 - 1. Lutron
 - 2. Cooper Industries.
 - 3. General Signal Corp.
 - 4. Mule Emergency Lighting.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Emergency battery power supply suitable for installation in ballast compartment of fluorescent luminaire.

- C. Lamp Ratings: One F32T8 lamp providing 1400 lumens, minimum.
- D. Battery: Sealed lead calcium type, rated for 10 year life.
- E. Include TEST switch and AC ON indicator light, installed to be operable and visible from outside of assembled luminaire.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned emergency lighting units, exit signs, lamps, and accessories.
- B. Extend existing emergency lighting and exit sign installations using materials and methods compatible with existing installations, or as specified.
- C. Clean and repair existing emergency lighting units and exit signs remaining or are to be reinstalled.

3.2 INSTALLATION

- A. Install suspended exit signs using pendants supported from swivel hangers. Install pendant length required to suspend sign at indicated height.
- B. Install surface-mounted emergency lighting units and exit signs plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- C. Install wall-mounted emergency lighting units and exit signs at height as indicated on Drawings.
- D. Install accessories furnished with each emergency lighting unit and exit sign.
- E. Connect emergency lighting units and exit signs to branch circuit outlets provided in Section 26 05 33 as indicated on Drawings.
- F. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within unit.
- G. Install specified lamps in each emergency lighting unit and exit sign.
- H. Ground and bond emergency lighting units and exit signs in accordance with Section 26 05 26.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust lamp fixtures as indicated on Drawings.
- C. Position exit sign directional arrows as indicated on Drawings.

3.5 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Protecting finished work.
- B. Relamp emergency lighting units and exit signs having failed lamps at Substantial Completion.

END OF SECTION

SECTION 26 56 00

EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes exterior luminaries, poles, and accessories.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C82.1 American National Standard for Lamp Ballast-Line Frequency Fluorescent Lamp Ballast.
 - 2. ANSI C82.4 American National Standard for Ballasts-for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).
 - 3. ANSI O5.1 Wood Poles, Specifications and Dimensions.

1.3 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate dimensions and components for each luminaire not standard Product of manufacturer.
- C. Product Data: Submit dimensions, ratings, and performance data.
- D. Samples: Submit two color chips 3 x 3 inch (75 x 75 mm) in size illustrating luminaire finish color where indicated in luminaire schedule.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Store and handle solid wood poles in accordance with ANSI O5.1.

1.6 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

1.7 MAINTENANCE MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two of each lamp installed.
- C. Furnish two pints of touch-up paint for each different painted finish and color.
- D. Furnish two ballasts of each lamp type installed.

PART 2 PRODUCTS

2.1 LUMINAIRES

- A. Product Description: Complete exterior luminaire assemblies, with features, options, and accessories as scheduled.
- B. Pole Mounted Site Lights
 - Manufacturers:
 - a. Lithonia
 - b. Kim
 - c. Substitutions: Section 01 60 00 Product Requirements

C. Ballard Lights

1.

- 1. Manufacturers:
 - a. Lithonia
 - b. Kim
 - c. Substitutions: Section 01 60 00 Product Requirements

D. Flood Lights

- 1. Manufacturers:
 - a. Lithonia
 - b. Substitutions: Section 01 60 00 Product Requirements
- E. Wall Mounted Lights
 - 1. Manufacturers:
 - a. Lithonia
 - b. Kim
 - c. Substitutions: Section 01 60 00 Product Requirements

F. Recessed and Surface Mounted Lights

- 1. Manufacturers:
 - a. Lithonia
 - b. Kim
 - c. Substitutions: Section 01 60 00 Product Requirements

G. Refer to Section 01 60 00 - Product Requirements for product options. Substitutions are not permitted.

2.2 FLUORESCENT BALLASTS

- A. Manufacturers:
 - 1. Sylvania
 - 2. Cooper Industries Inc.
 - 3. Duro-Test Corp.
 - 4. General Electric Co.
 - 5. Hubbell Lighting
 - 6. Magnetek Inc.
 - 7. Pass & Seymour.
 - 8. Philips Electronic North America.
 - 9. Thomas Industries, Inc.
 - 10. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: High-power-factor type electromagnetic ballast certified by Certified Ballast Manufacturers, Inc. to comply with ANSI C82.1, suitable for lamps and environmental conditions specified, with voltage to match luminaire voltage.

2.3 HIGH INTENSITY DISCHARGE (HID) BALLASTS

- A. Manufacturers:
 - 1. Sylvania
 - 2. Duro-Test Corp.
 - 3. General Electric Co.
 - 4. Philips Electronics North America
 - 5. Radiant Lamp Co.
 - 6. Venture Lighting International Inc.
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: ANSI C82.4, metal halide lamp ballast, suitable for lamp and environmental conditions specified, with voltage to match luminaire voltage.

