

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Air coils.
2. Baseboard radiation.
3. Finned tube radiation.
4. Convectors.
5. Unit heaters.
6. Cabinet unit heaters.
7. Electric unit heaters.
8. Fan coil units.
9. Hydronic radiant heaters.
10. Hydronic radiant floor systems
11. Electric unit heaters.

B. Related Sections:

1. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Product requirements for motors for placement by this section.
2. Section 23 07 00 - HVAC Insulation: Execution requirements for insulation specified by this section.
3. Section 23 21 16 - Hydronic Piping Specialties: Product requirements for hydronic piping specialties for placement by this section.
4. Section 23 22 16 - Steam and Condensate Piping Specialties: Product requirements for steam piping specialties for placement by this section.
5. Section 23 23 00 - Refrigerant Piping: Execution requirements for connection of refrigerant piping to units specified by this section.
6. Section 23 31 00 - HVAC Ducts and Casings: Execution requirements for ducts specified by this section.
7. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connection to units specified by this section.

1.02 REFERENCES

- A. Air-Conditioning and Refrigeration Institute:
 - 1. ARI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- B. Sheet Metal and Air Conditioning Contractors:
 - 1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
- C. UL.
- D. NEC and IBC-NJ.

1.03 SUBMITTALS

- A. Division 01 - 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. Samples: Submit one sample of each radiation cabinet detailed.
- E. Manufacturer's Installation Instructions: Submit assembly, support details, and connection requirements.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets required for access to valves.
- C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with IBC-NJ.

- B. Maintain one copy of each document on site.

1.06 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.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Accept units on site in factory packing. Inspect for damage. Store under roof.
- C. Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors. Protect coils from entry of dirt and debris with pipe caps or plugs.

1.08 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.09 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.10 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two (2) sets of filters.

PART 2 - PRODUCTS

2.01 AIR COILS

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Aerofin
 - 2. Substitutions: Division 01 - Product Requirements.

B. Fabrication:

1. Tubes: 1/2 inch (12.7 mm) OD seamless copper arranged in parallel or staggered pattern, expanded into fins, silver joints.
2. Fins: Aluminum continuous plate type with full fin collars. Spiral fins for heating coils only.
3. Casing: Die formed channel frame of 16 gage (1.8 mm) galvanized steel with 3/8 inch (9.5 mm) mounting holes on 3 inch (75 mm) centers. Furnish intermediate center tube supports for plate fin coils longer than 36 inches (900 mm). Furnish intermediate tube supports for spiral fin coils at manufacturer's recommended intervals to eliminate sagging during operation.

C. Water, Steam, Glycol, Heating and Cooling Coils:

1. Headers: Cast iron with tubes expanded into header, seamless copper tube with silver brazed joints, or prime coated steel pipe with brazed joints.
2. Leak Testing: Air test under water to 300 psig (2,070 kPa) for working pressure of 200 psig (1,380kPa) and 200 degrees F (104 degrees C).
3. Configuration: Self draining circuitry, with threaded plugs in headers for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes. Furnish threaded plugs in return bends or in headers opposite top and bottom of each tube.
4. Configuration: Self Draining circuitry, with threaded plugs in headers for drain and vent, threaded plugs in return bends or headers opposite each top and bottom tube, sloped within frame to condensate connection.
5. Maximum Fin Spacing: 10 fins per inch (2.5 mm on center).
6. Provide double wall stainless steel drip pan with insulation below cooling coil extending beyond coil with slope to drain outlet for piping connection.

D. Refrigerant Coils:

1. Headers: Seamless copper tubes with silver brazed joints.
2. Liquid Distributors: Brass or copper venturi or orifice type or removable nozzle type distributor with seamless copper distributor tubes, minimum 1/4 inch (6.4 mm) OD; maximum 12 circuits for each distributor.
3. Leak testing: Air test under water at 300 psig (2 070 kPa) for working pressure of 300psig (2 070 kPa); dehydrate, and seal with dry air or nitrogen charge.
4. Configuration: Self-draining, down feed with bottom non-oil trapping connection.
5. Maximum Fin Spacing: 10 fins per inch (2.5 mm on center).
6. Provide double wall stainless steel drip pan with insulation below coil extending beyond coil with slope to drain outlet for piping connection.

