**SECTION 23 83 16**

**Radiant Heating Hydronic Piping**

This specification covers radiant heating and cooling employing HeatLink’s HeatLink® PEX-a tubing system.

1. General
	1. section Includes

SPECIFIER NOTE: Remove types not required.

* + 1. Radiant heating system.
		2. Radiant cooling system.
		3. Radiant heating and cooling system.
	1. related sections

SPECIFIER NOTE: Remove sections that are not required. Add sections as required.

* + 1. Section 22 11 13 – Facility Water Distribution Piping.
		2. Section 23 09 00 – Instrumentation and Control for HVAC.
			1. Section 23 09 13 – Instrumentation and Control Devices for HVAC.
			2. Section 23 09 23 – Direct-Digital Control System for HVAC.
			3. Section 23 09 33 – Electric and Electronic Control System for HVAC.
			4. Section 23 09 93 – Sequence of Operation for HVAC Controls.
			5. Section 23 09 93.11 – Sequence of Operation for HVAC DDC.
		3. Section 23 21 13 – Hydronic Piping.
		4. Section 23 25 13 – Water Treatment for Closed-Loop Hydronic Systems
	1. references

SPECIFIER NOTE: Remove references that are not required.

* + 1. American National Standards Institute (ANSI)/National Sanitation Foundation (NSF) International ([www.nsf.org](http://www.nsf.org/)):
			1. ANSI/NSF-14 – Standard 14 Plastic Piping System Components and Related Materials.
		2. American National Standards Institute (ANSI)/Underwriters Laboratories (UL):
			1. ANSI/UL 263 - Standard for Fire Tests of Building Construction and Materials.
		3. American Society of Testing and Materials (ASTM) International ([www.astm.org](http://www.astm.org)):
			1. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
			2. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems.
			3. ASTM F876 – Standard Specification for Crosslinked Polyethylene (PEX) Tubing.
			4. ASTM F877 – Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems .
			5. ASTM F1807 – Standard Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.
			6. ASTM F1960 – Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing.
			7. ASTM F2159 – Standard Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing.
		4. Canadian Standards Association (CSA) International ([www.csagroup.org](http://www.csagroup.org)):
			1. CAN/CSA B137.5 – Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
			2. CAN/CSA B214 – Installation Code for Hydronic Heating Systems.
		5. German Institute for Standardization (DIN):
			1. DIN 4726 - Warm water surface heating systems and radiator connecting systems - Plastics piping systems and multilayer piping systems.
		6. HeatLink Group Inc. ([www.heatlink.com](http://www.heatlink.com)):
			1. HeatLink® Hydronic System Installation Guide (L3390).
			2. HeatLink Limited Heating Warranty.
			3. INFO 5 – PEX Tubing Technical Information (L2305).
			4. INFO 23 – Firestop System Ratings – CAN/ULC S115-05 & ASTM E814 (L2323).
			5. INFO 33 – Fire Resistance Ratings – CAN/ULC-S101 (L2333).
			6. INFO 34 – Fire Resistance Ratings – ANSI/UL 263 (L2334).
		7. International Association of Plumbing and Mechanical Officials (IAPMO) ([www.iapmo.org](http://www.iapmo.org)):
			1. Uniform Mechanical Code (UMC).
		8. International Code Council (ICC) ([www.iccsafe.org](http://www.iccsafe.org)):
			1. International Building Code (IBC).
			2. International Mechanical Code (IMC).
		9. Plastic Pipe Institute (PPI) ([www.plasticpipe.org](http://www.plasticpipe.org)):
			1. Technical Report TR- 4.
		10. Underwriters’ Laboratories of Canada (ULC) ([www.ul.com](http://www.ul.com)):
			1. CAN/ULC S101 – Standard Methods of Fire Endurance Tests of Building Construction and Materials.
			2. CAN/ULC S102.2 – 2007/2010 – Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies with, and without, fiberglass insulation.
			3. CAN/ULC S115 - Standard Method of Fire Tests of Firestop Systems.
	1. System Description
		1. Design Requirements:
			1. Standard grade hydrostatic pressure ratings from Plastics Pipe Institute (PPI) in accordance with TR-3 as listed in TR-4. The following standard-grade hydrostatic ratings are required:
				1. 180 degree F (82 degree C) at 100 psi (689 kPa).
				2. 73.4 degree F (23 degree C) at 160 psi (1,102 kPa).
			2. Certification of flame spread/smoke development rating of ≤25/≤50 in accordance with CAN/ULC S102.2 – 2007/2010 provided the installation meets one of the following requirements:
				1. Tubing spacing is a minimum of 8 inches apart for the following nominal sizes (no insulation required):

½ inch (13 mm).