2.4 LAMPS - GENERAL

A. Minimum Efficacy, Lamps Greater Than 100 Watts: 60 lumens/W, except where otherwise indicated or permitted by applicable code.

2.5 INCANDESCENT LAMPS

- A. Manufacturers:
 - 1. Sylvania
 - 2. General Electric Co.
 - 3. Philips Electronics North America
 - 4. Substitutions: Section 01 60 00 Product Requirements

2.6 FLUORESCENT LAMPS

- A. Manufacturers:
 - 1. Sylvania
 - 2. General Electric Co.
 - 3. Philips Electronics.
 - 4. Substitutions: Section 01 60 00 Product Requirements
- B. Color Rendering Index (CRI):
 - 1. Linear Fluorescent: 85.
 - 2. Compact Fluorescent: 82.

2.7 HID LAMPS

- A. Manufacturers:
 - 1. Sylvania
 - 2. General Electric Co.
 - 3. Philips Electronic North America.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Color Rednering Index (CRI): 82

2.8 METAL POLES

- A. Material and Finish: Aluminum with anodized finish.
- B. Section Shape and Dimensions: Square.
- C. Height: As indicated on Drawings.
- D. Base: Non-breakaway.
- E. Accessories:
 - 1. Handhole.
 - 2. Anchor bolts.
 - 3. Bolt Covers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and Project conditions.
- B. Verify foundations are ready to receive fixtures.

3.2 EXISTING WORK

- A. Disconnect and remove abandoned exterior luminaries.
- B. Extend existing exterior luminaire installations using materials and methods compatible with existing installations, or as specified.
- C. Clean and repair existing exterior luminaries to remain or to be reinstalled.

3.3 INSTALLATION

- A. Install concrete bases for lighting poles at locations as indicated on Drawings, in accordance with Section 03 30 00.
- B. Install poles plumb. Install double nuts to adjust plumb. Grout around each base.
- C. Install lamps in each luminaire.
- D. Bond and ground luminaries, metal accessories and metal poles in accordance with Section 26 05 26. Install supplementary grounding electrode at each pole.

3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Measure illumination levels to verify conformance with performance requirements.
- D. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.5 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Aim and adjust luminaries to provide illumination levels and distribution as indicated on Drawings.

3.6 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean photometric control surfaces as recommended by manufacturer.

- C. Clean finishes and touch up damage.
- 3.7 PROTECTION OF FINISHED WORK
 - A. Section 01 70 00 Execution and Closeout Requirements: Protecting finished work.
 - B. Relamp luminaries having failed lamps at Substantial Completion.

END OF SECTION

SECTION 27 05 23

TELEVISION SERVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes television antennas; television distribution equipment; arrangement with cable utility company for cable television service; payment of cable utility company charges for service installation; and service provisions.
- B. Related Sections:
 - 1. Section 27 05 26 Grounding and Bonding for Communications Systems.

1.2 REFERENCES

- A. National Fire Protection Association:
 - 1. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Service entrance from local cable utility.
- B. Premises wiring for channelized distribution of television signal, including individual outlets.
- C. Cable Utility Company:

1.4 PERFORMANCE REQUIREMENTS

- A. Signal at each outlet: 3 dBmV across 75 ohms, minimum, plus 5 dB, minus 0 dB.
- B. The MATV/CATV distribution system forward frequency response must be at 49 MHz to 860 MHz with +3 to +10 dBmV on every channel at each TV outlet. The return response must be 5MHz to 35MHz.
- C. The system must be able to deliver 6 to 10 dBmV return level at 5-35 MHz to the head end, with a 36dBmV reference from an extreme room location.
- D. The system must maintain a room to room isolation of 23 dB or greater.

1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Indicate electrical characteristics and connection requirements. Show installation details, cable routing, and system configuration.
- C. Product Data: Submit catalog data showing electrical characteristics and connection requirements for each component.
- D. Test Reports: Indicate procedures and results for specified field testing and inspection.
- E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of outlets, devices, and cable routing.
- C. Operation and Maintenance Data: Submit instructions for setting and tuning channels, and for basic trouble-shooting procedures.

1.7 QUALITY ASSURANCE

A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.
- C. Installer: Authorized installer of specified manufacturer with service facilities within 100 miles of Project.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 MAINTENANCE SERVICE

A. Section 01 70 00 - Execution and Closeout Requirements: Maintenance service.
B. Furnish service and maintenance of television equipment for one year from Date of Substantial Completion.

1.11 COORDINATION

- A. Coordinate with utility company relocation of overhead of underground lines interfering with construction. Where power lines are to be relocated, bill utility costs directly to Owner.
- B. Contact utility company regarding charges related to service installation. Include utility charges in this contract.
- C. Utility charges for service installation paid by Owner and are not part of this contract.

