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This specification is a manufacturer-specific proprietary product specification using the proprietary method of specifying applicable to project specifications and master guide specifications. Brackets indicate optional text []; delete optional text in final copy of specification. Specifier Notes typically precede specification text; delete notes in final copy of specification. Trade/brand names with appropriate symbols typically are used in Specifier Notes; symbols are not used in specification text. Metric conversion, where used, is soft metric conversion.

This specification is for Pre-insulated Pipe Systems. These products, manufactured by Uponor and marketed under the name Ecoflex[®], are pre-insulated pipes featuring flexible PEX tubing. Revise section number and title below to suit project requirements, specification practices and section content. Refer to CSI MasterFormat[™] 2004 for other section numbers and titles.

**SECTION 23 21 13
HYDRONIC PIPING
(ASTM ECOFLEX[®] PRE-INSULATED THERMAL SINGLE DISTRIBUTION SYSTEM)**

PART 1: GENERAL

1.01 SUMMARY

Specifier Note: The work covered by this section includes materials required to supply, install and pressure test pre-insulated crosslinked polyethylene (PEX) tubing manufactured by Uponor as shown on drawings or as specified. For the purpose of this specification, Uponor is hereby referred to as the tubing manufacturer relative to Wirsbo hePEX[™] tubing; it is referred to as the piping manufacturer relative to Ecoflex pre-insulated piping.

Section Includes: Flexible, pre-insulated distribution system that incorporates crosslinked polyethylene (PEX-a) service tubing for hot and cold fluid distribution systems.

Specifier Note: When specifying manufacturer's proprietary products and recommended installation, the following References Article (1.02) may be omitted.

Retain the References Article when specifying products and installation by an industry reference standard. If retained, list standard(s) referenced in this section. Indicate issuing authority name, acronym, standard designation and title. Establish policy for indicating edition date of the standard referenced. Conditions of the Contract or Division 1 References Section may establish the edition date of standards. This article does not require compliance with standard. It is a listing of all references used in this section.

1.02 REFERENCES

- A. General Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority, identifies the standards listed. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. ASTM International
 - 1. ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing
 - 2. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
 - 3. ASTM F1960 Standard Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing
- 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.
- D. National Sanitation Foundation (NSF) International
 - 1. NSF-rfh: Evaluated for use in Radiant Floor Heating (NSF-rfh) Applications
- E. Canadian Standards Association (CSA)
 - 1. CAN/CSA B137.5 Standard Specification for Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications
- F. Uponor, Inc.
 - 1. Uponor Pre-insulated Pipe Systems Design and Installation Manual, current edition

Specifier Note: Article below should be restricted to statements describing design or performance requirements and functional (not dimensional) tolerances of a complete system. Limit descriptions to composite and operational properties required to link components of a system together and to interface with other systems.

1.03 SYSTEM DESCRIPTION

- A. Design Requirements: The PEX-a service tubing is USA manufactured and tested in accordance with ASTM F876, ASTM F877, ASTM F1960, CSA B137.5 and NSF-rfh. The PEX service tubing has hydrostatic ratings in accordance with the temperatures and pressures listed in the ASTM standard. The hydrostatic ratings are:
 - 1. 200 degrees F (93 degrees C) at 80 PSI (551 kPa)
 - 2. 180 degrees F (82 degrees C) at 100 PSI (689 kPa)
 - 3. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa)
- B. Performance Requirements: Provide a pre-insulated distribution system that is USA manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and that maintains performance criteria stated by the tubing manufacturer without defects, damage or failure.
 - 1. Show compliance with ASTM F876 regarding Crosslinked Polyethylene (PEX) Tubing.

2. Show compliance with ASTM F877 regarding Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
3. Show compliance with DIN 4726 regarding Oxygen Diffusion.
4. Show compliance with ASTM F1960 regarding Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
5. Show compliance with CSA B137.5 regarding Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
6. Show compliance with NSF-rfh regarding Radiant Floor Heating Applications.

Specifier Note: Article below includes submittal of relevant data to be furnished by Contractor before, during or after construction. Coordinate this article with Architect's and Contractor's duties and responsibilities in Conditions of the Contract and Division 1 Submittal Procedures Section.