* + - * 1. No spacing requirement for the following nominal sizes if tubing is wrapped with ½ inch thick fiberglass insulation:

½ inch (13 mm).

⅝ inch (16 mm).

¾ inch (19 mm).

1 inch (25 mm).

1¼ inch (32 mm).

1½ inch (38 mm).

* + - 1. Certification of flame spread/smoke development rating of ≤25/≤50 in accordance with ASTM E84 provided the installation meets one of the following requirements:
				1. No spacing requirement for the following nominal sizes if tubing is wrapped with ½ inch thick fiberglass insulation:

½ inch (13 mm).

⅝ inch (16 mm).

¾ inch (19 mm).

1 inch (25 mm).

1¼ inch (32 mm).

1½ inch (38 mm).

* + 1. Performance Requirements:
			1. Show compliance with ANSI/NSF-14.
			2. Show compliance with ASTM F877.
			3. Installed through rated walls in compliance with CAN/ULC S115-05 and ASTM E814 through certification listings with Underwriters Laboratories (UL) and Underwriters Laboratories of Canada (cUL), and Warnock Hersey (WH) – See INFO 23 (L2323) for more details:
				1. Canada: Concrete Floor/Wall or Block Wall:

cUL System No. C-AJ-2030C – max rating: F = 2h; FH = 2h.

cUL System No. C-AJ-2061b – max rating: F = 2h; FH = 2h.

WH System No. PHV 120-11 – max rating: F = 2h; FH = 2h.

* + - * 1. Canada: Wood Ceiling/Floor:

cUL System No. F-C-2030C – max rating: F = 1h; FH = 1h.

cUL System No. F-C-2045a – max rating: F = 1h; FH = 1h.

WH System No. PH 60-04 – max rating: F = 1h; FH = 1h.

* + - * 1. Canada: Gypsum Wall:

cUL System No. W-L-2012C – max rating: F = 2h; FH = 2h.

cUL System No. W-L-2061a – max rating: F = 2h; FH = 0h.

WH System No. PV 60-02 – max rating: F = 1h; FH = 1h.

* + - * 1. USA: Concrete Floor/Wall or Block Wall:

UL System No. C-AJ-2626 – max rating: F = 2h; T = 2h.

UL System No. C-AJ-2567c – max rating: F = 2h; T = 2h.

* + - * 1. USA: Concrete and Steel Joist Floor:

UL System No. F-E-2040 – max rating: F = 1h; T = 1h.

* + - * 1. USA: Wood Ceiling/Floor:

UL System No. F-C-2391 – max rating: F = 1h; T = 1h.

UL System No. F-C-2081e – max rating: F = 2h; T = 2h.

UL System No. F-C-2334a – max rating: F = 1h; T = 1h.

* + - * 1. USA: Gypsum Wall:

UL System No. W-L-2543 – max rating: F = 2h; T = 2h.

UL System No. W-L-2474a – max rating: F = 2h; T = 0h.

