

TIPS:

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes radiant-heating piping, including:
 - 1. PEX pipe and fittings
 - 2. PEX-AL-PEX pipe and fittings
 - 3. Distribution manifolds
 - 4. Piping specialties
 - 5. Controls.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. PEX: Crosslinked polyethylene.
- C. PEX/AL/PEX: Crosslinked polyethylene/aluminum/crosslinked polyethylene.
- D. PTFE: Polytetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Provide submittals in accordance with section [01-33-00 Submittal Procedures]
- B. Product Data:
 - 1. Include data for piping, fittings, manifolds, specialties, and controls; include pressure and temperature ratings, oxygen-barrier performance, fire-performance characteristics, and water-flow and pressure-drop characteristics.
- C. Shop Drawings: Show piping layout and details drawn to scale, including valves, manifolds, controls, and support assemblies, and their attachments to building structure.

1. Shop Drawing Scale: [**1/4 inch = 1 foot (1:50)**] <Insert scale>.

- D. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are indicated and coordinated with each other, using input from installers of the items involved:
 1. Suspended ceiling components.
 2. Structural members to which radiant-heating piping will be attached.
 3. Items penetrating finished ceiling, including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. <Insert item>.
 4. Perimeter moldings.

- E. Operation and Maintenance Data: For radiant-heating piping valves and equipment to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Apollo Flow Controls; Conbraco Industries, Inc.
 2. Elkhart Products Corporation.
 3. FlorHeat Company (The).
 4. Heat Innovations Inc.
 5. HeatLink Group Inc.
 6. Infloor Radiant Heating Inc.
 7. IPEX USA LLC.
 8. MrPex Systems Inc.
 9. REHAU.
 10. SharkBite, A Division of Reliance Worldwide Corporation.
 11. Sioux Chief Manufacturing Company, Inc.
 12. Uponor.
 13. Vanguard Piping Systems, Inc.
 14. Viega LLC.
 15. Warmboard, Inc.
 16. Watts Radiant; A WATTS Brand.
 17. Zurn Industries, LLC.

18. <Insert manufacturer's name>.

- B. Pipe Material: PEX plastic in accordance with ASTM F876.
- C. Oxygen Barrier: Limit oxygen diffusion through the tube to maximum 0.10 mg per cu.m/day at 104 deg F (40 deg C) in accordance with DIN 4726.
- D. Fittings: [ASTM F1807, metal insert and copper crimp rings] [ASTM F1960, cold expansion fittings and reinforcing rings].
- E. Pressure/Temperature Rating: Minimum 100 psig (690 kPa) and 180 deg F (82 deg C).

2.2 PEX/AL/PEX PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Heat Innovations Inc.
 - 2. IPEX USA LLC.
 - 3. Uponor.
 - 4. Viega LLC.
 - 5. Watts Radiant; A WATTS Brand.
 - 6. <Insert manufacturer's name>.
- B. Pipe Material: PEX plastic bonded to the inside and outside of a welded aluminum tube in accordance with ASTM F1281.
- C. Oxygen Barrier: Limit oxygen diffusion through the pipe to maximum 0.10 mg per cu. m/day at 104 deg F (40 deg C) in accordance with DIN 4726.
- D. Fittings: ASTM F1974, metal insert fittings with split ring and compression nut (compression joint) or metal insert fittings with copper crimp rings (crimp joint).
- E. Flame-Spread and Smoke-Developed Indices: 25 and 50 or less, respectively, tested in accordance with ASTM E84.
- F. Pressure/Temperature Rating: Minimum 100 psi (690 kPa) and 210 deg F (99 deg C).

2.3 EPDM PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Watts Radiant; A WATTS Brand.
 - 2. <Insert manufacturer's name>.
- B. Pipe Material: Crosslinked EPDM inner and outer tubes.
- C. Wall Thickness: Minimum 0.125 inch (3.2 mm).

- D. Oxygen Barrier: Ductile aluminum foil layer applied to the inner tube to limit oxygen diffusion through the pipe to maximum 0.10 mg per cu.m/day at 104 deg F (40 deg C) in accordance with DIN 4726.
- E. Reinforcing Braid: Braided-aluminum wire between the inner and outer tube.
- F. Fittings: ASTM F1807, copper with stainless steel crimps or clamps.
- G. Pressure/Temperature Rating: Minimum 100 psig (690 kPa) and 210 deg F (99 deg C).