1.04 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.
- C. Shop Drawings: Provide installation drawings indicating piping layout, size dimension by installation segment, vault locations, support fixtures and schedules with all details required for installation of the system.
- D. Samples: Submit selection and verification samples of piping.
- E. Quality Assurance/Control Submittals
 1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
 2. Submit the following documentation.
 - a. Manufacturer's certificate stating that products comply with specified requirements
 - b. Manufacturer's flow schedule for the distribution system
 - c. Documentation that the installer is trained to install the manufacturer's products
- F. Closeout Submittals: Submit the following documentation.
 1. Warranty documents specified herein
 2. Operation and maintenance data
 3. Manufacturer's field reports specified herein
 4. Final as-built piping layout drawing

Specifier Note: Article below should include statements of prerequisites, standards, limitations and criteria that establish an overall level of quality for products and workmanship for this section. Coordinate article below with Division 1 Quality Assurance Section.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving familiarization training by the tubing manufacturer.

Specifier Note: Paragraph below should list obligations for compliance with specific code requirements particular to this section. General statements to comply with a particular code are typically addressed in Conditions of the Contract and Division 1 Regulatory Requirements Section. Avoid repetitive statements.

- B. Regulatory Requirements and Approvals: Ensure the pre-insulated PEX-a distribution system complies with all applicable codes and regulations.
- C. Certifications: Provide letters of certification indicating:
 - 1. Installer uses skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades person.

Specifier Note: Retain paragraph below if pre-installation meeting is required.

- D. Pre-installation Meetings
 - 1. Verify project requirements, excavation conditions, system performance requirements, manufacturer's installation instructions and warranty requirements.
 - 2. Review project construction timeline to ensure compliance or discuss modifications as required.
 - 3. Interface with other trade representatives to verify areas of responsibility.
 - 4. Establish the frequency and construction phase the project engineer intends for site visits and inspections by the tubing manufacturer's representative.

Specifier Note: Article below should include specific protection and environmental conditions required during storage. Coordinate article below with Division 1 Product Requirements Section.

1.06 DELIVERY, STORAGE and HANDLING

- A. General: Comply with Division 1 Product Requirement Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Storage and Protection: 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 to prevent dirt or foreign material from entering the service tubing.
 - 2. Do not expose the PEX-a service tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

Specifier Note: Coordinate article below with Conditions of the Contract and with Division 1 Closeout Submittals (Warranty) Section. Use this article to require special or extended warranty or bond covering the work of this section.

1.07 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty: Submit, for owner's acceptance, USA manufacturer's standard 5-year warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights owner may have under contract documents.
 - 1. Warranty covers the repair or replacement of any piping or fittings proven defective.
 - 2. Warranty may transfer to subsequent owners.
 - 3. The most recent limited warranty published by the manufacturer takes precedence at time of installation.

Specifier Note: List the requirements applicable to startup of the various systems. Include requirements for instruction of Owner's personnel in the operation of equipment and systems.

1.08 SYSTEM STARTUP

- A. [Specify system startup requirements.]
- B. Instruct Owner's personnel about operation and maintenance of installed system. Provide manufacturer's installation, operation and maintenance instructions for installed components within the system.

PART 2: PRODUCTS

Specifier Note: Retain article below for proprietary method specification. Add product attributes performance characteristics, material standards and descriptions as applicable. Use of such phrases as "or equal" or "or approved equal" or similar phrases may cause ambiguity in specifications. Such phrases require verification (procedural, legal and regulatory) and assignment of responsibility for determining "or equal" products.

2.01 PRE-INSULATED THERMAL SINGLE PEX DISTRIBUTION SYSTEM

Specifier Note: Paragraph below is an addition to *CSI SectionFormat*. Retain, edit or delete paragraph below to suit project requirements and Specifier practice.

- A. Manufacturer: Uponor, Inc.
 - 1. USA Contact: 5925 148th Street West, Apple Valley, MN 55124; Telephone: (800) 321-4739, (952) 891-2000; Fax: (952) 891-2008; Website: www.uponor-usa.com.
 - 2. Canada Contact: Uponor Ltd., 2000 Argentinia Road, Plaza 1, Suite 200, Mississauga, ON L5N 1W1 Canada; Telephone: (888) 994-7726; Fax: (800) 638-9517; Website: www.uponor.ca

Specifier Note: Edit Article below to suit project requirements. If substitutions are permitted, edit text below. Add text to refer to Division 1 Project Requirements (Product Substitutions Procedures) Section.

2.02 PRODUCT SUBSTITUTIONS

- A. All products, components, etc., specified herein are manufactured by and/or available from the piping manufacturer.
- B. Alternative equipment manufacturers must submit required data for all mechanical and engineering data revisions for an equivalent ASTM piping system for approval 15 days prior to bid.
- C. Alternative equipment manufacturers must submit completed distribution design layout to the project engineer for approval. Plagiarism of another manufacturer's design is unacceptable.