* 1. Submittals
		1. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
		2. Product Data:
			1. Provide manufacturer’s product submittal data and installation instructions.
		3. Shop Drawings:
			1. Provide calculations that support the performance requirements of the hydronic radiant system. Indicate the type of slab construction and tubing depth relative to the exposed surface. Calculations must show the required flow rate, operating temperatures and pressure drops.
			2. Provide drawings showing tubing layouts, fixing details, tubing details, and manifold locations of all areas where hydronic radiant systems are indicated. Indicate all pumps, valves, and other components that are required to operate the hydronic radiant system specified in the sequence of operations.
			3. Provide a schedule of manifolds listing loop lengths, tubing diameter, flow rate, operating water temperatures, and head loss to meet the required performance. Cross reference to product data.
			4. Provide a schedule of valves, pumps, and other components listing the number, model, and size. Cross reference to product data.
			5. Provide product and performance data for each component.
			6. Provide details for tubing crossing concrete expansion joints.
			7. Provide sequence of operation and control device requirements as specified in related Instrumentation and Control for HVAC sections.
		4. Quality Assurance/Control Submittals:
			1. Test Reports:
				1. Upon request, submit test reports from recognized testing laboratories.
			2. Qualifications:
				1. Provide proof of qualifications when requested by Consultant.
		5. Closeout Submittals:
			1. Warranty documents specified herein.
			2. Operation and maintenance data.
			3. Final as-built pipe and tubing layout drawing, indicating manifold locations, manifold schedule.
	2. Quality Assurance
		1. Qualifications
			1. Use installers having experience in performing work of this section that specialize in work similar in complexity and scope required for this project.
			2. Installer will use skilled tradesmen holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades professional.
		2. Pre-installation
			1. Verify project requirements, floor coverings, and substrate.
			2. Verify areas of responsibility with other trades.
	3. Delivery, Storage, and Handling
		1. Comply with Division 1 Product Requirement Section.
		2. Comply with manufacturer’s ordering instructions and lead-time requirements to avoid construction delays.
		3. Delivery:
			1. Deliver materials in manufacturer’s original, unopened, undamaged containers with identification labels intact.
		4. Storage and Protection:
			1. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.
			2. Store PEX tubing in cartons or under cover to avoid dirt or foreign material from being introduced into the tubing.
			3. Do not expose PEX tubing to direct sunlight for an extended period of time. If construction delays are encountered, provide cover to portions of tubing exposed to direct sunlight.
	4. Warranty
		1. HeatLink offers a limited warranty of up to 25 years for its HeatLink® Oxygen Barrier and Non Oxygen Barrier PEX tubing. See HeatLink Limited Heating Warranty for full details.
1. Products
	1. Manufacturers
		1. HeatLink Group Inc.
			1. Contact: 4603E 13th St NE, Calgary, AB, Canada, T2E 6M3; Toll free (800) 661-5332, Fax: (866) 450-1155; web: www.heatlink.com.
		2. Product Substitutions:
			1. HeatLink or Approved Equal.
	2. Components
		1. PEX-a Tubing (½ inch (13 mm) to 1½ in (38 mm) nominal size):
			1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method.
			2. Type: HeatLink® – HeatLink® PEX-a with oxygen barrier that meets DIN 4726.
			3. In compliance with ASTM F876, ASTM F877, CAN/CSA B137.5, NSF/ANSI-14, AWWA C904 and tested for compliance by an independent third party agency.
			4. Standard grade hydrostatic design and pressure ratings from PPI TR-4.
			5. Fire-rated assembly listings in accordance with CAN/ULC S101 and ANSI/UL 263 through certification listings with Underwriters Laboratories (UL) and Underwriters Laboratories of Canada (cUL), and Warnock Hersey (WH) – See INFO 33 (L2333) and 34 (L2334) for more details.
		2. Pre-Sleeved Piping (½ inch (13 mm) to ¾ inch (19 mm) nominal size):
			1. Material:
				1. High Density Polyethylene (HDPE) corrugated sleeve with PEX-a carrier tubing.
			2. Type: HeatLink® O2 Barrier Pipe-in-Pipe.

SPECIFIER NOTE; Start of Press System (F1807/F2159) components. Delete this section if not using Press System components.

* + 1. Stainless Steel Press Sleeve
			1. Material: 304 Annealed Stainless Steel.
			2. Type: HeatLink® Stainless Steel Press Sleeve.
			3. In compliance with ASTM F877, CAN/CSA B137.5, NSF/ANSI-14, NSF/ANSI-61, NSF/ANSI-372, and tested for compliance by an independent third party agency.
		2. PEX Press Fittings: elbows, couplings, plugs, tees, adapters (½ inch (13 mm) to 2 in (51 mm) nominal size)
			1. Material
				1. Modified Polyphenylsulfone.
				2. Polyphenylsulfone.
				3. UNS No. C69300 Eco Brass.
			2. Type:
				1. HeatLink® HPP fittings.
				2. HeatLink® No Lead Brass fittings.
			3. In compliance with ASTM F2159 or ASTM F1807, ASTM F877, CAN/CSA B137.5, NSF/ANSI-14, NSF/ANSI-61, NSF/ANSI-372, and tested for compliance by an independent third party agency.
			4. PEX tubing connection to each ASTM F2159 or ASTM F1807 outlet by corresponding stainless steel press sleeve.
			5. Press tools to install the Stainless Steel Press Sleeves are supplied by the PEX tubing manufacturer.
			6. All buried fittings will be installed and sealed in accordance with the manufacturer's instructions.

SPECIFIER NOTE; End of Press System (F1807/F2159) components.

SPECIFIER NOTE; Start of Expansion System (F1960) components. Delete this section if not using Expansion System components.