2.02 BARE FINNED TUBE ELEMENTS IN CUSTOM ENCLOSURES

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Vulcan Linovector
 - 2. Sterling
- B. Single row 1" copper tube with 4-1/4" x 4-1/4" aluminum fins finished in black enamel.
- C. Wall-mount Bracket - Saddle with nylon coated support arms.
- D. Coordinate enclosure fastening requirement with Architectural enclosure detail.

2.03 FIN-TUBE WITH ENCLOSURES - WALL MOUNTED

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Vulcan
 - 2. Sterling
 - 3. Substitutions: Division 01 - Product Requirements.
- B. Heating Elements: 1 inch copper tubing mechanically expanded into evenly spaced aluminum fins, two (2) tubes end belled. Hangers shall be quiet operating, ball bearing cradle type.
- C. Enclosure: Minimum 16 ga. steel with 18-7/16 inch high back and top of one piece; front panel, end panel, end caps, corners, and joiner pieces to snap together, with front panel easily removable. Furnish full-length damper. Provide corners, end caps, tamper proof access doors and blank sections.
- D. Finish: Factory applied baked enamel of custom color to be selected by Architect.
- E. Element Brackets: 0.0516 inch thick galvanized steel to support from panel and noise free element cradle.
- F. Capacity: As scheduled, based on 65 degrees F entering air temperature.

2.04 FINNED TUBE RADIATION WITH ENCLOSURE - PEDESTAL MOUNTED

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Vulcan
 - 2. Sterling
- B. Heating Elements: 1 inch ID seamless copper tubing, mechanically expanded into evenly spaced aluminum fins sized 4-1/4 x 4-1/4 inches, suitable for soldered fittings.

- C. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- D. Enclosures: Extruded aluminum construction of heavy gauge, with extended grilles and easily jointed components for wall to wall installation. Support rigidly, on floor mounted brackets at least 3 feet on center maximum. Provide corners, end caps, tamper proof access doors, blank sections.
- E. Finish: Factory applied baked enamel of custom color to be selected by Architect.
- F. Capacity: As scheduled, based on 65 degrees F entering air temperature.

2.05 UNIT HEATERS

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal
 - 1. QMark
 - 2. Trane
 - 3. Modine
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Coils: Seamless copper tubing, 0.025 inch (0.64 mm) minimum wall thickness, silver brazed to steel headers, and with evenly spaced aluminum fins mechanically bonded to tubing.
- C. Casing: 0.0478-inch (1.2 mm) thick steel with threaded pipe connections for hanger rods.
- D. Finish: Factory applied baked primer of custom color to be selected by Architect.
- E. Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard; horizontal models with permanently lubricated sleeve bearings; vertical models with grease lubricated ball bearings.
- F. Air Outlet: Adjustable pattern diffuser on projection models and [two] [four]-way louvers on horizontal throw models.
- G. Motor: Permanently lubricated sleeve bearings on horizontal models, grease lubricated ball bearings on vertical models. Refer to Section 23 05 13.
- H. Control: Local multi-speed disconnect switch and integral or remote thermostat where thermostats are shown.
- I. Capacity: As scheduled, based on 65 degrees F (18 degrees C) entering air temperature.

J. Electrical Characteristics: Refer to Contract Drawing.

2.06 CABINET UNIT HEATERS

A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:

1. QMark
2. Trane
3. Modine
4. Substitutions: Division 01 - Product Requirements.

B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 100 psi (1380 kPa) and 220 degrees F (104 degrees C).

C. Cabinet: 0.0598 inch (1.5 mm) thick steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation and integral air outlet and inlet grilles.

D. Provide recessing flanges and kits for recessed cabinet heaters. Integral air intake and discharge opening except for ducted units or where specifically called otherwise.