Specifier Note: Specify materials to be furnished. This article may be omitted and the materials can be included with the description of a manufactured unit, equipment, component or accessory.

2.03 PRE-INSULATED THERMAL SINGLE PEX DISTRIBUTION SYSTEM MATERIALS**A. Service Tubing**

- 1. Material: Crosslinked polyethylene (PEX) manufactured to PEX-a or Engel-method standard
- 2. Material Standard: Manufactured in accordance with ASTM F876 and F877
- 3. Pressure Ratings: Hydrostatic design and pressure ratings are in accordance with the ASTM standard. Operating limits are as follows.
 - a. -58 degrees F to 203 degrees F at 80 psi (-50 degrees C to 95 degrees C at 551 kPa)
- 4. The PEX service tubing in the Ecoflex Thermal Single pipe has an oxygen diffusion barrier that does not exceed an oxygen diffusion rate of 0.10 grams per cubic meter 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 inside diameter in accordance with ASTM F876, as indicated. Note: Numbers in brackets are the metric equivalent pipe size.
 - a. 1 inch [25mm]
 - b. 1¼ inch [32mm]
 - c. 1½ inch [40mm]
 - d. 2 inch [50mm]
 - e. 2½ inch [63mm]
 - f. 3 inch [75mm]
 - g. 3½ inch [90mm]
 - h. 4 inch [110mm]

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 is extruded directly over the insulation and is flexible.

4. The outer jacket shall contain 2 percent carbon black, finely divided and thoroughly dispersed to provide protection from UV degradation.

Specifier Note: Specify materials to be furnished. This article lists product by the inside nominal dimension which is common in ASTM dimensioned tubing. Note: there is one PEX-a service pipe within each pre-insulated tube.

5. Minimum Bend Radius

- a. 1-inch pre-insulated tubing with 5.5-inch [140mm] jacket has a bend radius of 10 inches [254mm].
- b. 1¼-inch pre-insulated tubing with 5.5-inch [140mm] jacket has a bend radius of 12 inches [304mm].
- c. 1½-inch pre-insulated tubing with 6.9-inch [175mm] jacket has a bend radius of 16 inches [406mm].
- d. 2-inch pre-insulated tubing with 6.9-inch [175mm] jacket has a bend radius of 18 inches [457mm].
- e. 2½-inch pre-insulated tubing with 6.9-inch [175mm] jacket has a bend radius of 30 inches [762mm].
- f. 3-inch pre-insulated tubing with 7.9-inch [200mm] jacket has a bend radius of 32 inches [812mm].
- g. 3½-inch pre-insulated tubing with 7.9-inch [200mm] jacket has a bend radius of 44 inches [1117mm].
- h. 4-inch pre-insulated tubing with 7.9-inch [200mm] jacket has a bend radius of 48 inches [1219mm].

C. Insulation

1. The insulation shall be layered, expanded cross-linked water-resistant polyethylene closed-cell foam.
2. All seams of the insulation shall be sealed.
3. Insulation shall not be bonded to the service tubing.

D. End Seals

1. The piping manufacturer will supply all EPDM rubber end caps with water stop seal.
2. EPDM rubber end caps are to be installed on each end prior to connecting the service pipes and insulating the field joints.
3. The EPDM end caps will seal onto the tubing and outer jacket forming a watertight seal.

Specifier Note: Two fitting programs are available for the PEX-a Service Tubing. Normally one fitting type is specified on the project. In this case, delete the other fitting reference. It is acceptable to specify both fittings allowing the installing contractor to choose the type of fitting used. For standardization purposes, the installing contractor should then only use one type of fitting for the installation.

E. Cold Expansion Fittings for PEX-a Service Tubing

1. For system compatibility, use fittings offered by the tubing manufacturer.
2. Fittings must comply with the performance requirements of ASTM F877.
3. Fittings are to be manufactured in accordance with ASTM F1960.