2.4 DISTRIBUTION MANIFOLDS

- A. Manifold: Minimum NPS 1 (DN 25), **[brass] [copper] [modular plastic] [or] [stainless steel]**.
- B. Main Shutoff Valves:
 - 1. Factory installed on supply and return connections.
 - 2. **[Two] [Three]**-piece body.
 - 3. Body: Brass or bronze.
 - 4. Ball: Chrome-plated bronze.
 - 5. Seals: PTFE.
 - 6. CWP Rating: 150 psig (1035 kPa).
 - 7. Maximum Operating Temperature: 225 deg F (107 deg C).
- C. Manual Air Vents:
 - 1. Body: Bronze.
 - 2. Internal Parts: Nonferrous.
 - 3. Operator: Key furnished with valve, or screwdriver bit.
 - 4. Inlet Connection: NPS 1/2 (DN 15).
 - 5. Discharge Connection: NPS 1/8 (DN 6).
 - 6. CWP Rating: 150 psig (1035 kPa).
 - 7. Maximum Operating Temperature: 225 deg F (107 deg C).
- D. Balancing Valves:
 - 1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
 - 2. Ball or Plug: Brass or stainless steel.
 - 3. Globe Cartridge and Washer: Brass with EPDM composition washer.
 - 4. Seat: PTFE.
 - 5. Visual Flow Indicator: Flowmeter with visible indication in a clear plastic cap at top of valve.
 - 6. Differential Pressure Gauge Connections: Integral seals for portable meter to measure loss across calibrated orifice.
 - 7. Handle Style: Lever or knob, with memory stop to retain set position if used for shutoff.
 - 8. CWP Rating: Minimum 125 psig (860 kPa).
 - 9. Maximum Operating Temperature: 250 deg F (121 deg C).

E. Zone Control Valves:

1. Body: Plastic or bronze, ball or plug, or globe cartridge type.
2. Ball or Plug: Brass or stainless steel.
3. Globe Cartridge and Washer: Brass with EPDM composition washer.
4. Seat: PTFE.
5. Actuator: Replaceable electric motor.
6. CWP Rating: Minimum 125 psig (860 kPa).
7. Maximum Operating Temperature: 250 deg F (121 deg C).

F. Thermometers:

1. Mount on supply and return connections.
2. Case: Dry type, metal or plastic, [2-inch (50-mm)] <Insert dimension> diameter.
3. Element: Bourdon tube or other type of pressure element.
4. Movement: Mechanical, connecting element and pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Black metal.
7. Window: Plastic.
8. Connector: Rigid, back type.
9. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem.
10. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

G. Mounting Brackets: Copper, or plastic- or copper-clad steel, where in contact with manifold.

2.5 PIPING SPECIALTIES

A. Insulated Floor Panel System for Hydronic Radiant Floor (Slab) Systems <Insert drawing designation>: 3-3/8 inch (86 mm) high, raised grid pattern from molded (expanded) polystyrene board insulation with high-impact polystyrene (HIPS) film laminated to top side only.

1. Alleguard.; Ampex
2. Panel Thickness:
 - a. [3-3/8 inches (86 mm)]
 - b. [3-7/8 inches (98 mm)]
 - c. [4-3/8 inches (111 mm)]
 - d. [4-7/8 inches (124 mm)]
3. Compressive Strength (ASTM D1621):
 - a. [30 psi (207 kPa)] [ASTM C578, Type II] [CAN/ULC S701, Type 2]
 - b. [45 psi (310 kPa)] [ASTM C578, Type IX]
 - c. [60 psi (414 kPa)] [ASTM C578, Type XV]

4. Density (ASTM D1622):
 - a. [1.5 lb/ft³ (24 kg/m³)]
 - b. [2.2 lb/ft³ (35 kg/m³)]
 - c. [3.5 lb/ft³ (56 kg/m³)]

5. Water Vapor Permeance (ASTM E96):
 - a. [0.42 perms (23.8 ng/Pa x s x m²)]
 - b. [0.31 perms (17.5 ng/Pa x s x m²)]
 - c. [0.20 perms (11.2 ng/Pa x s x m²)]

6. Thermal Resistance (ASTM C518):
 - a. [10 F x h x ft²/Btu (1.76 K x m²/W)]
 - b. [12 F x h x ft²/Btu (2.11 K x m²/W)]
 - c. [14 F x h x ft²/Btu (2.47 K x m²/W)]
 - d. [16 F x h x ft²/Btu (2.82 K x m²/W)]

2.6 CONTROLS

- A. Temperature-control devices and sequence of operations are specified in Section 23-09-23 "Direct Digital Control (DDC) System for HVAC" and Section 23-09-93.11 "Sequence of Operations for HVAC DDC."

