



This draft specification is for hydronic snow and ice melting systems using PE-RT tubing in slab, and as distribution piping. Roth Industries supplies these systems under the name Roth Radiant Heating Systems.

This draft specification is provided as a guide for the architect/engineer in developing final specifications and is not intended as a substitute for sound architectural/engineering judgment. The architect/engineer is ultimately responsible for creating the final specification that meets the functional and aesthetic needs of his/her client, as well as complying with all applicable codes.

This draft specification follows the format of CSI MasterFormat 2011. Section numbers and titles may be revised to suit project requirements, specification practices and section content.

Draft Specification – PEX tubing
Section 23 83 18
Hydronic Radiant Snow and Ice Melting Systems
(Roth Radiant Snow and Ice Melting Systems)

PART 1 - GENERAL

1.01 SUMMARY

- A. Hydronic snow and ice melting systems using PEX tubing imbedded in a concrete slab, under asphalt, under brick pavers or imbedded in poured-in-place concrete stairs.
- B. The work described in this section includes, but is not limited to, the following:
 - 1. Complete hydronic snow and ice melting system including tubing, manifolds, fittings, installation systems, fasteners and controls.
 - 2. Coordination with the selection and installation of circulation pumps and distribution piping.
 - 3. Coordination with system controls and automation.
 - 4. System commissioning and startup service.
- C. Related Sections
 - 1. The following sections, though not exhaustive, may have an impact on installation of the hydronic radiant heating system:
 - a. 03 06 00 Schedule for concrete
 - b. 07 21 00 Thermal Insulation

- c. 07 26 00 Vapor Retardation
- d. 22 06 00 Schedules for Plumbing
- e. 23 06 00 Schedule for HVAC
- f. 23 21 00 Hydronic Piping & Pumps
- g. 23 52 00 Heating Boilers
- h. 26 06 00 Schedule for Electrical

1.02 REFERENCES

A. Abbreviations and Acronyms

- 1. PEX - Cross linked polyethylene
- 2. EVOH - Ethyl Vinyl Alcohol (oxygen barrier compound)
- 3. SDR 9 - Standard Dimension Ratio 9 (ratio of pipe diameter to wall thickness- outside diameter is 9 times the wall thickness of the pipe)

B. Reference Standards

A. ASTM - American Society for Testing and Materials

- a. ASTM F876 *Standard Specification for Crosslinked Polyethylene (PEX) Tubing*
- b. ASTM F877 *Standard Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems*
- c. ASTM 1807-11ae1 *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*
- d. ASTM F2098-08 *Standard Specification for Stainless Steel Clamps for Securing SDR9 Cross-linked Polyethylene (PEX) Tubing to Metal Insert and Plastic Insert Fittings*

B. CSA - Canadian Standards Association

- a. CSA B137.5 *Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications*

C. DIN - German Institute for Standardization

- a. DIN 4726 *Warm water surface heating systems and radiator connecting systems - Plastics piping systems and multilayer piping systems (this standard is used as an oxygen diffusion rating)*

D. PPI - Plastic Pipe Institute

- a. PPI TR-3 *Policies and Procedures for Developing Hydrostatic Design (SDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe*
- b. PPI TR-4 *Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Compounds*

E. NSF/ANSI – National Sanitation Foundation/ American National Standards Institute

- a. NSF/ANSI 14 *Plastics Piping System Components and Related Materials:*

1.03 SUBMITTALS

A. General

1. Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section

B. Product Data

1. Submit manufacturer's product submittal forms, brochures, technical data sheets, catalog pages and installation manuals for each product listed in this section.
2. Submit data in sufficient detail to indicate compliance with the contract documents.

C. Shop Drawings

1. Submit detailed design report including heat load data, design temperature, maximum supply temperature, total flow rate, maximum head loss, zone plan, manifold summary including zone name, zone area, installation type, tubing size and spacing, loop lengths, manifold and loop flow rates, head losses and supply temperatures
2. Submit installation drawings indicating tubing layout, manifold locations, distribution piping and zoning requirements.
3. Submit drawings showing details of manifold installation. If manifolds are installed on a wall, then the details should include all fastening details. If the manifolds are installed in wall cavities, then provide details on all fasteners and access. If manifolds are to be placed in manifold cabinets, then provide details of fastening cabinets to walls, floors or wall cavities.

4. Submit detailed piping schematic including heat source, piping, valves, pumps, mixing devices, oxygen removal devices, expansion tanks, gauges, circuit setters, etc. Indicate type and size where necessary.
5. Provide sectional drawings indicating tubing and accessory installation method(s).

