Designation: F2165 – 13

Standard Specification for Flexible Pre-Insulated Piping[1]

This standard is issued under the fixed designation F2165; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

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*

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/

[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.

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[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**

Polyethylene (PE-AL-PE) Composite Pressure Pipe

2.2 *NSF Standards:*[4]

NSF/ANSI 14 Plastics and Plumbing System Components

NSF/ANSI 61 Drinking Water System Components—Health Effects[4]

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 Standard*[6]

ISO 15875 Plastic Piping Systems for Hot and Cold Water-Installations-Crosslinked Polyethlene (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*—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 confirm 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·ft^2·°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.

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.

[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 fur 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.

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.

7.2.4 The bend force test will be conducted by attaching the pipe sample to a rotating bending-mandrel that is part of a test fixture that also includes a roller guide, pulling cable, and load cell as shown in Fig. 1. The mandrel is sized so that it will form the radius as required in Table 2 or Table 3. For piping systems with more than 2 carrier pipes in a common jacket, the bending radius shall be 6 × the jacket diameter.

7.2.5 The sample shall be firmly attached to the rotating bending-mandrel with the end of the sample in direct contact with the mandrel.

7.2.6 The bending force required to bend the pipe sample 90° shall be measured. The pipe sample shall be bent against the natural curve the pipe develops from being stored in a coil. The pipe sample shall be tested within 1 h after being taken from the coil.

7.2.7 The bending radius shall be in accordance to Table 2 or Table 3.

7.2.8 The rotating mandrel shall include a cable tray that is the same radius as the rotating-bending mandrel. The pulling cable shall be installed in the cable tray and attached to the mandrel. The cable is pulled by a winch, causing the rotating bending-mandrel to turn. The force required to bend the pipe sample shall be measured with "a calibrated load cell" installed in the pulling cable. The pulling cable shall not be attached directly to the pipe sample.

7.2.9 The load cell shall be calibrated and certified accurate to within 0.5 weight percent.

7.2.10 The pulling cable shall be pulled by a winch that is rated at a no-load cable speed of minimum 7.5 ft/min, and 4 ft/min at full load.

7.2.11 The force required to bend each carrier pipe and jacket size combination shall be tested, with the resulting force marked on the outer jacket.

7.2.12 *Jacket Inspection*—Any cracks or discoloration in the outer jacket shall be grounds for rejection.

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)

TABLE 2 Bending Radius for a Single Pipe in a Jacket[A]

Nominal Pipe Size	DN	Bending Radius	
		in.	(mm)
1	25	10	(250)
1.25	32	12	(300)
1.5	40	14	(350)
2	50	18	(450)
2.5	63	30	(550)
3	75	32	(800)
3.5	90	44	(1100)
4	110	48	(1200)

[A] To be used for bend force test.

TABLE 3 Bending Radius for Two Pipes in a Single Jacket Pipes[A]

Nominal Pipe Size	DN	Bending Radius	
		in.	(mm)
1	25	20	(500)
1.25	32	28	(600)
1.5	40	35	(800)
2	50	40	(1000)

[A] To be used for bend force test.

8. Certification

8.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each product have been tested and inspected as directed

