

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SECTION INCLUDES

- A. Radiant floor heating systems using cross-linked polyethylene (PEX) tubing and appropriate fittings.

1.03 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.

1.04 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Certified to ASTM International by NSF:
 - 1. ASTM F876 Standard Specification for Cross-linked Polyethylene (PEX) Tubing.
 - 2. ASTM F877 Standard Specification for Cross-linked Polyethylene (PEX) Plastic Hot-and Cold-Water Distribution Systems.
- C. Certified to ASTM International, UL, NFPA and ULC by Intertek:
 - 1. ASTM E84, Standard Test Method for Surface Burning Characteristics of Test Materials.
 - 2. ASTM E119, UL 263 and NFPA 251 Fire Tests of Building Construction and Materials.
- D. Certified to International Code Council (ICC) by NSF:
 - 1. International Mechanical Code (IMC)
 - 2. International Building Code (IBC)
- E. German Institute for Standards (Deutsches Institut für Normung e.V., DIN):
 - 1. DIN 4726 Pipelines of Plastic Materials Used in Warm Water Floor Heating Systems; General Requirements
- F. International Association of Plumbing and Mechanical Officials (IAPMO):
 - 1. Certificate of Listing
- G. National Sanitary Foundation (NSF) International:
 - 1. NSF - RFH (Radiant Floor Heating)
- H. Plastics Pipe Institute (PPI)
 - 1. Technical Report TR - 3 Policies and Procedures for Developing Recommended Hydrostatic Design Stresses for Thermoplastic Pipe Materials
 - 2. Technical Report TR - 4 Recommended Hydrostatic Strengths and Design Stresses for Thermoplastic Piping and Fitting Compounds

1.05 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. Cross-linked Polyethylene Tubing (PEX): Standard Grade hydrostatic pressure ratings from Plastics Pipe Institute in accordance with TR-3 as listed in TR-4. The following three standard-grade hydrostatic ratings are required:
 - a. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
 - b. 180 degrees F (82 degrees C) at 100 psi (689 kPa).
 - c. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa).
- B. Performance requirements: Provide Hydronic system that is manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the tubing manufacturer without defects, damage, or failure.

1. Cross-linked Polyethylene Tubing (PEX):
 - a. Show compliance with ASTM F877
 - b. Show compliance with DIN 4726 regarding oxygen diffusion concerns where applicable.
 - c. Show compliance with NFPA 90A requirements of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 through certification listings with Intertek.
 - 1) Show compliance with ASTM E119, UL 263 and NFPA 251.

1.06 SUBMITTALS

- A. See Section 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit manufacturer's product submittal data and installation instructions for each product.
- C. Shop Drawings - Hydronic System
 1. Provide engineering analysis using manufacturer's proprietary software.
 2. Provide installation drawings indicating tubing layout, manifold locations, zoning requirements, and manifold schedules with details required for installation of the system.
- D. Samples: Submit selection and verification samples of primary materials.
- E. Documentation:
 1. Provide manufacturer's detailed instructions for site preparation and product installation.
 2. Provide documentation indicating the installer is trained to install the manufacturer's products, as needed.
- F. Quality Assurance and Control Submittals:
 1. Upon request, submit test reports from recognized testing laboratories.
- G. Closeout Submittals - Submit the following:
 1. Warranty documents specified
 2. Operation and maintenance data
 3. Manufacturer's field reports as specified in this document
 4. Final as-built tubing layout drawing

1.07 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 1. Manufacturer shall have a minimum of ten years experience in similar systems.
 2. Manufacturer shall provide products of consistent quality in appearance and physical properties.
 3. Manufacturer shall use the highest quality products in the production of systems and components referenced in this document.
 4. Materials shall be from a single manufacturer to ensure consistent quality and compatibility.
- B. Installer Qualifications:
 1. Use and installer with demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of familiarization training hosted/approved in writing by the system manufacturer.
- C. Certifications: Provide letters of certification as follows:
 1. Installer employs skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades person.
- D. Regulatory Requirements and Approvals - Hydronic Systems: Provide a radiant system that complies with the following requirements:
 1. International Code Council (ICC):
 - a. International Mechanical Code (IMC)
 - b. International Building Code (IBC)
 - c. ICC Evaluation Service (ES) Evaluation Report No. ESR 1155

- E. Pre-installation meetings
 - 1. Verify project requirements, substrate conditions, excavation conditions, system performance requirements, coverings, manufacturer's installation instructions, and warranty requirements.
 - 2. Review project construction timeline to ensure compliance or discuss modifications as required.
 - 3. Coordinate with other trade representatives to verify areas of responsibility.
 - 4. Establish the frequency (during construction phase of the project) the engineer intends for site visits and inspections by the manufacturer's representative.
- F. Mock-up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer:
 - 1. Store tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
 - 2. Do not expose tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

1.09 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Mortar-set Systems: Mortar shall cure for 25 days (or time specified by mortar manufacturer) prior to starting heating systems.

1.10 WARRANTY

- A. See Section 017700 - Closeout Procedures, for additional warranty requirements.
- B. Manufacturer's Warranty - Hydronic Systems
 - 1. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.
 - 2. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
 - a. Warranty covers the repair or replacement of any tubing or fittings proven defective.
 - b. Warranty may transfer to subsequent owners.
 - c. Warranty Period for Tubing shall be minimum 25-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.
 - d. Warranty Period for Manifolds and Fittings shall be minimum 2-year, non-prorated warranty against failure due to defect in material or workmanship, beginning with date of substantial completion.