D. Certificates

1. Submit contractor(s) certification statement(s) that the hydronic snow and ice melting system has been installed in accordance with this specification.

E. Closeout

1. Maintenance Contracts
 - a. Submit maintenance contract for system or any part in the system, as required.
2. Operation and Maintenance Data
 - a. Provide operational and maintenance data, as required
 - b. Final as-built tubing layout drawing
3. Warranty Documentation
 - a. Submit final executed warranty document for system

1.04 QUALITY ASSURANCE

A. Qualifications

1. Manufacturer
 - a. Manufacturer shall have a minimum of five years of experience in similar systems.
 - b. Manufacturer shall provide products of consistent quality in appearance and physical properties.
2. Installers
 - a. Installers shall have demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of system training hosted/approved by the system manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General

1. Comply with Section 01 60 00, Product Requirements

B. Delivery

1. Deliver materials in original, unopened, undamaged containers or packaging with manufacturer identification labels intact.

C. Storage

1. Store materials in dry, enclosed, well-ventilated area protected from exposure to harmful environmental conditions.
2. PEX tubing and manifold openings shall be covered or capped to prevent contaminants from entering.
3. Do not expose PEX tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing to prevent exposure to direct sunlight.

D. Handling

1. PEX tubing shall be kept away from sharp objects and not be handled in a way as to cause damage and/or puncture.
2. Protect materials from damage by other trades.

1.06 WARRANTY

A. General

1. Comply with Section 01 78 36, Warranties

B. Manufacturer's Warranty

1. Provide manufacturer's standard warranty document.
 - a. PEX tubing shall be under warranty for a period of twenty five (25) years, non-prorated, against failure due to defect in material or workmanship beginning with successful pressurized water tests immediately following system installation.
 - b. Manifolds and fittings shall be under warranty for a period of two (2) years, non-prorated, against failure due to defect in material or workmanship beginning with successful pressurized water tests immediately following system installation.
 - c. Electrical and control parts shall be under warranty for a period of two (2) years, non-prorated, against failure due to defect in material or workmanship beginning with successful pressurized water tests immediately following system installation.
2. Manufacturer's warranty is in addition to, and not a limitation of, other rights the Owner may have under contract documents.

PART 2 – PRODUCTS

2.01 MANUFACTURER

A. Acceptable Manufacturer

Roth Industries, Inc.
268 Bellew Ave. S.
Watertown, NY 13601
(888) 266-8674 (315) 755-1011
Fax (315) 755-1013
Website: www.roth-america.com

B. Substitutions not permitted

C. All components shall be supplied by one manufacturer

2.02 MATERIALS

A. Tubing

1. All tubing shall be 5-layer PEX.
2. Layers shall consist of the following:
 - a. Inner PEX layer
 - b. Adhesive layer
 - c. EVOH layer
 - d. Adhesive layer
 - e. Outer PEX layer
3. Tubing shall conform to ASTM F876 and CSA B137.5
4. Pipe shall be rated for continuous operation of 160 psi at 73°F (11.03 bar at 23°C) and 100 psi at 180°F (6.89 bar at 82.2°C) and 80 psi at 200°F (5.51 bar at 23°C).
5. EVOH layer shall be capable of limiting oxygen diffusion through the pipe to less than 0.32 mg/(m²/d) @ 104°F (40°C) water temperature, in accordance with DIN 4726.
6. The minimum bend radius for cold bending of the tubing shall be no less than six (6) times the outside diameter. Bends with a smaller radius shall require the use of manufacturer supplied metal bend supports.

B. Manifolds

1. Brass manifold sets

- a. Brass manifold sets shall be manufactured in the USA.
- b. A manifold set shall consist of one 1" supply and one 1" return manifold preassembled onto a mounting bracket.
- c. Manifolds shall be manufactured from extruded brass stock with threaded connections.
- d. Manifold sets shall contain visual flow gauge with built in flow adjustment and stop valves, integral valve assemblies for loop isolation and for mounting thermostat controlled valve actuators, manual air vent/fill valve and isolation valves on supply and return.
- e. Manifold sets shall have the following ratings:
 1. Maximum flow rate – 10gpm (37.9lpm)
 2. Maximum operating temperature - 180°F (82°C) continuous
 3. Maximum operating pressure – 150 psi (10.3 bar) continuous
- f. Manifold fittings shall be R20 (nominal 3/4") threaded brass compression fittings.
- g. Manifold sets shall accommodate 3/8", 1/2", 5/8" and 3/4" five layer PEX tubing.