PART 2 PRODUCTS

2.1 ATTENUATOR PADS

A. Product Description: 75 ohm impedance attenuator pad, with bandwidth of 6 MHz, plus or minus 0.5 dB.

2.2 TAP

- A. Manufacturers:
 - 1. Blonder Tounge
 - 2. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: All-channel, back-matched tap.
- C. Surface mounted.
- D. Through Loss: 0.7 dB, maximum.
- E. Return Loss: 20 dB, maximum.
- F. Isolation: At each tap to meet specified performance.
- G. Connector: F type coaxial connector.

2.3 SPLITTER

- A. Manufacturers:
 - 1. Blounder Tounge
 - 2. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: In-line, channel, back-matched splitter.

- C. Through Loss: 3.5 dB for two-way; 6.7 dB for four-way.
- D. Isolation: 16 dB, minimum.

2.4 DISTRIBUTION CABLE

- A. Manufacturers:
 - 1. Belder
 - 2. Substitutions: Section 01 60 00 Product Requirements.
- B. Main Distribution Cable: RG 11/F.
- C. Branch Distribution Cable: RG 6/F.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove exposed abandoned television cable including abandoned cable above accessible ceiling finishes. Cut cable flush with walls and floors, and patch surfaces.
- B. Disconnect and remove abandoned television equipment.
- C. Maintain access to existing television equipment and cables and other installations remaining active and requiring access. Modify installation or provide access panel.
- D. Extend existing television installations using materials and methods compatible with existing installations, or as specified.
- E. Clean and repair existing television equipment to remain or to be reinstalled.

3.2 INSTALLATION

- A. Connect cable television service in accordance with Cable Utility instructions.
- B. Install grounding of television system components and wiring in accordance with Section 27 05 26.
- C. Bond outdoor components to lightning protection system in accordance with Section 26 41 00.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Measure signal level at each outlet.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 40 00 Quality Requirements: Manufacturer's field services.
- B. Supervise final adjustments and tuning of system.

3.5 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust each antenna using field strength meter to orient for maximum signal reception. acceptable signal reception on all channels.
- C. Adjust amplifier gain and make other system adjustments to achieve specified output levels at each outlet.

3.6 DEMONSTRATION AND TRAINING

A. Furnish eight hours of instruction each for two persons, to be conducted at Project site with manufacturer's representative.

END OF SECTION

SECTION 27 05 26

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wire.
 - 2. Mechanical connectors.
 - 3. Exothermic connections.
- B. Related Sections:
 - 1. Section 26 05 26 Grounding and Bonding for Electrical Systems.

1.2 REFERENCES

- A. Building Industry Consulting Service International, Inc.
 - 1. BICSI TDM Manual Telecommunications Distribution Methods Manual.
- B. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- C. Telecommunication Industry Association/Electronic Industries Alliance:
 - 1. TIA/EIA 607 Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.3 SYSTEM DESCRIPTION

- A. Communications grounding systems use the following elements as grounding electrodes:
 1. Building grounding electrode.
- B. Do not use the following elements as grounding electrodes:1. Building plumbing system.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on grounding electrodes and connections.
- C. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

- D. Manufacturer's Installation Instructions: Submit for active electrodes.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

A. Provide grounding, surge protection and lightning protection of telecommunications system in accordance with latest version of Grounding, Bonding and Electrical Protection chapter of the BICSI TDM Manual, TIA/EIA 607, and NFPA 70.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Requirements for coordination.
- B. Complete grounding and bonding of building reinforcing steel prior concrete placement.

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PART 2 PRODUCTS

- 2.1 WIRE
 - A. Material: Stranded copper.
 - B. Grounding Conductor: Copper conductor bare.
 - C. Bonding Conductor: Copper conductor bare.

2.2 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Copperweld, Inc.
 - 3. Erico, Inc.
 - 4. ILSCO Corporation.
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.3 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Cadweld, Erico, Inc.
 - 3. Copperweld, Inc.
 - 4. ILSCO Corporation
 - 5. O-Z Gedney Co.
 - 6. Thomas & Betts, Electrical
 - 7. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 EXECUTION

- 3.1 PREPARATION
 - A. Remove paint, rust, mill oils, and surface contaminants at connection points.
- 3.2 INSTALLATION
 - A. Install in accordance with BICSI TDM Manual, TIA/EIA 607, and NFPA 70.

- B. Install grounding and bonding conductors concealed from view.
- C. Install grounding for equipment using 6 AWG THHN, rated for 90 degrees C, insulated, copper stranded conductor to copper communication grounding bus bar located in main telecommunications entrance facility.
- D. Bond main telecommunications grounding system to building grounding electrode system at main electrical service entrance location with 6 AWG THHN, rated for 90 degrees C, insulated, copper stranded conductor.
- E. Install routing for grounding conductor as short and direct as practical.
- F. Install routing of bonding conductors with minimum number of bends and splices. Use sweeping bends.
- G. Install bonding connections with listed bolts, crimp pressure connectors, clamps, or lugs.
- H. Between each room, install multiple busbars directly bonded with 6 AWG copper conductor.
- I. Position busbars near associated equipment and insulate from supports.
- J. Construct busbars of copper, 4 inches x 8 inches by 1/4 inch (100 mm x 200 mm x 6 mm) thick with pilot holes for ground lug.
- K. Bond backbone cabling at each sheath opening.
- L. Label grounding conductors and grounding bus bars in accordance with BICSI guidelines.
- M. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Visually inspect from each bus bar to main grounding electrode service location.
- C. Test in accordance with BICSI TDM Manual, TIA/EIA 607, and NFPA 70.
- D. When improper grounding is found, check entire project and correct. Perform retest.