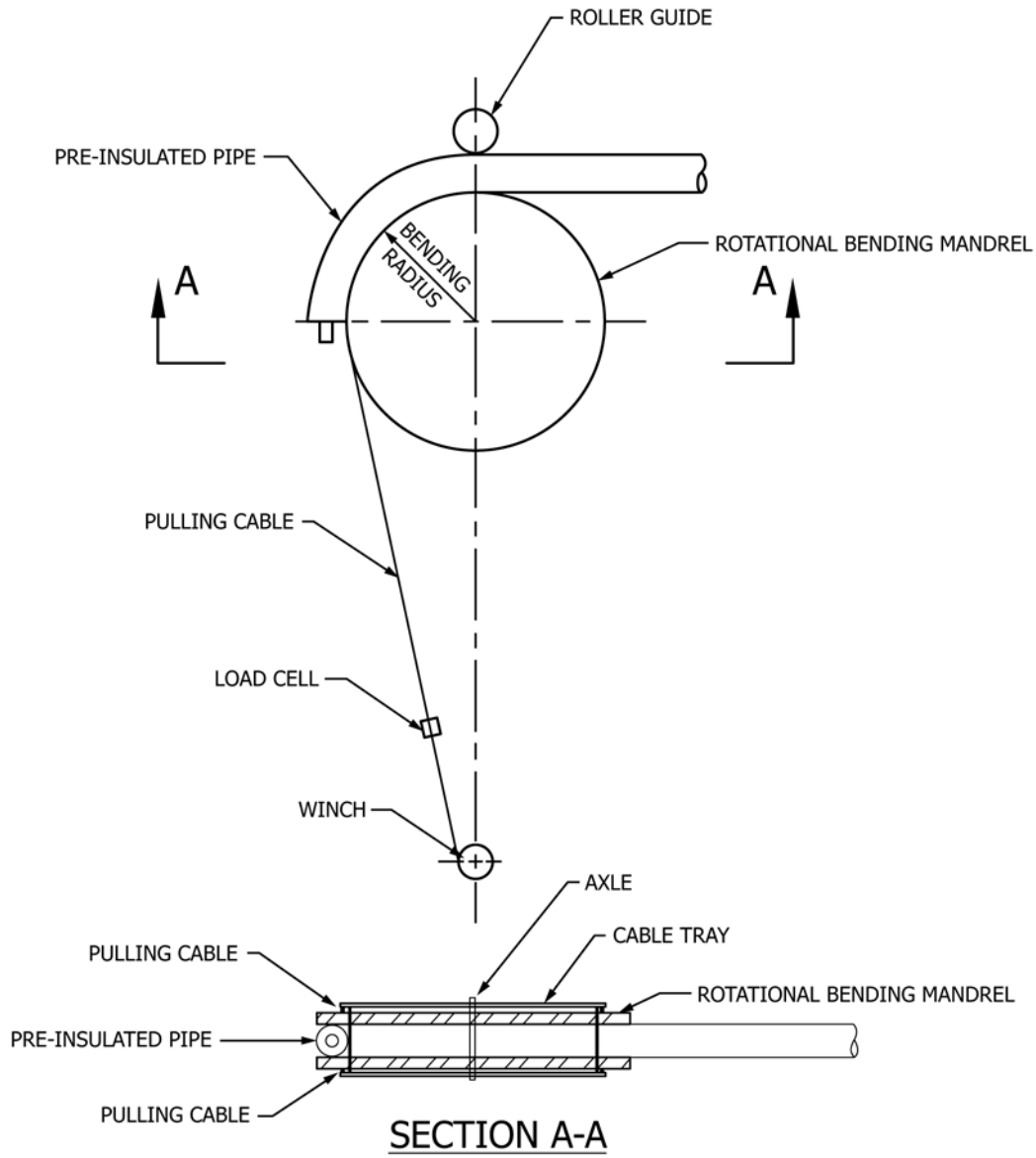

FIG. 1 Bend Force Test Fixture

in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the test results shall be furnished.

9. Product Marking

9.1 The outer jacket shall be labeled at one-meter intervals with the following information:

9.1.1 Manufacturer's name,

9.1.2 Size and quantity of carrier pipes inside jacket,

9.1.3 Carrier pipe SDR,

9.1.4 ASTM designations for carrier pipe,

9.1.5 Jacket size, and,

9.1.6 ASTM designations for piping system.

10. Package Marking

10.1 Product packaged for delivery to customer shall be marked with the following information:

10.1.1 Size and quantity of carrier pipes,

10.1.2 Carrier pipe wall thickness,

10.1.3 Carrier pipe specification,

10.1.4 Jacket size,

10.1.5 Coil length,

10.1.6 Production code/coil number. The coil number shall be traceable to component lot numbers, and

10.1.7 Bend force test result shown in pounds force.

11. Precision and Bias

11.1 No precision and bias statement can be made for test method 7.2, bending force test, since a controlled round-robin test program has not been run at this time. A controlled round-robin test program is not considered feasible due to the unique nature of the testing apparatus. No information can be presented on the bias of the test procedure in test method 7.2, bending force test, because no material having an accepted reference value is available.

12. Keywords

12.1 bend force test; flexible pre-insulated piping; plastic pre-insulated piping; pre-insulated pipe

SUPPLEMENTARY REQUIREMENTS

S1.1 All carrier pipes for piping systems designated for drinking water shall be certified to be in compliance with and listed to NSF 14.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F2165–02(2008)) that may impact the use of this standard.

(1) Added ISO 15875 to referenced standards in 2.4. Added ISO 15875 to 5.1.1.
(2) Revised definition of crosslinked polyethylene in 3.2.3 in accordance with new definition in F876.
(3) Revised callout for NSF/ANSI 14 and NSF/ANSI 61 in 2.2.