E. Finish: Factory applied baked enamel of custom color as selected by Architect on visible surfaces of enclosure or cabinet.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

H. Control: Multiple speed switch, factory wired, located in cabinet. Provide return air thermostat and local disconnect switch.

I. Filter: Easily removed 1 inch (25 mm) thick glass fiber throw-away type, located to filter air before coil.

J. Mixing Dampers: Where indicated, mixing sections with dampers.

K. Capacity: As Scheduled, based on 65 degrees F (18 degrees C) entering air temperature.

L. Electrical Characteristics: Refer to Contract Drawing.

2.07 FAN COIL UNITS

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. Trane.
 - 2. Carrier.
 - 3. International Fan.
 - 4. Substitutions: Division 01 - Product Requirements.
- B. Coils: Evenly spaced aluminum fins mechanically bonded to copper tubes, designed for 200 psi (1380 kPa) and 220 degrees F (104 degrees C). Furnish drain pan under cooling coil, easily removable for cleaning, with drain connection.
- C. Cabinet: 0.0598 inch (1.5 mm) thick steel with exposed corners and edges rounded, easily removed panels, glass fiber insulation with foil coating and integral air outlet and inlet grilles.
- D. Finish: Factory apply baked enamel of custom color as selected by Architect on visible surfaces of enclosure or cabinet.
- E. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.
- F. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.
- G. Control: Multiple speed switch, factory wired, located in cabinet.
- H. Filter: Easily removed 1 inch (25 mm) thick glass fiber throw-away type, located to filter air before coil.
- I. Mixing Dampers: As indicated on Drawings, mixing sections with dampers.
- J. Capacity: As indicated on Drawings.
- K. Electrical Characteristics: Refer to Contract Drawing.

2.08 HYDRONIC RADIANT HEATERS

- A. Manufacturers: Subject to requirements of the specification, provide the following manufacturer's products by one of the following or approved equal:
 - 1. SUN EL

- B. Ceiling Panels: Constructed of modular aluminum pans with silk-screened pattern matching ceiling tile; manufactured and assembled to sizes and configurations indicated.
- C. Pipe Coil: Module to incorporate extruded void into continuous 1/2 inch (15 mm) copper pipe is rolled and thermally bonded. Aluminum pan module to incorporate continuous 1/2 inch (15 mm) copper pipe thermally bonded. Furnish return bends for two water connections to each panel. Unit shall be rated for 125 psig construction.
- D. Cross brace entire assembly with structural members and insulate with 1 inch (25 mm) thick fiberglass insulation. Configure panels within T-bar ceiling module and run wall to wall.
- E. Heating Capacity: As scheduled, based on 180 degrees F (82 degrees C) average water temperature, 70 degrees F (21 degrees C) space temperature.

2.09 RADIANT FLOOR SYSTEMS

- A. Scope: Provide a radiant tubing system, consisting of PEX tubing with oxygen permeation protection, distribution manifolds and associated fittings.
- B. References:
 - 1. American Society of Testing and Materials Standard Specification F1281 entitled "Crosslinked Polyethylene (PEX) Tubing".
- C. Materials:
 - 1. Tube: All PEX tubing shall conform to ASTM F1281 "American Society of Testing and Materials, Standard Specification F1281 entitled "Crosslinked Polyethylene (PEX) Tubing", tubing shall be "aluminPex" supplied by Weil McLain, Uponor or approved equal, in reference to workmanship, dimensions, density, hydrostatic burst, sustained pressure, stress cracking, degree of crosslinking and stabilizer migration.
 - a. Tube Composition: Crosslinked Polyethylene (PEX) in accordance with ASTM F1281, with main layer of PEX, longitudinally welded aluminum core and outer layer of PEX, and shall be electronically traceable.
 - b. Tube Wall Thickness: All PEX buting sizes above 1/2" shall have a Standard Dimension Ratio (SDR) of 9 minimum. PEX tubing sizes of 3/8" and 1/2" have wall thicknesses of .070" minimum.
 - c. Physical Properties:
 - 1) Density: .94 mg/cm³
 - 2) Thermal conductivity: .202 Btu.ft per hr.ft² per °F
 - 3) Thermal expansion: .00029 inches/inch per °F
 - d. Working Pressure/Temperature: The minimum continuous working pressure rating of the PEX tubing shall be 100 psi @ 200°F working temperature.

