



Standard Specification for Crosslinked Polyethylene (PEX) Tubing with Oxygen Barrier for Hot- and Cold-Water Hydronic Distribution Systems¹

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1. Scope*

1.1 This specification covers requirements, test methods, and marking requirements for crosslinked polyethylene (PEX) tubing with a polymeric oxygen barrier layer, made in one standard dimension ratio (SDR 9), and distribution system components intended for hydronic heating and cooling applications up to and including a maximum working temperature of 200 °F (93 °C).

1.1.1 Components are comprised of tubing, fittings, valves, and manifolds. Tubing made to this specification incorporates a single outer or middle wall oxygen barrier layer intended for inhibiting the transmission or permeation of oxygen through the tubing wall. Requirements and test methods are included for materials, workmanship, tubing dimensions and tolerances, burst pressure, sustained pressure, excessive temperature and pressure, thermo-cycling, bent tube, oxidative resistance, layer adhesion, UV resistance, oxygen permeation, and fitting pull-out strength tests. The components covered by this specification are intended for use in residential and commercial hydronic heating and cooling systems. Requirements for potable water applications are outside the scope of this specification.

1.2 The text of this specification references notes, footnotes, and appendixes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.3 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.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

- D618 Practice for Conditioning Plastics for Testing
- D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- D1505 Test Method for Density of Plastics by the Density-Gradient Technique
- D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure
- D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings
- D1600 Terminology for Abbreviated Terms Relating to Plastics (Withdrawn 2024)³
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2749 Symbols for Dimensions of Plastic Pipe Fittings
- D2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
- D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
- F412 Terminology Relating to Plastic Piping Systems
- 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
- F1588 Test Method for Constant Tensile Load Joint Test (CTLJT)

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.61 on Water.

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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.

- F1960** Specification for Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing
- F1807** Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps, for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- F1865** Specification for Mechanical Cold Expansion Insert Fitting With Compression Sleeve for Cross-linked Polyethylene (PEX) Tubing (Withdrawn 2018)³
- F2023** Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water
- F2080** Specification for Cold-Expansion Fittings with Metal Compression-Sleeves for Crosslinked Polyethylene (PEX) Pipe and SDR9 Polyethylene of Raised Temperature (PE-RT) Pipe
- F2159** Specification for Plastic Insert Fittings Utilizing a Copper Crimp Ring, or Alternate Stainless Steel Clamps for SDR9 Crosslinked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- F2434** Specification for Metal Insert Fittings Utilizing a Copper Crimp Ring for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Cross-linked Polyethylene/Aluminum/Cross-linked Polyethylene (PEX-AL-PEX) Tubing
- F2657** Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing
- F2735** Specification for Plastic Insert Fittings For SDR9 Cross-linked Polyethylene (PEX) and Polyethylene of Raised Temperature (PE-RT) Tubing
- F3347** Specification for Metal Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- F3348** Specification for Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing and SDR9 Polyethylene of Raised Temperature (PE-RT) Tubing
- 2.2 *AWWA Standard*.⁴
Manual M-11, Steel Pipe Design and Installation
- 2.3 *Federal Standard*.⁵
FED-STD-123 Marking for Shipment (Civil Agencies)
- 2.4 *ISO Standards*.⁶
ISO 1167 Thermoplastics pipes, fittings and assemblies for the conveyance of fluids -- Determination of the resistance to internal pressure -- Part 1: General method

- ISO 13760** Plastics pipes for the conveyance of fluids under pressure -- Miner's rule -- Calculation method for cumulative damage
- ISO 17455** Plastics piping systems — Multilayer pipes — Determination of the oxygen permeability of the barrier pipe
- ISO R161-1690** Pipes of Plastic Materials for the Transport of Fluids (Outside Diameters and Nominal Pressures) Part 1, Metric Series
- 2.5 *Military Standard*.⁷
MIL-STD-129 Marking for Shipment and Storage
- 2.6 *NSF Standard*.⁷
NSF/ANSI Standard No. 14 for Plastic Piping Components and Related Materials
- 2.7 *PPI Standard*.⁸
PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Hydrostatic Design Stresses (HDS), Pressure Design Basis (PDB), Strength Design Basis (SDB), Minimum Required Strength (MRS) Ratings, and Categorized Required Strength (CRS) for Thermoplastic Piping Materials or Pipe
- PPI TR-4** PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe

3. Terminology

3.1 The terminology used in this specification is in accordance with Terminology **F412**, Terminology **D1600**, and Symbols **D2749**, unless otherwise specified. The abbreviation for crosslinked polyethylene is PEX.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *barrier layer*—a very thin polymeric film within the tube wall or around the circumference of the tubing which provides a means for greatly reducing the transmission of oxygen from the atmosphere and into the fluid within the tube.

3.2.2 *hydrostatic design basis (HDB)*—As defined by Terminology **F412** is one of a series of established stress values (specified in Test Method **D2837**) for a plastic compound obtained by categorizing the long-term hydrostatic strength determined in accordance with Test Method **D2837**.

3.2.2.1 *Discussion*—A voluntary listing of HDB, and HDS values are contained in PPI publication PPI TR-4.

3.2.3 *hydrostatic design stress (HDS)*—As defined by Terminology **F412** is the estimated maximum tensile stress the material is capable of withstanding continuously with a high degree of certainty that failure of the tube will not occur. This stress is circumferential when internal hydrostatic water pressure is applied. The HDS is equal to the hydrostatic design basis (HDB) times the design factor (DF) for water; $HDS = HDB \times DF$. For this specification, the design factor is less than or equal to 0.50.

⁴ Available from American Water Works Association (AWWA), 6666 W. Quincy Ave., Denver, CO 80235, <http://www.awwa.org>.

⁵ DLA Document Services Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 <http://quicksearch.dla.mil/>

⁶ Available from International Organization for Standardization (ISO), ISO Central Secretariat, BIBC II, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <http://www.iso.org>.

⁷ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁸ Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825 Irving TX, 75062. <http://www.plasticpipe.org>