2. Nickel Plated brass manifold sets

- a. A manifold set shall consist of one 1" supply and one 1" return manifold or one 1 1/4" supply and one 1 1/4" return manifold preassembled onto a mounting bracket.
- b. Manifolds shall be manufactured from extruded brass stock with threaded connections.
- c. Manifold sets shall contain visual flow gauge with built in flow adjustment and stop valves on each loop outlet, integral valve assemblies for loop isolation and for mounting thermostat controlled valve actuators. Each supply and return manifold shall include a manual air vent/fill valve, temperature gauge, and isolation ball valve.
- d. Manifold sets shall have the following ratings:
 1. Maximum flow rate – 1" - 12gpm (37.9lpm)
1 1/4" - 18gpm (68.2lpm)
 2. Maximum operating temperature - 230°F (110°C) continuous

3. Maximum operating pressure – 145 psi (10 bar) continuous

- e. Manifold fittings shall be Roth Uni-bloc threaded brass compression fittings.
- f. Manifold sets shall accommodate 3/8", 1/2", 5/8" and 3/4" five layer PEX tubing.

3. Plastic commercial modular, large bore manifold sets

- 1. A manifold set shall consist of one 1 1/2" supply and one 1 1/2" return manifold assembled onto a mounting bracket.
- 2. Manifolds shall be manufactured from glass-fiber reinforced polyamide 66.
- 3. Manifold trunks shall consist of supply modules with flow meters and flow adjustment valves, and return modules with manual valves and operators.
- 4. Supply and return manifolds shall each contain a 1 1/2" ball valve, temperature gauges, drain/fill valve, automatic air vent, and mounting brackets.
- 5. Manifold sets shall have the following ratings:
 - 1. Maximum flow rate – 62gpm (37.9lpm)
 - 2. Maximum operating temperature
 - 140°F (60°C) continuous @ 87 psi (6 bar)
 - 194°F (90°C) continuous @ 43 psi (3 bar)
 - 3. Maximum operating pressure – 87 psi (6 bar) continuous
 - 4. Flowmeter range - 1-5 gpm (4-20 lpm)
- 6. Manifold fittings shall be R20 (nominal 3/4") threaded brass compression fittings.
- 7. Manifold sets shall accommodate 3/8", 1/2", 5/8" and 3/4" five layer PEX tubing.

4. Copper manifolds

- a. Copper manifolds shall be constructed of Type L copper
- b. Manifolds shall have a 1 1/2" or 2" trunk, dependent upon design flow rates, with one end flared to receive copper tubing or add manifolds for additional loops.
- c. Manifolds shall have 6 - 3/4" branches.
- d. Manifolds shall include closed end cap with air vent and fill/drain valve.

- e. Manifolds shall have combination PE-RT compression fitting and isolation or a combination of balancing valve and isolation valve on each branch.
- f. Manifolds shall accommodate 1/2", 5/8" and 3/4" five layer PEX tubing.
- g. Manifolds shall have isolation valves on supply and return.

5. Fittings

- a. For system compatibility, use fittings offered by PEX manufacturer.
- b. Fittings shall be third party certified to applicable standards ASTM F877 and F2098-08.

6. Manifold Cabinets

- a. Manifold cabinets, if required, shall be constructed of 18 gauge steel with a gray primer coating.
- b. Cabinets may be surface mount on wall or floor or recessed mount.
- c. Cabinets shall have knockouts on each side and open at bottom or top for tubing.
- d. Cabinets shall be lockable.

7. Distribution Piping (supply and return to manifolds)

- a. Distribution piping shall be properly sized for the given volume and velocity required by system design.
- b. When using 5-layer PEX tubing, do not exceed 80 psig @ 200°F (5.51 bar @ 93.3°C).
- c. Fittings shall be compatible with piping material and transition to system manifolds.
- d. If copper or black iron is imbedded in concrete or soil, insulate or protect with sleeves.

8. Controls

Specifier Note: There are several control strategies that may apply to your specific project. You should consider your requirements and add control specifications to this section as required. Electronic Weather Compensating Mixing controls are recommended, as these match water supply temperature to heat loss, based on outdoor air temperature. Your local ROTH representative or corporate technical team can assist with design and specification of a control system. Please be aware of the need, in some cases, to regulate the supply water temperature to the radiant heating system so as not to exceed limits of flooring materials.