END OF SECTION

SECTION 27 05 29

HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Conduit supports.
 - 2. Formed steel channel.
 - 3. Spring steel clips.
 - 4. Sleeves.
 - 5. Mechanical sleeve seals.
 - 6. Firestopping relating to electrical work.
 - 7. Firestopping accessories.
 - 8. Equipment bases and supports.
- B. Related Sections:
 - 1. Section 26 05 29 Hangers and Supports for Electrical Systems.

1.2 REFERENCES

- A. ASTM International:
 - 1. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
 - 4. ASTM E1966 Standard Test Method for Fire-Resistive Joint Systems.
- B. FM Global:
 - 1. FM Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.
- C. National Fire Protection Association:
 - 1. NFPA 70 National Electrical Code.
- D. Underwriters Laboratories Inc.:
 - 1. UL 263 Fire Tests of Building Construction and Materials.
 - 2. UL 723 Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 Tests for Fire Resistance of Building Joint Systems.
 - 5. UL Fire Resistance Directory.
- E. Intertek Testing Services (Warnock Hersey Listed):

1. WH - Certification Listings.

1.3 DEFINITIONS

A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119 ASTM E814 UL 263 and UL 1479 to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1 hour fire rating.
 - 1. Ratings may be 3-hours for firestopping in through-penetrations of 4-hour fire rated assemblies unless otherwise required by applicable codes.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- C. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- D. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- E. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- F. Manufacturer's Installation Instructions:
 - 1. Hangers and Supports: Submit special procedures and assembly of components.
 - 2. Firestopping: Submit preparation and installation instructions.

- G. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- H. Engineering Judgments: For conditions not covered by UL or WH listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 - 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 - 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10 inch water gage (24.9 Pa) minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum years documented experience approved by manufacturer.

1.9 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F (15 degrees C).
- C. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- D. Provide ventilation in areas to receive solvent cured materials.

PART 2 PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. Electroline Manufacturing Company.
 - 3. O-Z Gedney Co.
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- C. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

- D. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- E. Conduit clamps general purpose: One hole malleable iron for surface mounted conduits.
- F. Cable Ties: High strength nylon temperature rated to 185 degrees F (85 degrees C). Self locking.
- 2.2 FORMED STEEL CHANNEL
 - A. Manufacturers:
 - 1. Allied Tube & Conduit Corp.
 - 2. B-Line Systems.
 - 3. Midland Ross Corporation, Electrical Products Division.
 - 4. Unistrut Corp.
 - 5. Substitutions: Section 01 60 00 Product Requirements.
 - B. Product Description: Galvanized 12 gage (2.8 mm) thick steel. With holes 1-1/2 inches (38 mm) on center.
- 2.3 SPRING STEEL CLIPS
 - A. Product Description: Mounting hole and screw closure.
- 2.4 SLEEVES
 - A. Sleeves for Through Non-fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.
 - B. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage (1.2 mm) thick galvanized steel.
 - C. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
 - D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

- A. Manufacturers:
 - 1. Thunderline Link-Seal, Inc.
 - 2. NMP Corporation
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

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2.6 FIRESTOPPING

- A. Manufacturers:
 - 1. Dow Corning Corp.
 - 2. Fire Trak Corp.
 - 3. Hilti Corp.
 - 4. International Protective Coating Corp.
 - 5. 3M fire Protection Products.
 - 6. Specified Technology, Inc.
 - 7. Substitutions: Section 01 60 00 Product Requirements
- B. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 - 1. Silicone Firestopping Elastomeric Firestopping: Multiple component silicone elastomeric compound and compatible silicone sealant.
 - 2. Foam Firestopping Compounds: Multiple component foam compound.
 - 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 - 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 - 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 - 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 - 7. Firestop Pillows: Formed mineral fiber pillows.
- C. Color: As selected from manufacturer's full range of colors.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 - 1. Mineral fiberboard.
 - 2. Mineral fiber matting.
 - 3. Sheet metal.
 - 4. Plywood or particle board.
 - 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.
- D. General:
 - 1. Furnish UL listed products or products tested by independent testing laboratory.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.

