



Standard Specification for Flexible Pre-Insulated Piping¹

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INTRODUCTION

This specification covers materials and test methods for flexible, pre-insulated piping with non-bonded insulation. For the purpose of this standard, flexible pre-insulated piping system shall refer to a piping system that is supplied complete with carrier pipe, thermal insulation, and outer jacket manufactured as an integrated system, and is supplied in a coil. This specification covers the requirements, material specifications, and test methods of piping systems intended to convey hot and cold fluids. Piping systems may include one or more carrier pipes within a common outer jacket.

1. Scope—Scope*

- 1.1 This specification covers flexible, pre-insulated piping commonly used to convey hot and cold fluids.
- 1.2 This specification establishes materials and performance requirements for flexible, pre-insulated piping intended for hot and chilled water applications.
- 1.3 Piping systems may include one or more carrier pipes within a common outer jacket.
- 1.4 The text of this specification references notes and footnotes that provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered part of this standard.
- 1.5 *Units*—The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.
- 1.6 The following safety hazards caveat pertains to the test methods portion, Section 7, of this specification. *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory requirements prior to use.*

2. Referenced Documents

2.1 ASTM Standards:²

- C168 Terminology Relating to Thermal Insulation
- C177 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2104 Specification for Polyethylene (PE) Plastic Pipe, Schedule 40 (Withdrawn 2010)³
- D2239 Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
- D3035 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- F412 Terminology Relating to Plastic Piping Systems
- F714 Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
- F876 Specification for Crosslinked Polyethylene (PEX) Tubing
- F877 Specification for Crosslinked Polyethylene (PEX) Hot- and Cold-Water Distribution Systems
- F1281 Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe
- F1282 Specification for Polyethylene/Aluminum/Polyethylene (PE-AL-PE) Composite Pressure Pipe

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.11 on Composite. Current edition approved May 1, 2008; Nov. 1, 2013. Published November 2008; December 2013. Originally approved in 2002. Last previous edition approved in 2002 as F2165-02(2008)-02. DOI: 10.1520/F2165-02R08-10.1520/F2165-13.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

2.2 NSF Standards:⁴

[ANSI/NSF/ANSI 14](#) Plastics and Plumbing System Components

[ANSI/NSF/ANSI 61](#) Drinking Water System Components—Health Effects⁴

2.3 DIN Standards:⁵

[DIN 8074](#) Polyethylene (PE) Pipes, PE 63, PE 80, PE-100, PE-HD—General Quality Requirements and Testing

[DIN 8075](#) Polyethylene (PE) Pipes, PE 63, PE 80, PE-100, PE-HD—Dimensions

[DIN 16892](#) Crosslinked Polyethylene Pipes—General Quality Requirements and Testing

[DIN 16893](#) Crosslinked Polyethylene Pipes—Dimensions

2.4 ISO Standard⁶

[ISO 15875](#) Plastic Piping Systems for Hot and Cold Water-Installations-Crosslinked Polyethylene (PE-X)

3. Terminology

3.1 Definitions are in accordance with Terminology [F412](#) for plastic piping systems and [C168](#) for thermal insulating materials; abbreviations are in accordance with Terminology [D1600](#) unless otherwise indicated.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bonded insulation system, n*—a product that is the result of applying thermal insulation to a carrier pipe where a bond forms between the insulation and the carrier pipe that exceeds the modulus of elasticity of the carrier pipe.

3.2.2 *carrier pipe, n*—the pipe(s) that are used to convey the medium.

3.2.3 *crosslinked polyethylene (PEX) plastic, n*—~~plastic prepared by crosslinking (curing) polyethylene compounds a polyethylene material which has undergone a change in molecular structure using a chemical or a physical process whereby the polymer chains are chemically linked.~~

3.2.4 *end seal, n*—a device that provides a seal between the outer jacket and carrier pipe, providing a moisture barrier for the insulation.

3.2.5 *flexible pre-insulated pipe system, n*— a factory manufactured pre-insulated pipe system consisting of carrier pipe(s), thermal insulating material, and protective jacket. This product is supplied in coils.

3.2.6 *jacket, n*—the outer covering of the flexible pre-insulated pipe system. The jacket provides mechanical and moisture protection for the insulation.

3.2.7 *non-bonded insulation system, n*—a product that is the result of applying thermal insulation to a carrier pipe without bonding the insulation to the carrier pipe, allowing the carrier pipe to move freely within the insulation.

3.2.8 *pipe joint, n*—a connection between two sections of piping material. The pipe joint shall include the connection of the carrier pipe, insulation of the bare section carrier pipe, and protective outer jacket.

3.2.9 *thermal insulation, n*—a general term used to describe any material that reduces heat transfer.