9. Accessories

- a. Use accessories with the installation of the hydronic radiant heating system as recommended by or available from the manufacturer.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verification of Conditions

1. Verify that site conditions are acceptable for installation of the hydronic snow and ice melting system.
 - a. Verify that work from other trades will not interfere with installation.
 - b. All installation areas shall be cleaned and free from all construction debris.
2. Do not proceed with installation of the hydronic snow and ice melting system until unacceptable conditions are corrected.

3.02 INSTALLATION

A. General

1. Install system according to design parameters and final shop drawings. All installation notes shown on the drawings shall be followed.
2. Determine manifold locations before installing tubing.
3. Mount manifolds in previously prepared locations and/or in previously installed cabinets. Manifold should be installed as level and plumb as possible.
4. At connections and fittings, use a plastic tubing cutter to ensure square and clean cuts.
5. Tubing shall be dispensed using a suitable uncoiling device. Remove twists prior to securing tubing. Fasten tubing at no more than 3 feet intervals, being careful not to twist the tubing. In thin concrete or gypsum slabs, secure tubing every 2 feet. Use only fasteners supplied or approved by the PE-RT tubing manufacturer.
6. At time of installation of each loop of tubing, connect the tubing to the correct manifold outlet and record zone area serviced and tubing length for balancing. If manifold is not installed, cap the tubing ends and label the tubing's loop number along with S for supply and R for return and loop length.

7. If the radiant snow and ice melting system substrate material (thermal mass) requires curing and/or has other limitations which can be influenced by the radiant heating system while in operation, then the radiant heating system shall not be put into operation until such time that the substrate material has fully cured or set according to the material requirements of the substrate manufacturer.

B. Slab-on-Grade

1. Verify sub-grade is compacted, flat and smooth to prevent damage to pipe or insulation.
2. Edge and underslab insulation shall be specified by the project engineer. The structural engineer shall determine the vertical compressive strength of the insulation material used.
3. If edge and underslab insulation is specified, Install vertical edge insulation along the perimeter of the slab and down to the depth equal to the bottom of the underslab insulation.
4. If only edge insulation is specified, install edge insulation along the perimeter of the slab and down to a minimum of 12" (305 mm) below the slab.
5. Reinforcing wire mesh, if required by structural design, must be flat and level. Overlap reinforcing wire mesh a minimum of 6 inches and tie them together with wire twist ties.
6. Attach tubing to reinforcing wire mesh, rebar or foam insulation in accordance with the PE-RT tubing manufacturer's installation recommendations. Tubing shall be attached every 2' to 3' and at the beginning, middle and end of each bend.
7. Loop lengths and tubing on-center distances shall be determined by the snowmelt design. On-center distances shall not exceed 12 inches (305 mm).
8. Do not install tubing closer than 6" (152 mm) from the edge of the concrete slab.
9. Pressure test tubing before pouring concrete and maintain pressure during the pour.
10. Install tubing at a consistent depth below the surface elevation as determined by the project engineer. Ensure sufficient clearance to avoid control joint cuts.
11. In areas where tubing must cross metal expansion joints in the concrete, the tubing shall be sleeved and routed below the joints. Depending on the manufacturer's and structural engineer's recommendation, fibrous expansion joints may tolerate penetration.
12. Tubing shall be sleeved with fully enclosed polyethylene conduit (straight or long sweep 90° elbows) at penetration point of concrete.

C. Pavers over a Compacted Bed Construction

1. Verify sub-grade is compacted, flat and smooth to prevent damage to pipe or insulation.
2. Edge and underslab insulation shall be specified by the project engineer. The structural engineer shall determine the vertical compressive strength of the insulation material used.
3. If edge and underslab insulation is specified, Install vertical edge insulation along the perimeter of the pavers and down to the depth equal to the bottom of the underslab insulation.
4. If only edge insulation is specified, install edge insulation along the perimeter of the pavers and down to a minimum of 12" (305 mm) below the soil/slab bed.
5. Reinforcing wire mesh, if required by structural design, must be flat and level. Overlap reinforcing wire mesh a minimum of 6 inches and tie them together with wire twist ties.
6. Attach tubing to reinforcing wire mesh, rebar or foam insulation in accordance with the PE-RT tubing manufacturer's installation recommendations. Tubing shall be attached every 2' to 3' and at the beginning, middle and end of each bend.
7. Loop lengths and tubing on-center distances shall be determined by the snowmelt design. On-center distances shall not exceed 12 inches (305 mm).
8. Do not install tubing closer than 6" (152 mm) from the edge of the pavers.
9. Pressure test tubing before installing soil/sand bed and maintain pressure during installation.
10. Install the tubing in a 3 inch (76 mm) compactable soil/sand bed. The fill over the PE-RT tubing must be void of any sharp material. Install the pavers over the compacted soil/sand bed.