1.11 SYSTEM START-UP

- A. Do not start the system for a minimum of 25 days or as specified by mortar, concrete and/or covering manufacturer as applicable.
- B. Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.12 OWNER'S INSTRUCTIONS

- A. Instruct Owner about operation and maintenance of installed system.
- B. Provide Owner with manufacturer's installation instructions for installed components within the system.
- C. Provide Owner with all operating instructions/documents for sensors and controls.
- D. Provide Owner with copies of any detailed layout drawings and photos of installed product before coverings are installed.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Watts Radiant (Radiant PEX+): www.wattsradiant.com

2.02 PRODUCT CHARACTERISTICS

- A. Material:
 - 1. Cross-linked polyethylene (PEX)
 - 2. Manufactured by PEX-a or PEX-b (Engle or Silane) method to ensure the highest level of oxidation protection.
- B. Material Standard:
 - 1. Manufactured in accordance with ASTM F876 and ASTM F877
 - 2. Tested for compliance by an independent third-party agency.
- C. Pressure Ratings:
 - 1. Standard Grade hydrostatic design
 - 2. Pressure ratings as issued by the Plastics Pipe Institute (PPI), a division of the Society of the Plastics Industry (SPI).
- D. Temperature/Pressure Ratings: shall be capable of withstanding temperatures of:
 - 1. 73.4°F (23°C) at 160 psi (1.10 MPa)
 - 2. 180°F (82.2°C) at 100 psi (0.69 MPa)
 - 3. 200°F (93.3°C) at 80 psi (0.55 MPa).
- E. Minimum Bend Radius (Cold Bending):
 - 1. No less than six times the outside diameter.
 - 2. Use the tubing manufacturer's bend supports if radius is less than stated.
- F. Barrier Tubing Type:
 - 1. Oxygen Diffusion Barrier
 - a. Tubing has an oxygen diffusion barrier that shall not exceed an oxygen diffusion rate of 0.10 g/cubic meter (.000062 lb/cu. ft.) per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.
 - b. Tubing also adds a protective polypropylene layer to the outside of the EVOH barrier.
 - 2. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated:
 - a. 5/8 inch (15.88 mm)

2.03 MANIFOLDS AND FITTINGS

- A. Manifolds (Stainless Steel)
 - 1. For system compatibility, use Stainless Steel manifolds offered by the respective tubing manufacturer.

2. Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.
3. Manifolds shall feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold. Balance valves shall not be ball valves.
4. Manifolds accommodate PEX tubing.
5. Each manifold location shall have the ability to vent air manually from the system.
6. Stainless Steel Manifolds
 - a. Heavy-duty, DIN Standard, 304 stainless steel
 - b. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
 - c. Internal balancing valves
 - d. 0 - 2½ gpm (0 - 0.16 L/sec) flow meters
 - e. Manifold brackets
 - f. All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.
 - g. 2" (54 mm) OC circuit spacing
 - h. 12 gpm (.75 L/sec) maximum flow rate
 - i. 194°F (90°C) maximum operating temperature
 - j. 87 psi (600 kPa) maximum operating pressure
 - k. 2½ gpm (0.16 L/sec) per circuit maximum flow rate
- B. Fittings
 1. For system compatibility, use fittings offered by the tubing manufacturer.
 - a. The fitting assembly shall comply with ASTM F877 and CAN/CSA B137.5 requirements.
 - b. Fittings shall be designed to work with either ASTM F1807 CrimpRings or ASTM F2098 CinchClamps or a Compression ferrule, and are designed to be used with ASTM F876 (SDR-9) rated PEX tubing.
 - c. Available connections:
 - 1) Sweat
 - 2) NPT
 - 3) BSP
 - d. Material:
 - 1) UNS 31400 Copper Alloy
 - 2) UNS 36000 Copper Alloy
 - 3) UNS 37700 Copper Alloy

PART 3 EXECUTION

3.01 EXAMINATION

- A. Site Verification of Conditions:
 1. Verify that site conditions are acceptable for installation of the system. Refer to manufacturer's installation manual for information.
 2. Do not proceed with installation of the system until unacceptable conditions are corrected.

3.02 INSTALLATION OF FLOOR HEATING SYSTEMS

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:
 1. Installation manuals
 2. Design software engineering and analysis
- B. Slab-On-Grade Installation:
 1. Fasten the tubing to the flat mesh or reinforcing bar in accordance with the tubing manufacturer's installation recommendations.

2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall as determined by manufacturer analysis.
3. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
4. Where tubing crosses metal expansion joints in the concrete, ensure the tubing passes below the joints or is sleeved through the joint.

3.03 FIELD QUALITY CONTROL AND TESTING

- A. Site 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.

3.04 SYSTEM ADJUSTING

- A. Balancing Across Manifold: Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.
- B. 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 or the circuits deviate by more than 10%.

3.05 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.

3.06 DEMONSTRATION

- A. Demonstrate operation of system to Owner or Owner's personnel.
- B. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.07 PROTECTION

- A. Protect installed work from damage caused by subsequent construction activity on the site. Provide Owner with copy of photos and drawings of product locations to assist.

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