* + 1. PEX Expansion Ring
			1. Material: Crosslinked polyethylene (PEX) manufactured by PEX-a or Engel method.
			2. Type: HeatLink® PEX Expansion Ring.
			3. In compliance with ASTM F877, ASTM F1960, CAN/CSA B137.5, and tested for compliance by an independent third party agency.
		2. PEX Expansion Fittings: elbows, couplings, plugs, tees, adapters (½ inch (13 mm) to 1 in (25 mm) nominal size)
			1. Material
				1. Modified Polyphenylsulfone.
				2. Polyphenylsulfone.
				3. UNS No. C69300 Eco Brass.
			2. Type:
				1. HeatLink® PEX F1960 HPP fittings.
				2. HeatLink® PEX F1960 No Lead Brass fittings.
			3. In compliance with ASTM F1960, ASTM F877, CAN/CSA B137.5, NSF/ANSI-14, NSF/ANSI-61, NSF/ANSI-372, and tested for compliance by an independent third party agency.
			4. PEX tubing connection to each ASTM F1960 outlet by corresponding PEX expansion ring.
			5. All buried fittings will be installed and sealed in accordance with the manufacturer's instructions.

SPECIFIER NOTE; End of Expansion System (F1960) components

SPECIFIER NOTE; Start of compression components. Delete this section if not using compression components.

* + 1. PEX-a Compression Fittings: (½ inch (13 mm) to ⅝ inch (16 mm) nominal size):
			1. Material:
				1. Brass.
			2. In compliance with ASTM F877, CAN/CSA B137.5.
			3. Fittings will consist of a compression nut, split ring ferrule, and a fitting body insert.
			4. All buried fittings will be installed and sealed in accordance with the manufacturer's instructions.

SPECIFIER NOTE; End of compression components

SPECIFIER NOTE: Select the preferred manifold type and remove the others.

* + 1. Stainless Steel Manifolds with Flow Meters:
			1. Stainless Steel manifold assemblies shall be constructed of stainless-steel with 1-1/4 inch (32 mm) trunk, sized for flow rates required on manifold schedule.
			2. Manifold assemblies shall be furnished and installed with:
				1. Supply and return ball valves.
				2. Loop balancing and isolation valves.
				3. Supply and return drain connections.
				4. Mounting brackets.
				5. Manual balancing valves with visual flow meters 1.5 gpm (5 L/min).

SPECIFIER NOTE: Only specify loop actuators if individual loop control is required.

* + - * 1. Individual loop actuators with adapter rings, as needed.
				2. Manifolds support ½ inch (13 mm), ⅝ inch (16 mm), and ¾ inch (19 mm) PEX tubing.
				3. Use appropriately-sized manifold housings to allow the manifold assemblies to be mounted inside the wall cavity.
		1. High Flow Stainless Steel Manifolds:
			1. Stainless Steel manifold assemblies shall be constructed of stainless-steel with 1-1/4 inch (32 mm) trunk, sized for flow rates required on manifold schedule.
			2. Manifold assemblies shall be furnished and installed with:
				1. Supply and return ball valves.
				2. Loop balancing and isolation valves.
				3. Supply and return drain connections.
				4. Mounting brackets.
				5. Manual balancing valves.

SPECIFIER NOTE: Only specify loop actuators if individual loop control is required.

* + - * 1. Individual loop actuators with adapter rings, as needed.
				2. Manifolds support ½ inch (13 mm), ⅝ inch (16 mm), and ¾ inch (19 mm) PEX tubing.
				3. Use appropriately-sized manifold housings to allow the manifold assemblies to be mounted inside the wall cavity. Provide manifold elbows and offsets, as required.
		1. TwistSeal® (55 mm) Manifolds:
			1. TwistSeal® (55 mm) manifold assemblies shall be constructed of polysulfone, sized for flow rates required on manifold schedule.
			2. Manifold assemblies shall be furnished and installed with:
				1. Supply and return temperature gauges.
				2. Supply manual air vent.
				3. Return automatic air vent and drain valve.
				4. Loop balancing and isolation valves.
				5. Mounting brackets.

SPECIFIER NOTE: Only specify loop actuators if individual loop control is required.

* + - * 1. Individual loop actuators with adapter rings, as needed.
				2. Use appropriately-sized manifolds cabinets to allow the manifold assemblies to be mounted inside the wall cavity.
		1. TwistSeal® Mini Multiport (40 mm) Manifolds:
			1. TwistSeal® Mini Multiport (40 mm) manifold assemblies shall be constructed of nylon & polysulfone, sized for flow rates required on manifold schedule.
			2. Manifold assemblies shall be furnished and installed with:
				1. Supply and return temperature gauges and automatic air vents.
				2. Return drain valve.
				3. Loop balancing and isolation valves.
				4. Mounting brackets.
				5. Manual balancing valves with visual flow meters 0.4-1.0 US gpm (1.5-3.8 L/min).