C. Asphalt over a Compacted Bed Construction

1. Verify sub-grade is compacted, flat and smooth to prevent damage to pipe or insulation.
2. Edge and underslab insulation shall be specified by the project engineer. The structural engineer shall determine the vertical compressive strength of the insulation material used.
3. If edge and underslab insulation is specified, Install vertical edge insulation along the perimeter of the asphalt and down to the depth equal to the bottom of the underslab insulation.

4. If only edge insulation is specified, install edge insulation along the perimeter of the asphalt and down to a minimum of 12" (305 mm) below the soil/slab bed.
5. Reinforcing wire mesh, if required by structural design, must be flat and level. Overlap reinforcing wire mesh a minimum of 6 inches and tie them together with wire twist ties.
6. Attach tubing to reinforcing wire mesh, rebar or foam insulation in accordance with the PE-RT tubing manufacturer's installation recommendations. Tubing shall be attached every 2' to 3' and at the beginning, middle and end of each bend.
7. Loop lengths and tubing on-center distances shall be determined by the snowmelt design. On-center distances shall not exceed 12 inches (305 mm).
8. Do not install tubing closer than 6" (152 mm) from the edge of the asphalt.
9. Pressure test tubing before installing asphalt and maintain pressure during installation.
10. Install the tubing in a 3 inch (76 mm) compactable soil/sand bed. The fill over the PE-RT tubing must be void of any sharp material. Install the asphalt over the compacted soil/sand bed.

D. Poured-in-place Stair Construction

1. Verify sub-grade is compacted, flat and smooth to prevent damage to pipe or insulation.
2. Edge and underslab insulation shall be specified by the project engineer. The structural engineer shall determine the vertical compressive strength of the insulation material used.
3. If edge and underslab insulation is specified, Install vertical edge insulation along the perimeter of the slab and down to the depth equal to the bottom of the underslab insulation.
4. If only edge insulation is specified, install edge insulation along the perimeter of the slab and down to a minimum of 12" (305 mm) below the slab.
5. Reinforcing wire mesh, if required by structural design, must be flat and level. Overlap reinforcing wire mesh a minimum of 6 inches and tie them together with wire twist ties.
6. Attach tubing to reinforcing wire mesh, rebar or foam insulation in accordance with the PE-RT tubing manufacturer's installation recommendations. Tubing shall be attached every 2' to 3' and at the beginning, middle and end of each bend.

7. Loop lengths and tubing on-center distances shall be determined by the snowmelt design. On-center distances shall not exceed 9 inches (229 mm).
8. Install tubing parallel to the step tread. Tubing shall be 3" (76 mm) from the step's edge. Install supply side of loop along the edge of the step.
9. Pressure test tubing before pouring concrete and maintain pressure during the pour.
10. Tubing shall be sleeved with fully enclosed polyethylene conduit (straight or long sweep 90° elbows) at penetration point of concrete.

F. Glycol/Water Solution

1. PE-RT tubing manufacturer shall recommend glycol/water concentration ratio.
 - a. Site mixed solutions must be fully mixed to stated concentration before entering system.
 - b. Mix the glycol/water solution to proper concentration levels to protect the system from freezing during operation shutdown.
 - c. System circulators shall operate continuously for a minimum of 30 days after the system is filled to ensure the glycol and water does not separate in a static system.
2. Do not use ethylene glycol due to toxicity issues. Use only PE-RT manufacturer approved inhibited propylene glycol for hydronic snow and ice melting systems.

3.04 Field Quality Control

A. Tests

1. To ensure system integrity, pressure test the system before covering tubing in concrete or when other trades are working in the vicinity of the tubing.
2. Test all electrical controls in accordance with respective installation manuals.

3.05 Adjusting

A. Balancing across the manifold set

1. Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.

B. Balancing between manifold sets

1. 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.

C. Controls

1. Adjust system controls after the system has stabilized to ensure proper operation in accordance with the system design.

3.06 Cleaning

- A. Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean installed products in accordance with manufacturer's instructions prior to owner's acceptance.
- D. Remove construction debris from project site and legally dispose of debris.

3.07 Demonstration

- A. Demonstrate operation of the snow and ice melting system to owner's personnel.
- B. Advise the owner's representative about the type and concentration of glycol/water solution if used in the snow and ice melting system.
- C. The owner monitors the solution effectiveness through an established maintenance program as outlined by the glycol manufacturer.

3.08 Protection

- A. Protect installed work from damage caused by subsequent construction activity on the site.

END OF SECTION