3.2.10 *ultraviolet (UV) stability, n*—the resistance to ultraviolet degradation of the jacket material.

4. Significance and Use

4.1 This specification establishes materials and performance requirements for flexible, pre-insulated piping intended for hot and chilled water applications.

4.2 The bending force test ensures that the installer will obtain materials that will be suitable for installation as flexible piping.

5. Materials

5.1 Carrier Pipe(s):

5.1.1 PEX carrier pipe shall conform to one or more of the following: Specifications [F876](#), [F877](#); [DIN 16892](#) or [DIN 16893](#); [ISO 15875](#).

5.1.2 PE carrier pipe shall conform to one or more of the following: Specifications [D2104](#), [D2239](#), [D3035](#), [F714](#); [DIN 8075](#) or [DIN 8074](#).

5.1.3 Composite carrier pipe shall conform to Specifications [F1281](#) or [F1282](#).

5.1.4 Other piping materials as specified by customer specifications.

5.2 Thermal Insulation:

5.2.1 Insulation shall have a maximum thermal conductivity of 0.30 BTU·in./h·ft²·°F (0.04 W/(m·K)) when measured in accordance with Test Method [C177](#).

5.2.2 All seams of the insulation shall be sealed.

⁴ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁵ Available from Beuth Verlag GmbH (DIN-- DIN Deutsches Institut für Normung e.V.), Burggrafenstrasse 6, 10787, Berlin, Germany, <http://www.en.din.de>.

⁶ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

5.2.3 Insulation shall be visually inspected for voids and other defects prior to the application of the jacket. Any voids or variance in thickness greater than 0.1 in. shall be reason for rejection. Manufacturer shall repair or replace defective insulation before product is shipped to the customer. Channels for heat trace, control wiring, or orientation markings are excluded from this requirement.

5.2.4 Insulation shall not be bonded to the carrier pipe.

5.3 Outer Jacket:

5.3.1 The outer jacket shall be constructed of a watertight, corrugated material.

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

5.4 Materials to join sections of the carrier pipe or to transition to other piping materials shall be supplied by the system supplier and shall be one of the following types:

5.4.1 Compression Fittings, or

5.4.2 Heat-Fusion Welding.

5.5 The system supplier shall supply insulation and cover for any joints.

6. Requirements

6.1 The system shall be supplied in coil form. Carrier-pipe, thermal-insulation, and protective-jacket material shall be continuous and uniform throughout the coil. Connections and joints in the carrier pipe and the protective jacket shall not be allowed within the coil.

6.2 End Seals:

6.2.1 End seals shall be installed at all terminal ends of each section of piping.

6.2.2 End seals shall be watertight after being subjected to an external-pressure equivalent to a 20 ft water column for 48 h, as described in 7.1.

NOTE 1—Experience has shown that the oxygen barrier of PEX piping systems can be damaged by excessive heat being applied to heat-shrink materials during installation.

6.3 Outer Jacket:

6.3.1 The outer jacket diameter shall be determined by measuring the outside diameter of the jacket. In the case of corrugated jacket, the outside diameter of the corrugation shall be measured.

6.3.2 The outer jacket thickness shall be based on outer diameter of the jacket. Outer jacket thickness shall be as in Table 1.

7. Test Methods

7.1 End Seal Testing:

7.1.1 Testing samples shall be selected randomly from completed stock.

7.1.2 A section of pipe a minimum of 12 in. long shall be fitted with end seals on both ends.

7.1.3 A test fixture shall be prepared that allows for the test sample to be submerged in water, exposed to an external-pressure equivalent to a 20 ft water column.

7.1.4 Prior to test, testing sample with end seals installed shall be weighed and recorded.

7.1.5 Maintain the hydrostatic pressure for 48 h at 70°F.

7.1.6 After 48 h, the pipe assembly shall be inspected for water infiltration. Any indications of water infiltration by 5 % weight increase of the sample or by visual inspection shall be grounds for rejection.

7.2 Bending Force Test:

7.2.1 The flexible pre-insulated pipe system sample shall be selected randomly from completed stock in normal coil form.

7.2.2 Bend testing shall be carried out at 70 ± 10°F.

7.2.3 Pipe sample shall be 15 × jacket diameter in length.

TABLE 1 Outer-Jacket Dimensions

Outer-Jacket Outside Diameter		Outer Jacket Thickness Min. Thickness	
in.	(mm)	in.	(mm)
Up to 2.5 inclusive	(Up to 63)	.040	(1)
Over 2.5 to 3.5 inclusive	(63–90)	.045	(1.1)
Over 3.5 to 5.0 inclusive	(90–128)	.050	(1.2)
Over 5.0 to 6.3 inclusive	(128–160)	.070	(1.8)
Over 6.3 to 7.9 inclusive	(160–200)	.085	(2.1)