- e. Manufacturing Method: All PEX tubing shall be manufactured using the "electron beam method" of crosslinking, performed at ambient temperature and pressure.
- f. Oxygen Barrier: PEX tubing shall have an oxygen diffusion barrier capable of limiting oxygen diffusion through the tube to no greater than 0g/m³/day @ 104°F water temperature.
- g. Bend Radius: The minimum bend radius of cold bending of the tube shall not be more than six (6) times the outside diameter for up to a 90-degree bend. For 180-degree bends, the minimum bend radius shall be as follows:

1/2" tubing	3.75" radius
5/8" tubing	4.5" radius
3/4" tubing	5.75" radius

Bend supports shall be available for smaller bend radii.

- h. Marking: All PEX tubing shall be marked at intervals for not more than 5 feet in accordance with ASTM F876 as follows:
 - 1) Nominal tubing size.
 - 2) Type of plastic tubing material.
 - 3) Standard dimension Ratio: SDR9.
 - 4) Pressure rating for water and temperature for which the pressure rating is valid.
 - 5) ASTM designation, ASTM F876.
 - 6) Manufacturer's name and production code.
 - 7) Date of manufacturing.
 - 8) Oxygen diffusion protection.
 - 9) Length indications in 5-foot intervals, for ease of measuring the tubing.
- i. Warranty period for PEX-A/R shall be 30 years. Warranty period for manifolds and fittings shall be 5 years.

- 2. Manifolds: Copper manifolds used in PEX tubing installation shall consist of individual loop control and adaptation utilizing components ready for assembly. The manifold shall also include the following features:

- a. Modular Design: This eliminates the need for multiple manifold configurations and allows for future expansion.
- b. Venting: Each supply and return vent/temperature module shall have an automatic vent.
- c. Temperature Measurements: Each supply and return manifold shall have a thermometer integrated to indicate supply and return water

temperatures. Temperature readouts will assist in the diagnostics and setup of a radiant heating system.

- d. Flow Measurements: Each loop (circuit) return block shall have incremental adjustment and flow rate indication. Temperature and flow readouts will assist in the diagnostics and setup of a radiant heating system.
- e. Balancing Valves: Each return block shall be provided with a balancing valve and flow meter for proper balancing of the radiant heating system. Each valve shall be able to fully close to allow complete loop isolation. Install supply and return piping to the manifold in a reverse return configuration.
- f. Supply/Return Indication: Each loop supply module shall be red to indicate incoming hot water and each return loop module shall be blue to indicate cooler return water.
- g. Loop Isolation: Each loop supply and return module shall have a means of fully isolating the loop from the rest of the system.
- h. Piping Inlet/Outlet Size: All manifold inlets/outlets shall be 1-1/4" NPT female, to fit maximum size plumbing and greater system adaptability.
- i. Provide control valves with electric actuators for each individual loop (circuit) served by the manifold. Control valves shall be controlled by the building management system.
- j. Provide recessed enclosure box for each manifold.

3. Fittings:

- a. Fitting Composition: Brass compression fittings consisting of nut, ferrule and insert with o-ring for connecting PEX or Copper tubing to manifold.
- b. Fitting Types: Manifold to PEX tubing sizes 1/2", 5/8", 3/4"
Manifold to Copper tubing.
Hose Bib
Manifold Cap
- c. Required Features: Well fitting, easily installed, copper tubing should not require soldering.

