

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flexible, pre-insulated piping system that incorporates cross-linked polyethylene (PEX) service tubing for hot and cold fluid distribution systems.

1.2 RELATED SECTIONS

- A. Section 02551 – Underground Hydronic Piping
- B. Section 03300 – Concrete
- C. Section 06100 – Rough Carpentry
- D. Section 07210 – Insulation
- E. Section 15093 – Sleeves and Sleeve Seals for HVAC Piping
- F. Section 15181 – Hydronic Piping

1.3 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. ASTM International:
 - 1. ASTM F2165 Standard Specification for Flexible Pre-Insulated Piping
- C. 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
 - 2. DIN 16892 Crosslinked Polyethylene Pipes – General Quality Requirements and Testing
 - 3. DIN 16893 Crosslinked Polyethylene Pipes - Dimensions
- D. Watts Radiant
 - 1. Watts Radiant R-flex™ Pre-Insulated PEX Installation Manual
 - 2. RadiantWorks Professional Software

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
 - 1. The PEX service tubing is manufactured and tested in accordance with DIN 16892 and 16893.

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2. The PEX service tubing has hydrostatic ratings in accordance with the temperatures and pressures listed below. The hydrostatic ratings are:
 - a. 200 degrees F (93 degrees C) at 80 psi (551 kPa)
 - b. 180 degrees F (38 degrees C) at 100 psi (689 kPa)
 - c. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa)
- B. Performance requirements: Provide pre-insulated piping 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. Show compliance with DIN 16892
 2. Show compliance with DIN 16893
 3. Show compliance with DIN 4726 regarding oxygen diffusion
 4. Insulation of all carrier tubing shall consist of a microcellular, cross-linked polyethylene foam in multi-layer arrangements. The insulation's closed cell structure shall ensure minimal water absorption at all times to preserve insulating effect against thermal loss.
 5. Insulation shall not crush, break, or pulverize.
 6. All materials shall be CFC free.
 7. The outer jacket shall be cast with a corrugated pattern along its entire length. The corrugation pattern shall provide flexibility in the longitudinal direction and rigidity against radial forces.
 8. The corrugation shall employ a double-walled closed-cell construction to provide an extra layer of protection from piercing of the outer jacket.
 9. Single wall exterior jackets shall be deemed not equal for the long-term protection of the Owner.

1.5 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product submittal data and installation instructions for each product.
- C. Shop Drawings – Pre-insulated Piping System:
 1. Provide installation drawings indicating:
 - a. Piping layout
 - b. Piping size dimension by installation segment
 - c. Vault locations
 - d. Support fixtures
 - e. Schedules with all 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 manufacturer's electrical power requirements and heat output in watts delivered to the structure.

3. 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 piping layout drawing

1.6 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.
 2. Electrical rough-in and connections shall be done by a licensed electrician.
- 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: Ensure the pre-insulated piping system complies with all applicable codes and regulations.
- 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

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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

1.7 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 pre-insulated piping coils under cover or supply plugs to prevent dirt or foreign material from entering the service tubing.
 2. Do not expose the PEX service tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

1.8 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.

1.9 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty – Pre-insulated Piping 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 piping or fittings proven defective.
 - b. Warranty may transfer to subsequent owners.
 - c. The manufacturer's warranty shall be a minimum of 10 years, non-prorated, on the carrier tubing and 10 years on the fittings, insulation, and cover beginning with the date of substantial completion.