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Apollo Flow Controls; Conbraco Industries, Inc.
 2. Danfoss Inc.
 3. HeatLink Group Inc.
 4. Honeywell Building Solutions; Honeywell International, Inc.
 5. Infloor Radiant Heating Inc.
 6. IPEX USA LLC.
 7. Oventrop Corporation.
 8. REHAU.
 9. Slant/Fin Corp.
 10. tekmar; A WATTS Brand.
 11. Vanguard Piping Systems, Inc.
 12. Viega LLC.
 13. Watts Radiant; A WATTS Brand.
 14. Zurn Industries, LLC.
 15. <Insert manufacturer's name>.

- C. Wall-Mounted Thermostat:
 1. Minimum temperature range from [50 to 90 deg F (10 to 32 deg C)] <Insert temperature range>.
 2. Manually operated with on-off switch.

3. Day and night setback and clock program with minimum four periods per day.
 4. Operate pumps or open zone control valves if room temperature falls below the thermostat setting, and stop pumps or close zone control valves when room temperature rises above the thermostat setting.
- D. Heated-Panel Thermostat:
1. Remote bulb unit with adjustable temperature range from **[50 to 90 deg F (10 to 32 deg C)] <Insert temperature range>**.
 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump or zone control valve.
 3. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant-panel temperature.
 4. Stop pump or close zone control valves if heated-panel thermostat setting is exceeded.
 5. Corrosion-resistant, waterproof control enclosure.
- E. Heated-Panel Thermostat with Outdoor Temperature Reset:
1. Remote bulb unit with adjustable temperature range from **[50 to 90 deg F (10 to 32 deg C)] <Insert temperature range>**.
 2. Snap action; open-on-rise, single-pole switch with minimum current rating adequate for connected pump or zone control valve.
 3. Remote bulb on capillary tube, resistance temperature device, or thermistor for directly sensing radiant-panel and outdoor-air temperature.
 4. Operate zone control valves to reset supply-water temperature inversely with outdoor-air temperature as follows:
 - a. Low outdoor-air temperature, **[0 deg F (minus 18 deg C)] <Insert temperature>** with high supply-water temperature **[110 deg F (43 deg C)] <Insert temperature>**.
 - b. High outdoor-air temperature, **[60 deg F (16 deg C)] <Insert temperature>** with low supply-water temperature **[70 deg F (21 deg C)] <Insert temperature>**.
 5. Corrosion-resistant, waterproof control enclosure.
- F. Precipitation and Temperature Sensor:
1. **[Microprocessor-based] [Automatic]** control with manual on, automatic, and standby/reset switch.
 2. Precipitation and temperature sensors shall sense the surface conditions of pavement and shall be programmed to operate pump and zone control valves as follows:
 - a. Temperature Span: **[34 to 44 deg F (1 to 7 deg C)] <Insert temperature range>**.
 - b. Adjustable Delay Off Span: **[30 to 90] <Insert numbers>** minutes.
 - c. Start Pump or Open Zone Control Valves: Following **[two] <Insert number>**-minute delay if ambient temperature is below set point and precipitation is detected.
 - d. Stop Pump or Close Zone Control Valves: On detection of a dry surface plus time delay.

3. Corrosion-proof and waterproof enclosure suitable for outdoor mounting, for controls and precipitation and temperature sensors.
4. Minimum 30-A contactor to start pump and open valves.
5. Precipitation sensor shall be mounted in pavement.
6. Provide relay with contacts to indicate operational status, on or off, for interface with central HVAC control-system workstation.

G.

H. Insulating Concrete Forms (ICF): Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than [1/240] [1/360] [1/600] [1/720] <Insert ratio> of the wall height.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces and substrates to receive radiant-heating piping for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
 1. Ensure that surfaces and pipes in contact with radiant-heating piping are free of burrs and sharp protrusions.
 2. Ensure that surfaces and substrates are level and plumb.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Install the following types of radiant-heating piping for the applications described:
 1. Piping in Exterior Pavement: [EPDM] [PEX] [PEX/AL/PEX].
 2. Piping in Interior Reinforced-Concrete Floors: [EPDM] [PEX] [PEX/AL/PEX].
 3. Piping in Level Fill Concrete Floors (Not Reinforced): [EPDM] [PEX] [PEX/AL/PEX].