D. System Requirements:

- 1. Installations: Radiant tubing systems shall be installed in accordance with the manufacturer's instructions and recommendations. All relevant information shall be included in shop drawing submittal as noted below:
 - a. Tube handling
 - b. Tube measuring
 - c. Tube cutting

- d. Tube bending
 - e. Tube repairing
 - f. Tube connections
 - g. Tube solvent sensitivity
 - h. Tube UV light sensitivity
 - i. Tube capacity and pressure drop
 - j. Tube loop layout patterns
 - k. Tube fastening procedures
 - l. Manifold assembly instructions
 - m. Manifold location
 - n. Fitting assembly instructions
 - o. Insulation practices
 - p. Installation method by construction type
 - q. Control applications
 - r. System start-up procedures
 - s. System capacity and heat output
2. Shop Drawings: All shop drawings of the radiant tubing system shall be in accordance with manufacturer recommended procedures for the products utilized.
3. Components: All product components of the radiant tubing system shall be supplied by one manufacturer, including: PEX tubing, fittings, manifolds and other recommended and required hardware to assure a compatible and a complete radiant tubing system.
- a. Manifolds: Manifolds shall be of cast brass construction, manufactured by alloys to prevent dezincification, and shall have integral circuit balancing valves. Manifolds shall be able to vent air from the system, manifolds shall be provided with support brackets and tube bend supports and wall cabinets. Manifolds shall be isolated from supply and return tubing with valves that are suitable for isolation and balancing. Each individual loop/circuit shall have an electronically actuated control valve.
 - b. Fittings: Fittings shall be manufactured by dezincification resistant brass. These fittings must be supplied by the tube manufacturer. The fittings shall consist of an insert, a compression ring and a compression nut.
 - c. Supply and Return Piping to the Manifolds:

- 1) Piping shall be copper.
- 2) Fittings shall be compatible to the piping material used.
- 3) All fittings shall be accessible for maintenance. Tubing loops shall be installed without splices, as a minimum, from the point at which the tubing enters the panel to the point at which it exits the panel.
4. Installation shall follow the shop drawings for tubing layout, tube spacing, manifold configuration, manifold location, and controls. All notes on the drawings shall be followed.
5. The tubing system shall be pressurized, with water, to a pressure of 150 psig 24 hours prior to encasement in the radiant panel. The tubing system shall remain at this pressure during the panel installation, and for a minimum of 24 hours thereafter to ensure system integrity. The contractor shall provide the water for the pressurization of the tubing system. The contractor assumes all liabilities for suitable safety precautions and testing.
6. At start-up time, the contractor shall: follow the manufacturer's recommendations for system water and temperature balancing, record balance settings at each manifold location, and deliver to the owner a complete record of these settings for inclusion in the operation and maintenance manuals.
7. The entire assembly including tubing, valves, manifolds, etc. shall be capable of continuous operation of 200°F water at 100 psig.
8. Manufacturer to provide tie-downs for tubing system

2.10 ELECTRIC UNIT HEATERS

- A. Assembly: UL listed and labeled assembly with terminal box and cover, and built-in controls.
- B. Heating Elements: Enclosed copper tube, aluminum finned element of coiled nickel-chrome resistance wire centered in tubes and embedded in refractory material.
- C. Cabinet: 0.0478-inch (1.2 mm) thick steel with easily removed front panel with integral air outlet and inlet grilles.
- D. Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- E. Fan: Direct-drive propeller type, statically and dynamically balanced, with fan guard.
- F. Motor: Permanently lubricated, sleeve bearings for horizontal models; ball bearings for vertical models.
- G. Control: Separate fan speed switch and thermostat heat selector switch, factory wired, with switches built-in behind cover. Furnish thermal overload. Provide integral disconnect switch and return air thermostat.

- H. Electrical Characteristics: Refer to Contract Drawing.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Division 01 - 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 ductwork is ready for installation.
- E. Verify concealed blocking and supports are in place and connections are correctly located.