1.10 SYSTEM START-UP

- A. Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.11 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

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - Watts Radiant, Inc.
 - (Subsidiary of Watts Water Technologies, Inc.)
 - 4500 E. Progress Place
 - Springfield, MO 65803
 - (800) 276-2419; (417) 864-6108; Fax: (417) 864-8161
 - Web: <http://www.wattsradiant.com>
- B. Substitutions: not permitted

2.2 PRODUCT CHARACTERISTICS

- A. Service Tubing:
 - 1. Material: Cross-linked polyethylene (PEX) manufactured by PEX-a or Engel method
 - 2. Material Standard: Manufactured in accordance with DIN 16892 and 16893
 - 3. Pressure Ratings: Hydrostatic design and pressure ratings are in accordance with the manufacturer.
 - 4. The PEX service tubing in R-flex has an oxygen diffusion barrier that does not exceed an oxygen diffusion rate of 0.10 grams per cubic meter (0.000062 lb/cu. ft.) per day at 104 degrees F (40 degrees C) water temperature in accordance with German DIN 4726.
 - 5. Nominal Inside Diameter: Provide tubing with nominal outside diameter in accordance with DIN 16892, as indicated:
 - a. Single R-flex
 - 1) 40 mm (approximately 1½ inch)
 - 2) 50 mm (approximately 2 inch)
 - 3) 63 mm (approximately 2½ inch)
 - 4) 75 mm (approximately 3 inch)
 - 5) 90 mm (approximately 3½ inch)
 - 6) 110 mm (approximately 4 inch)
 - b. Dual R-flex
 - 1) 28.58 mm (approximately 1⅛ inch)

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- 2) 32 mm (approximately 1¼ inch)
- 3) 40 mm (approximately 1½ inch)
- 4) 50 mm (approximately 2 inch)
- 5) 63 mm (approximately 2½ inch)

B. Outer Jacket

1. Material is corrugated seamless high-density polyethylene (HDPE)
2. The HDPE jacket completely encompasses and protects the insulation from moisture and damage.
3. The outer jacket shall be cast with a corrugated pattern along its entire length. The corrugation pattern shall provide flexibility in the longitudinal direction and rigidity against radial forces.
4. The corrugation shall employ a double walled closed cell construction to provide an extra layer of protection from piercing of the outer jacket.
5. Single wall exterior jackets shall be deemed not equal for the long-term protection of the Owner.
6. The outer jacket shall contain two percent carbon black to provide protection from UV degradation.
7. Minimum Bend Radius:
 - a. Single R-flex:
 - 1) 40 mm (approximately 1½ inch) pre-insulated tubing with a 6.3 inch (160 mm) jacket has a bend radius of 13.8 inches (350 mm).
 - 2) 50 mm (approximately 2 inch) pre-insulated tubing with a 6.3 inch (160 mm) jacket has a bend radius of 17.8 inches (450 mm).
 - 3) 63 mm (approximately 2½ inch) pre-insulated tubing with a 6.3 inch (160 mm) jacket has a bend radius of 21.7 inches (550 mm).
 - 4) 75 mm (approximately 3 inch) pre-insulated tubing with a 7.9 inch (200 mm) jacket has a bend radius of 31.5 inches (800 mm).
 - 5) 90 mm (approximately 3½ inch) pre-insulated tubing with a 7.9 inch (200 mm) jacket has a bend radius of 43.4 inches (1100 mm).
 - 6) 110 mm (approximately 4 inch) pre-insulated tubing with a 7.9 inch (200 mm) jacket has a bend radius of 47.3 inches (1200 mm).
 - b. Dual R-flex:
 - 1) 28.58 mm (approximately 1⅛ inch) pre-insulated tubing with 4.9 inch (125 mm) jacket has a bend radius of 11.8 inches (300 mm).
 - 2) 32 mm (approximately 1¼ inch) pre-insulated tubing with 4.9 inch (125 mm) jacket has a bend radius of 11.8 inches (300 mm).
 - 3) 40 mm (approximately 1½ inch) pre-insulated tubing with 6.3 inch (160 mm) jacket has a bend radius of 23.7 inches (600 mm).
 - 4) 50 mm (approximately 2 inch) pre-insulated tubing with 7.9 inch (200 mm) jacket has a bend radius of 31.5 inches (800 mm).
 - 5) 63 mm (approximately 2½ inch) pre-insulated tubing with 7.9 inch (200 mm) jacket has a bend radius of 47.3 inches (1200 mm).