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E. Non-Rated Surfaces:

- 1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
- 2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.
- C. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install damming materials to arrest liquid material leakage.]
- D. Obtain permission from [Architect/Engineer] before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

- A. Anchors and Fasteners:
 - 1. Concrete Structural Elements: Provide precast inserts, expansion anchors, powder actuated anchors and preset inserts.
 - 2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
 - 3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
 - 4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts and hollow wall fasteners.
 - 5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
 - 6. Sheet Metal: Provide sheet metal screws.
 - 7. Wood Elements: Provide wood screws.
- B. Inserts:
 - 1. Install inserts for placement in concrete forms.

- 2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
- 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
 - 1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 - 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 - 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch (25 mm) off wall.
 - 4. Support vertical conduit at every other floor.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:

1.

- Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Pack void with backing material.

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- d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
- 2. Where cable tray, bus, cable bus, conduit, wireway, and trough, penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:

1.

- Seal opening through non-fire rated wall, partition floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch (25 mm) on both sides of building element.
 - b. Size sleeve allowing minimum of 1 inch (25 mm) void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
- 2. Install escutcheons floor plates or ceiling plates where conduit, penetrates nonfire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
- 3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
- 4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- B. Construct supports of steel members. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch (25 mm) above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for cleaning.
- B. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 27 05 33

CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes conduit and tubing, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

B. Related Sections:

- 1. Section 26 05 03 Equipment Wiring Connections.
- 2. Section 26 05 33 Raceway and Boxes for Electrical Systems.
- 3. Section 26 27 26 Wiring Devices.
- 4. Section 27 05 26 Grounding and Bonding for Communications Systems.
- 5. Section 27 05 29 Hangers and Supports for Communications Systems.
- 6. Section 27 05 53 Identification for Communications Systems.

1.2 REFERENCES

- A. American National Standards Institute:
 - 1. ANSI C80.1 Rigid Steel Conduit, Zinc Coated.
 - 2. ANSI C80.3 Specification for Electrical Metallic Tubing, Zinc Coated.
 - 3. ANSI C80.5 Aluminum Rigid Conduit (ARC).
- B. National Electrical Manufacturers Association:
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. NEMA FB 1 Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
 - 3. NEMA OS 1 Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 4. NEMA OS 2 Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
 - 5. NEMA RN 1 Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - 6. NEMA TC 2 Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - 7. NEMA TC 3 PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.

- B. Underground More than 5 feet (1500 mm) outside Foundation Wall: Provide plastic coated conduit, thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.
- C. Underground Within 5 feet (1500 mm) from Foundation Wall: Provide plastic coated conduit, thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.
- D. In or Under Slab on Grade: Provide thickwall nonmetallic conduit]. Provide cast or nonmetallic metal boxes.
- E. Outdoor Locations, Above Grade: Provide rigid aluminum conduit. Provide cast metal or nonmetallic outlet, pull, and junction boxes.
- F. In Slab Above Grade: Provide thickwall nonmetallic conduit. Provide cast boxes.
- G. Wet and Damp Locations: Provide rigid aluminum conduit, thickwall nonmetallic conduit. Provide cast metal or nonmetallic outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Dry Locations: Provide aluminum conduit, intermediate metal conduit, electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.
- I. Above Suspended Acoustical Ceilings: J-Hooks (exposed cable, plenum rated where required) and supports. Provide sheet-metal boxes.
- J. Exposed Dry Locations: Provide rigid steel and aluminum conduit, intermediate metal conduit, electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

A. Minimum Raceway Size: 3/4 inch (19 mm) unless otherwise specified.

1.5 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.
 - 4. Flexible nonmetallic conduit.
 - 5. Nonmetallic tubing.
 - 6. Raceway fittings.
 - 7. Conduit bodies.
 - 8. Surface raceway.
 - 9. Wireway.

- 10. Pull and junction boxes.
- 11. Handholes.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inch (DN50).
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 Product Requirements: Product storage and handling requirements.
- B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- C. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
- B. Coordinate installation of outlet boxes for equipment connected under Section 26 05 03.
- C. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.

PART 2 PRODUCTS

2.1 METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Rigid Steel Conduit: ANSI C80.1.

- C. Rigid Aluminum Conduit: ANSI C80.5.
- D. Intermediate Metal Conduit (IMC): Rigid steel.
- E. Fittings and Conduit Bodies: NEMA FB 1; material to match conduit.

2.2 PVC COATED METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 20 mil (0.05 mm) thick.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp..
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Interlocked aluminum construction.
- C. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Interlocked aluminum construction with PVC jacket.

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C. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: ANSI C80.3; galvanized tubing.
- C. Fittings and Conduit Bodies: NEMA FB 1; steel, compression type.

2.6 NONMETALLIC CONDUIT

- A. Manufacturers:
 - 1. Carlon Electrical Products.
 - 2. Hubbell Wiring Devices.
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: NEMA TC 2; Schedule 40 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.
- 2.7 OUTLET BOXES
 - A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements.
 - B. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 1/2 inch (13 mm) male fixture studs where required.
 - 2. Concrete Ceiling Boxes: Concrete type.
 - C. Nonmetallic Outlet Boxes: NEMA OS 2.