3.02 INSTALLATION

- A. Install air coils in ducts and casings in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible. Refer to Section 23 31 00. Provide access doors on both sides of coil.
- B. Support air coil sections independent of piping on steel channel or double angle frames and secure to casings. Furnish frames for maximum three coil sections. Arrange supports to avoid piercing drain pans. Install with airtight seal between coil and duct or casing.
- C. Protect coils to prevent damage to fins and flanges. Comb out bent fins.
- D. Install coils level. Install cleanable tube fluid coils and level frame steam coils with 1: 50 pitch.
- E. Make connections to coils with unions and flanges.
- F. On water coils, install shut-off valve on supply piping and lockshield balancing valve on return piping. Locate water supply at bottom of supply header and return water connection at top. Install manual air vents at high points complete with stop valve. Install water coils to be drainable and install drain connection at low points. Refer to Section 23 21 16.
- G. On water and glycol heating coils, and chilled water cooling coils, connect water supply piping to leaving airside of coil (counter flow arrangement). Refer to Section 23 21 16.
- H. For cooling coils where air velocity exceeds 500 ft/min (2.5 m/sec), install three break moisture eliminators of 24 gage (0.60 mm) galvanized steel.

- I. Install insulation air coil casings. Refer to Section 23 07 00.
- J. Install drain pan and drain piping connection for cooling coils without integrated pan. Fabricate drain pan from 20 gage (0.90 mm) stainless steel insulated double wall. Extend 3 inches (75 mm) from face of coil entering air side, 6 inches (150 mm) from face of coil leaving air side and 4 inches (100 mm) from face of eliminators. Pipe drain pans individually to floor drain with water seal trap. Refer to Section 23 21 16.
- K. In steam coils, install vacuum breaker in steam piping at or in header. Install steam traps with outlet minimum 12 inches (300 mm) below coil return connection. Refer to Section 23 22 16.
- L. On refrigerant coils, install sight glass in liquid piping within 12 inches (300 mm) of coil. Refer to Section 23 23 00.
- M. Insulate headers located outside airflow, insulate as specified for piping. Refer to Section 23 07 00.
- N. Wire electric duct coils. Refer to Section 26 05 03.
- O. Install equipment exposed to finished areas after walls and ceilings are finished and painted. Avoid damage.
- P. Protection: Install finished cabinet units with protective covers during remainder of construction.
- Q. Baseboard Radiation: For surface-mounted units, run cover continuously wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install end caps where units butt against walls.
- R. Finned Tube Radiation: For surface-mounted units, run cover wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Align cabinet joints with window mullions. Install wall angles where units butt against walls.
- S. Convectors: Install at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed convectors.
- T. Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as allowed by manufacturer to maintain greatest headroom unless otherwise indicated.
- U. Cabinet Unit Heaters: Install at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed units.
- V. Fan-Coil Units: Install at locations as indicated on Drawings. Coordinate to assure correct recess size for recessed units.

- W. Hydronic Units: Install with shut-off valve on supply piping and lock shield balancing valve on return piping. Where not accessible, extend vent to exterior surface of cabinet for servicing. For cabinet unit heaters, fan coil units, and unit heaters, install float operated automatic air vents with stop valve. Refer to Section 23 21 16.
- X. Units with Cooling Coils: Install drain piping to condensate drain or open drain. Refer to Section 23 21 16.
- Y. 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.

3.03 INSTALLATION OF RADIANT FLOOR

- A. Factory tubing shall be secured to flat mesh or reinforcing bar in accordance with manufacturer's recommendations.
- B. Use smaller tubing on center distances along exterior walls.
- C. Adjusting:
 - 1. Balancing Across the Manifold:
 - a. Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.
 - b. Balancing is unnecessary when all loop lengths across the manifold are within 3 percent of each other in length. Install the supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.
 - 2. Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains.
- D. Cleaning:
 - 1. Remove temporary coverings and protection of adjacent work areas.
 - 2. Repair or replace damaged installed products.
 - 3. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
 - 4. Remove construction debris from project site and legally dispose of debris

3.04 CLEANING

- A. Division 01 - Execution and Closeout 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.
- D. Install new filters.

END OF SECTION