4. The fitting assembly consists of a barbed adapter and appropriately sized PEX ring.
 5. All buried fittings will be installed, insulated, and sealed in accordance with the instructions of the piping manufacturer.
- F. Compression Fittings for PEX Service Tubing
1. For system compatibility, use fittings offered by the tubing manufacturer.
 2. Fittings are to be manufactured from dezincification-resistant brass.
 3. The fitting assembly must comply with performance requirements of ASTM F877.
 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 nut.
 5. All buried fittings will be installed, insulated, and sealed in accordance with the piping manufacturer's instructions.
 6. Male NPT thread for each compression fitting is shown below.
 - a. 1-inch PEX compression fitting has 1-inch male NPT thread.
 - b. 1¼-inch PEX compression fitting has 1¼-inch male NPT thread.
 - c. 1½-inch PEX compression fitting has 1½-inch male NPT thread.
 - d. 2-inch PEX compression fitting has 2-inch male NPT thread.
 - e. 2½-inch PEX compression fitting has 2-inch male NPT thread.
 - f. 3-inch PEX compression fitting has 2½-inch male NPT thread.
 - g. 3½-inch PEX compression fitting has 3-inch male NPT thread.
 - h. 4-inch PEX compression fitting has 4-inch male NPT thread.
 7. All transition fittings connecting to the compression fittings shall be manufactured of dezincification-resistant brass.

2.04 PIPE AND FITTING IDENTIFICATION

- A. The pipe shall be marked in accordance with the standards to which it is manufactured.
- B. Color identification by the use of stripes on pipe to identify pipe service shall be optional. If used, stripes or colored exterior pipe product shall be blue for potable water, green for wastewater/sewage, or purple for reclaimed water. [Optional]
- C. Tracing wire shall be placed parallel and 18 inches above, but separate from, the pipe and shall be 10 AWG. [Specifier can change this to preferred material or method; all pipes should have a locatable methodology.]
- D. Marking tape shall be approved by the engineer and placed between 12 and 18 inches above the crown of the pipe. [Optional]

2.05 ACCESSORIES

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

F. Insulation Kits

1. Insulation kits will be manufactured of ABS shells or HDPE sleeves, will feature equal thickness of closed-cell PEX insulation as the pipe, and sealed watertight.

G. Connection Vaults

1. The piping manufacturer will provide the connection vaults when required by the project construction.
2. Connection vaults shall be constructed of rotationally molded composite polyethylene and PE foam, providing a structurally sound and thermally insulated chamber.
3. Heat shrink seals as provided by the tubing manufacturer shall be installed to prevent introduction of water into the vault.

D. Anchors

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

PART 3: EXECUTION

Specifier Note: Article below is an addition to the CSI *SectionFormat*. Revise article below to suit project requirements and Specifier practice.

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including:

1. Product technical bulletins
2. Installation instructions and design drawings
3. Uponor Pre-insulated Pipe Systems Design and Installation Manual

Specifier Note: Specify actions to determine physically that conditions are acceptable to receive primary products of the section.

3.02 EXAMINATION

A. Site Verification of Conditions

1. Verify that site conditions are acceptable for installation of the pre-insulated PEX-a piping distribution system.
2. Do not proceed with installation until unacceptable conditions are corrected.

Specifier Note: Coordinate article below with manufacturer's recommended installation requirements.

3.03 INSTALLATION

A. 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 EPDM rubber 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. Connection Vaults or Insulation Kits are required for all below-grade installations.

B. Backfill

1. The pre-insulated piping system will be backfilled with clean sand material.
 - a. Minimum vertical distance from the bottom of the tubing to the trench floor is 4 inches [100mm].
 - b. Minimum lateral distance from the side of the tubing to the trench wall is 6 inches [150mm].
 - c. Install a minimum of 12 inches [300mm] of clean fill over the top of the pre-insulated piping.
2. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches [50mm] in diameter.

Specifier Note: Specify the tests and inspections required for installed or completed work.

3.04 FIELD QUALITY CONTROL

A. Site Tests

1. To ensure system integrity, pressure-test the tubing before and during backfilling.
2. The service tubing will be air tested at 1½ times the operating pressure for a minimum of 1 hour prior to system burial.

Specifier Note: Specify the final actions required to prepare installed equipment or other completed work to properly function or perform.

3.05 ADJUSTING

- A. [Specify any required adjustments to the system.]**

Specifier Note: Specify the final actions required to clean installed equipment or other completed work to properly function or perform. Coordinate article below with Division 1 Execution Requirements (Cleaning) Section.

3.06 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean the 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.

Specifier Note: Specify requirements of the installer or manufacturer to demonstrate or train the Owner's personnel in the operation and maintenance of equipment.

3.07 DEMONSTRATION

- A. Demonstrate operation of pre-insulated PEX-a distribution system to Owner's personnel.

Specifier Note: Specify provisions for protecting work after installation but prior to acceptance by the Owner. Coordinate article below with Division 1 Execution Requirements Section.

3.08 PROTECTION

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

END OF SECTION