- D. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer.
- E. Wall Plates for Finished Areas: As specified in Section 26 27 26.
- F. Wall Plates for Unfinished Areas: Furnish gasketed cover.
- 2.8 PULL AND JUNCTION BOXES
 - A. Manufacturers:
 - 1. Carlon Electrical Products
 - 2. Hubbell Wiring Devices
 - 3. Thomas & Betts Corp.
 - 4. Walker Systems Inc.
 - 5. The Wiremold Co.
 - 6. Substitutions: Section 01 60 00 Product Requirements
 - B. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
 - C. Hinged Enclosures: As specified in Section 26 27 16.
 - D. Surface Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface mounted junction box:
 - 1. Material: Cast aluminum.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless steel cover screws.
 - E. In-Ground Cast Metal Box: NEMA 250, Type 6, inside flanged, recessed cover box for flush mounting:
 - 1. Material: Cast aluminum.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless steel cover screws.
 - 3. Cover Legend: "ELECTRIC".
 - F. Fiberglass Concrete composite Handholes: Die-molded, glass-fiber concrete composite hand holes:
 - 1. Cable Entrance: Pre-cut 6 inch x 6 inch (150 mm x 150 mm) cable entrance at center bottom of each side.
 - 2. Cover: Glass-fiber concrete composite, weatherproof cover with nonskid finish.

PART 3 EXECUTION

- 3.1 EXAMINATION
 - A. Section 01 30 00 Administrative Requirements: Coordination and project conditions.
 - B. Verify outlet locations and routing and termination locations of raceway prior to roughin.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods compatible with existing electrical installations, or as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes in accordance with Section 26 05 26.
- B. Fasten raceway and box supports to structure and finishes in accordance with Section 26 05 29.
- C. Identify raceway and boxes in accordance with Section 26 05 53.
- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel specified in Section 26 05 29; provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.

- G. Construct wireway supports from steel channel specified in Section 26 05 29.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maximum Size Conduit in Slab Above Grade: 3/4 inch (19 mm). Do not cross conduits in slab larger than 1/2 inch (DN 13).
- L. Maintain clearance between raceway and piping for maintenance purposes.
- M. Maintain 12 inch (300 mm) clearance between raceway and surfaces with temperatures exceeding 104 degrees F (40 degrees C).
- N. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- O. Bring conduit to shoulder of fittings; fasten securely.
- P. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- Q. Install conduit hubs or sealing locknuts to fasten conduit to cast boxes.
- R. Install no more than equivalent of three 90 degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2 inch (50 mm) size.
- S. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- T. Install fittings to accommodate expansion and deflection where raceway crosses seismic, control and expansion joints.
- U. Install suitable pull string or cord in each empty raceway except sleeves and nipples.
- V. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- W. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- X. Close ends and unused openings in wireway.

3.5 INSTALLATION - BOXES

- A. Install wall mounted boxes at elevations to accommodate mounting heights as indicated on Drawings.
- B. Adjust box location up to 10 feet (3 m) prior to rough-in to accommodate intended purpose.
- C. Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- D. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- E. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches (150 mm) from ceiling access panel or from removable recessed luminaire.
- F. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- G. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches (150 mm) separation. Install with minimum 24 inches (600 mm) separation in acoustic rated walls.
- H. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- I. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- J. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- K. Install adjustable steel channel fasteners for hung ceiling outlet box.
- L. Do not fasten boxes to ceiling support wires or other piping systems.
- M. Support boxes independently of conduit.
- N. Install gang box where more than one device is mounted together. Do not use sectional box.
- O. Install gang box with plaster ring for single device outlets.

3.6 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods in accordance with Section 07 84 00.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation specified in Section.

- C. Locate outlet boxes to allow luminaires positioned as indicated on Drawings.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.7 ADJUSTING

- A. Section 01 70 00 Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust flush-mounting outlets to make front flush with finished wall material.
- C. Install knockout closures in unused openings in boxes.

3.8 CLEANING

- A. Section 01 70 00 Execution and Closeout Requirements: Final cleaning.
- B. Clean interior of boxes to remove dust, debris, and other material.
- C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 27 05 53

IDENTIFICATION FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.
- B. Related Sections:
 - 1. Section 09 90 00 Painting and Coating: Execution requirements for painting specified by this section.
 - 2. Section 26 05 53 Identification for Electrical Systems.
 - 3. Section 28 05 53 Identification for Electronic Safety and Security.

1.2 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- C. Samples:
 - 1. Submit two samples of each type of identification products applicable to project.
 - 2. Submit two nameplates, 4×4 inch (100 x 100 mm) in size illustrating materials and engraving quality.
- D. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.
- 1.5 DELIVERY, STORAGE, AND HANDLING
 - A. Section 01 60 00 Product Requirements: Requirements for transporting, handling, storing, and protecting products.
 - B. Accept identification products on site in original containers. Inspect for damage.
 - C. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
 - D. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 Product Requirements: Environmental conditions affecting products on site.
- B. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

1.7 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Requirements for extra materials.
- B. Furnish two containers of spray-on adhesive.