SPECIFIER NOTE: Only specify loop actuators if individual loop control is required.

* + - * 1. Individual loop actuators with adapter rings, as needed.
				2. Use appropriately-sized manifolds cabinets to allow the manifold assemblies to be mounted inside the wall cavity.
		1. Accessories:
			1. Bend supports designed for maintaining tight radius bends are supplied by the PEX tubing manufacturer.
			2. Conduit elbows designed to direct and protect PEX tubing in transition area where tubing enters and exits a concrete slab are supplied by the PEX tubing manufacturer.
			3. Press tools to install the Stainless Steel Press Sleeves are supplied by the PEX tubing manufacturer.
			4. All horizontal tubing hangers and riser clamps are epoxy-coated material.
			5. Tie Straps used to secure PEX tubing to wire mesh or rebar are supplied by the PEX tubing manufacturer. Minimum 5-½ inches (140 mm) nylon cable tie. Minimum 20 lb. tensile strength.
			6. Polypropylene staples used to secure ½ inch (13 mm) to ⅝ inch (16 mm) PEX tubing directly onto polystyrene insulation are supplied by the PEX tubing manufacturer. Ensure that the proper size staples are used for the insulation thickness. Use 1-½ inch (38 mm) staples for 1 inch (25 mm) polystyrene insulation and 2 inch (51 mm) staples for 1-½ inch (38 mm) or thicker polystyrene insulation.
			7. Tubing tracking used to hold ½ inch (13 mm) to ⅝ inch (16 mm) PEX tubing are supplied by the PEX tubing manufacturer. Spacing as indicated on approved shop drawings. Can be fastened to concrete, steel Q decking, and polystyrene insulation.
			8. Recessed manifold housings are supplied by the PEX tubing manufacturer. Minimum 16 gauge (1.2 mm) galvanized steel construction with paintable satin coated steel cover. Manifold housings shall be sized to accommodate the manifolds and associated equipment.
			9. Surface mount manifold housings are supplied by the PEX tubing manufacturer. Minimum 16 gauge (1.2 mm) galvanized steel and paintable satin coated steel construction. Manifold housings shall be sized to accommodate the manifolds and associated equipment.
		2. Controls:
			1. Refer to Section 23 09 00 - Instrumentation and Control for HVAC and plans for radiant system controls.
1. Execution
	1. Examination
		1. Site Verification of Conditions:
			1. Verify that site conditions are acceptable for installation of the hydronic system.
			2. Do not proceed with installation of the hydronic system until unacceptable conditions are corrected.
	2. Installation
		1. Install hydronic radiant system according to approved shop drawings or system layouts.
		2. Comply with manufacturer's product data, including product technical bulletins, installation instructions, design drawings, including the following.
		3. PEX-a tubing installation:
			1. Install tubing in compliance with HeatLink® Hydronic System Installation Guide (L3390).
		4. All loop numbers to be clearly marked on PEX tubing wall before being connected to manifold. Verify each loop length. All loops to be identified to allow for system balancing in the future.
		5. Through-penetration Firestop:
			1. Ensure compliance of one- and two-hour rated through penetration assemblies in accordance with CAN/ULC S115-05 and ASTM E814.
			2. A list of firestop manufacturers that list PEX tubing with their firestop systems is available from the PEX tubing manufacturer.
		6. Related Products Installation:
			1. Refer to other sections listed in Related Sections paragraph herein for related products installation.
	3. Field Quality Control
		1. Site Tests:
			1. Pressure test the PEX-a tubing before and during burial, as per manufacturer’s instructions.

SPECIFIER NOTE; Specify applicable test requirements to be performed during and after product installation.

* + 1. Manufacturer’s Field Services: Provide manufacturer’s field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer’s instructions.
			1. Site Visits

SPECIFIER NOTE: Specify number and duration of periodic site visits.

* 1. ADJUSTING
		1. Balance all manifold loops according to the flow rates specified on the manifold schedule.
	2. 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. Protection
		1. Protect installed work from damage due to subsequent construction activity on the site.
		2. In all areas where other trades will be drilling, coring or anchoring other equipment, furniture, or structures to the slab, locations of in-slab tubing shall be marked on the concrete slab surface to avoid penetration of fasteners used.
		3. Manifolds to be wrapped with plastic sheets for protection from dirt/dust, construction chemicals, and/or concrete in the course of construction.

**End of Section**