C. Insulation

1. The insulation shall be cross-linked polyethylene closed cell foam with a water absorption after 28 days of less than 1.04 percent.
2. All seams of the insulation shall be sealed.
3. Insulation shall not be bonded to the service tubing.
4. Insulation shall not crush, break or pulverize.

D. End Seals

1. The piping manufacturer will supply all end caps.
2. End caps are to be installed on each end prior to connecting the service pipes and insulating the field joints.
3. Where necessary, the end caps will heat shrink onto the piping outer jacket forming a watertight seal.

E. Compression Fittings for PEX Service Tubing

1. For system compatibility, use fittings offered by the tubing manufacturer.
2. Fittings are to be manufactured from brass.
3. The fitting assembly must comply with performance requirements of DIN 16892.
4. The fittings will consist of a compression fitting with a coupling sleeve, a fitting body insert with o-ring(s) and a bolt and a nut.
5. All buried fittings will be installed, insulated, and sealed in accordance with the piping manufacturer's instructions.

2.3 ACCESSORIES

- A. Use accessories associated with the installation of the pre-insulated piping system as recommended by or available from the piping manufacturer.

B. Protective Casings

1. Protective casings will be manufactured of high density polyethylene shells with insulation, bolts, nuts, and a sealant compound.

C. Protective Inspection Chambers

1. The piping manufacturer will provide the inspection chambers when required by the project construction.
2. Inspection chambers shall be constructed of shock-resistant high density polyethylene.
3. Heat shrink seals as provided by the piping manufacturer shall be installed to prevent introduction of water into the vault.

D. Anchors

1. The use of anchors, if required, within the piping system will be determined by the project engineer.

PART 3 EXECUTION

3.1 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.

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3.2 INSTALLATION OF PRE-INSULATED PIPING SYSTEM

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:
 - 1. Watts Radiant R-flex Installation Manual

- B. Below-grade Installation:
 - 1. Pre-insulated piping shall be installed in accordance with manufacturer's recommendations and the details as shown on the contract drawings.
 - 2. The system will be installed with the fewest number of underground joints as possible.
 - 3. The system does not require expansion loops, expansion joints or compensators of any type.
 - 4. An end cap shall be applied at all terminations of the pre-insulated piping system, including all fitting locations to form a watertight seal.
 - 5. All buried fittings will be installed, insulated and sealed in accordance with the piping manufacturer's instructions.
 - 6. Protective Inspection Chamber or Protective Casings are required for all below-grade connections.

- C. Backfill:
 - 1. The pre-insulated piping will be backfilled with clean sand material.
 - a. R-flex should always be installed below the frost line.
 - b. Minimum vertical distance from the bottom of the piping to the trench floor is 4 inches (100 mm).
 - c. Minimum lateral distance from the side of the piping to the trench wall is 6 inches (150 mm) for 4.9 inch (125 mm) outer jacket; 7.1 inches (180 mm) for 6.3 inch (160 mm) or 7.9 inch (200 mm) outer jacket.
 - d. Install a minimum of 6 inches (300 mm) of clean fill over the top of the pre-insulated piping.
 - e. Minimum depth of backfill over the sand is 9.9 inches (250 mm) for pedestrian traffic or 25.6 inches (650 mm) for vehicular traffic.
 - 2. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches (51 mm) in diameter.
 - a. Caution tape shall be installed in the backfill along the entire length of the trench.

3.3 FIELD QUALITY CONTROL AND TESTING

- A. Site tests:
 - a. To ensure system integrity, pressure-test the system before and during backfilling or when other trades are working near the piping.
 - b. The service tubing will be water-tested at 1 ½ times the operating pressure for a minimum of 3 hours prior to system burial.

3.4 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.

3.5 DEMONSTRATION

- A. Pre-insulated Piping System
 - 1. Demonstrate operation of system to Owner or Owner's personnel.
 - 2. Instruct Owner or Owner's personnel about operation and maintenance of the installed system.
 - 3. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.6 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.