3.3 INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of insulated floor panel and piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings or coordination drawings.
- B. Install insulated floor panel system in accordance with manufacturer's written instructions.
- C. Install radiant-heating piping continuous from the manifold through the heated panel and back to the manifold without piping joints in heated panels.
- D. Connect radiant piping to manifold in a reverse-return arrangement.
- E. Do not bend pipes in radii smaller than manufacturer's minimum bend radius dimensions.
- F. Install manifolds in accessible locations, or install access panels to provide maintenance access as required in Section 08-31-13 "Access Doors and Frames."
- G. Comply with requirements in Section 23-21-13 "Hydronic Piping" and Section 23-21-16 Hydronic Piping Specialties" for pipes and connections to hydronic systems and for glycol-solution fill requirements.
- H. Fire- and Smoke-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials in accordance with Section 07-84-13 "Penetration Firestopping."
- I. Piping in Exterior Pavement:
 - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of [**18 inches (457 mm)**] <Insert dimension> o.c. and at center of turns or bends.
 - 3. Maintain 3-1/2-inch (89-mm) minimum cover.
 - 4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of [**10 inches (250 mm)**] <Insert dimension> on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 - 5. Maintain minimum 40-psig (275-kPa) pressure in piping during concrete placement and continue for 24 hours after placement.
- J. Piping in Interior Reinforced-Concrete Floors:
 - 1. Secure piping in concrete floors by attaching pipes to reinforcement using cable ties.
 - 2. Space cable ties a maximum of [**18 inches (457 mm)**] <Insert dimension> o.c. and at center of turns or bends.
 - 3. Maintain 3-1/2-inch (89-mm) minimum cover.
 - 4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of [**10 inches (250 mm)**] <Insert dimension> on each side

- of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
5. Maintain minimum 40-psig (275-kPa) pressure in piping during concrete placement and continue for 24 hours after placement.
- K. Piping in Level Fill Concrete Floors (Not Reinforced):
1. Secure piping in concrete floors by attaching pipes to subfloor using tracks, clamps, or staples.
 2. Space tracks, clamps, or staples a maximum of **[18 inches (457 mm)] <Insert dimension>** o.c. and at center of turns or bends.
 3. Maintain 3-1/2-inch (89-mm) minimum cover.
 4. Install a sleeve of 3/8-inch- (9.5-mm-) thick, foam-type insulation or PE pipe around tubing and extending for a minimum of **[10 inches (250 mm)] <Insert dimension>** on each side of slab joints to protect the tubing passing through expansion or control joints. Anchor sleeve to slab form at control joints to provide maximum clearance for saw cut.
 5. Maintain minimum 40-psig (275-kPa) pressure in piping during the concrete pour and continue for 24 hours during curing.
- L. Revise locations and elevations from those indicated as required to suit field conditions and ensure integrity of piping and as approved by Architect.
- M. After system balancing has been completed, mark balancing valves to permanently indicate final position.
- N. Perform the following adjustments before operating the system:
1. Open valves to fully open position.
 2. Check operation of automatic valves.
 3. Set temperature controls so all zones call for full flow.
 4. Purge air from piping.
- O. After concrete or plaster heating panel has cured as recommended by concrete or plaster supplier, operate radiant-heating system as follows:
1. Start system heating at a maximum of 10 deg F (6 deg C) above the ambient radiant-panel temperature and increase 10 deg F (6 deg C) each following day until design temperature is achieved.
 2. For freeze protection, operate at a minimum of 60 deg F (16 deg C) supply-water temperature.
- 3.4 FIELD QUALITY CONTROL
- A. Prepare radiant-heating piping for testing as follows:
1. Open all isolation valves and close bypass valves.
 2. Open and verify operation of zone control valves.
 3. Flush with clean water and clean strainers.

- B. Perform the following tests and inspections [**with the assistance of a factory-authorized service representative**]:
 - 1. Leak Test: After installation, charge system and test for leaks. Subject piping to hydrostatic test pressure that is not less than 1.5 times the design pressure but not more than [**100 psi (690 kPa)**] <Insert value>. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Radiant-heating piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Protect hydronic piping system from damage during construction.

END OF SECTION 23-83-16