PART 2 PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Letter Size:
 - 1. 1/8 inch (3 mm) high letters for identifying individual equipment and loads.
 - 2. 1/4 inch (6 mm) high letters for identifying grouped equipment and loads.

C. Minimum nameplate thickness: 1/8 inch (3 mm).

2.2 LABELS

A. Labels: Embossed adhesive tape, with 3/16 inch (5 mm) white letters on black background.

2.3 WIRE MARKERS

A. Description: Cloth tape, split sleeve, or tubing type wire markers.

B. Legend:

- 1. Power and Lighting Circuits: Branch circuit or feeder number.
- 2. Control Circuits: Control wire number as indicated on schematic and interconnection diagrams.

2.4 CONDUIT AND RACEWAY MARKERS

- A. Description: Labels fastened with adhesive.
- B. Color:
 - 1. Telephone System: Blue lettering on white background.
- C. Legend:
 - 1. Telephone System: TELEPHONE.
 - 2. Cable Television: CATV
 - 3. Data: DATA

2.5 STENCILS

- A. Stencils: With clean cut symbols and letters of following size:
 - 1. Up to 2 inches (50 mm) Outside Diameter of Raceway: 1/2 inch (13 mm) high letters.
 - 2. 2-1/2 to 6 inches (64 to 150 mm) Outside Diameter of Raceway: 1 inch (25 mm) high letters.
- B. Stencil Paint: As specified in Section 09 90 00, semi-gloss enamel, colors conforming to the following:
 - 1. Black lettering on white background.
 - 2. White lettering on gray background.
 - 3. Red lettering on white background.
 - 4. Blue lettering on white background.

2.6 UNDERGROUND WARNING TAPE

A. Description: 4 inch (100 mm) wide plastic tape, detectable type, colored yellow with suitable warning legend describing buried electrical lines.

PART 3 EXECUTION

- 3.1 PREPARATION
 - A. Degrease and clean surfaces to receive adhesive for identification materials.
 - B. Prepare surfaces in accordance with Section 09 90 00 for stencil painting.

3.2 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates labels and markers.
- D. Re-stencil existing equipment.

3.3 INSTALLATION

- A. Install identifying devices after completion of painting.
- B. Nameplate Installation:
 - 1. Install nameplate parallel to equipment lines.
 - 2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
 - 3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
 - 4. Secure nameplate to equipment front using screws, rivets, or adhesive.
 - 5. Secure nameplate to inside surface of door on recessed panels in finished locations.
- C. Label Installation:
 - 1. Install label parallel to equipment lines.
 - 2. Install label for identification of individual control device stations.
 - 3. Install labels for permanent adhesion and seal with clear lacquer.
- D. Wire Marker Installation:
 - 1. Install wire marker for each conductor at pull boxes, outlet and junction boxes.
 - 2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
 - 3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.
- E. Conduit Raceway Marker Installation:
 - 1. Install conduit marker for each conduit longer than 6 feet (2000 mm).
 - 2. Conduit Marker Spacing: 20 feet (6000 mm) on center.

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- 3. Raceway Painting: Identify conduit using field painting in accordance with Section 09 90 00.
 - a. Paint colored band on each conduit longer than 6 feet (2000 mm).
 - b. Paint bands 20 feet (6000 mm) on center.
 - c. Color:
 - 1) Telephone System: Green.
- F. Stencil Installation:
 - 1. Apply stencil painting in accordance with Section 09 90 00.
- G. Underground Warning Tape Installation:
 - 1. Install underground warning tape along length of each underground conduit, raceway, or cable 6 to 8 inches (150 to 200 mm) below finished grade, directly above buried conduit, raceway, or cable.

END OF SECTION

SECTION 27 13 43

COMMUNICATIONS SERVICES CABLING

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes arrangement with Telecommunications Utility Company for telecommunication service and backboards, termination devices, outlets, and premises wiring.
- B. Related Sections:
 - 1. Section 26 27 26 Wiring Devices: Wall plates.
 - 2. Section 27 05 26 Grounding and Bonding for Communications Systems.
 - 3. Section 27 05 33 Conduits and Backboxes for Communications Systems.
 - 4. Section 27 05 53 Identification for Communications Systems.

1.2 REFERENCES

- A. International Electrical Testing Association:
 - 1. NETA ATS Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
 - 1. NFPA 262 Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Telecommunications Industry Association/Electronic Industries Alliance:
 - 1. TIA/EIA 568 Commercial Building Telecommunications Cabling Standard.
 - 2. TIA/EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces.
- D. Underwriters Laboratories, Inc.:
 - 1. UL 2043 Fire Test for Heat and Visible Smoke Release for Discrete Products and their Accessories Installed in Air-Handling Spaces.

1.3 SYSTEM DESCRIPTION

- A. Service entrance from Telecommunications Utility Company.
- B. Service Entrance Pathway: Empty ducts and raceway from point of Telephone Utility connection at overhead pole to building service terminal backboard.
- C. Horizontal Pathway: Conform to TIA/EIA 569, using raceway as indicated on Drawings.
- D. Entrance Wiring: By Telephone Utility Company.

E. Horizontal Wiring: Complete from telecommunications closet to each outlet using unshielded horizontal cables.

1.4 SUBMITTALS

- A. Section 01 33 00 Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog data for each termination device, cable, and outlet device.
- C. Test Reports: Indicate procedures and results for specified field testing and inspection.

1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations and sizes of pathways and outlets.

1.6 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet (1.5 m) when tested in accordance with NFPA 262.
- B. Provide combustible electrical equipment exposed within plenums with peak rate of heat release not greater than 100 kW, peak optical density not greater than 0.5, and average optical density not greater than 0.15 when tested in accordance with UL 2043.
- C. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in installing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.
- C. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.
1.9 EXTRA MATERIALS

- A. Section 01 70 00 Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two telephone outlet jacks.

1.10 COORDINATION

- A. Coordinate with utility company, relocation of overhead of underground lines interfering with construction. Where power lines are to be relocated, bill utility costs directly to Owner.
- B. Contact utility company regarding charges related to service installation. Include utility charges in this contract.
- C. Utility charges for service installation paid by Owner and are not part of this contract.

PART 2 PRODUCTS

2.1 TELEPHONE TERMINATION BACKBOARDS

- A. Material: Plywood.
- B. Size: 4 x 8 feet (1.2 x 2.4 m), 3/4 inch (19 mm) thick.

2.2 CROSS-CONNECT

- A. Manufacturers:
 - 1. Hubbell
 - 2. AMP (TYCO)
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: TIA/EIA 568, wall-mounted assembly of terminals with adequate capacity for active and spare circuits.

2.3 PATCH PANEL

- A. Manufacturers:
 - 1. Hubbell
 - 2. AMP (TYCO)
 - 3. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: TIA/EIA 568, wall-mounted assembly of terminals and accessory patch cords, with adequate capacity for active and spare circuits.

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2.4 TELEPHONE OUTLET JACKS

- A. Manufacturers:
 - 1. Hubbell
 - 2. AMP (TYCO)
 - 3. Pass & Seymour
 - 4. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: Conform to TIA/EIA 568 requirements for cable connectors for specific cable types.

2.5 UNSHIELDED HORIZONTAL CABLE (PHONE AND DATA)

- A. Manufacturers:
 - 1. Hubbell
 - 2. Berk-Tek
 - 3. AMP (TYCO)
 - 4. Belden
 - 5. Substitutions: Section 01 60 00 Product Requirements.
- B. Product Description: TIA/EIA 568, unshielded twisted pair noncombustible cable with 4 pairs, 23 AWG copper conductor (Enhanced Category 6).
- C. Tested to 550 MHZ.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Remove exposed abandoned telecommunications cables and pathways, including abandoned cables and pathways above accessible ceiling finishes. Cut flush with walls and floors, and patch surfaces.
- B. Disconnect and remove abandoned telecommunications equipment.
- C. Maintain access to existing telecommunications equipment, cabling, and terminations and other installations remaining active and requiring access. Modify installation or provide access panel.
- D. Extend existing telecommunications installations using materials and methods compatible with existing installations, or as specified.
- E. Clean and repair existing telecommunications equipment remaining or is to be reinstalled.

3.2 INSTALLATION

A. Install pathways in accordance with TIA/EIA 569.

- B. Install wire and cable in accordance with TIA/EIA 568.
- C. Finish paint termination backboards with durable white enamel in accordance with Section 09 90 00 prior to installation of telephone equipment.
- D. Install termination backboards and cabinets plumb, and attach securely to building wall at each corner. Install cabinet trim plumb.
- E. Install recessed cabinets flush with wall finishes, and stub 5 empty 1 inch (25 mm) conduits to accessible location above ceiling below floor at each location.
- F. Install polyethylene pulling string in each empty telephone conduit over 10 feet (3 m) in length or containing bends.
- G. Install engraved plastic nameplates in accordance with Section 27 05 53. Mark backboards and cabinets with legend "TELEPHONE."
- H. Ground and bond pathways, cable shields, and equipment in accordance with Section 27 05 26.
- 3.3 FIELD QUALITY CONTROL
 - A. Section 01 40 00 Quality Requirements: Field inspecting, testing, adjusting, and balancing.
 - B. Inspect and test optical fiber cables in accordance with NETA ATS, except Section 4. Perform inspections and tests listed in NETA ATS, Section 7.25.
 - C. Inspect and test copper cables and terminations in accordance with TIA/EIA 568.

END OF SECTION