



## Standard Specification for Crosslinked Polyethylene (PEX) Tubing of 0.070 in. Wall and Fittings for Radiant Heating Systems up to 75 psig<sup>1</sup>

This standard is issued under the fixed designation F2929; 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.

### 1. Scope\*

1.1 This specification covers 0.070 in. wall thickness cross-linked polyethylene (PEX) tubing that is outside diameter controlled, and intended for non-potable radiant heating applications for pressures up to 75 psig in sizes  $\frac{5}{8}$  NTS (nominal tubing size) and  $\frac{7}{8}$  NTS. This specification also includes fittings that are specifically designed for this 0.070 in.-wall PEX tubing. Only maximum 75-psig relief valves shall be used with this tubing. Included in this specification are requirements and test methods for material, workmanship, dimensions, burst pressure, hydrostatic sustained pressure, environmental stress cracking, stabilizer functionality, bent-tube hydrostatic pressure, excessive temperature and degree of crosslinking. Requirements for tubing markings are also given. This specification incorporates an optional middle or outer oxygen barrier layer. This tubing is not intended for field bending at temperatures above 120 °F (49 °C).

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 The following safety hazards caveat pertains only 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, 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 standardization 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:

- A269/A269M Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A276/A276M Specification for Stainless Steel Bars and Shapes
- A312/A312M Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- B16/B16M Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines
- B61 Specification for Steam or Valve Bronze Castings
- B62 Specification for Composition Bronze or Ounce Metal Castings
- B140/B140M Specification for Copper-Zinc-Lead (Red Brass or Hardware Bronze) Rod, Bar, and Shapes
- B283 Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed)
- B371/B371M Specification for Copper-Zinc-Silicon Alloy Rod
- B584 Specification for Copper Alloy Sand Castings for General Applications
- B967/B967M Specification for Copper-Zinc-Tin-Bismuth Alloy Rod, Bar and Wire
- 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
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2765 Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
- D2837 Test Method for Obtaining Hydrostatic Design Basis

<sup>1</sup> 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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for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products

**D3895** Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

**E18** Test Methods for Rockwell Hardness of Metallic Materials

**F412** Terminology Relating to Plastic Piping Systems

**F1281** Specification for Crosslinked Polyethylene/Aluminum/Crosslinked Polyethylene (PEX-AL-PEX) Pressure Pipe

**F2657** Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing

2.2 *ANSI Standard*.<sup>2</sup>

**B36.10** Standards Dimensions of Steel Pipe (IPS)

2.3 *Federal Standard*.<sup>3</sup>

**FED-STD-123** Marking for Shipment (Civil Agencies)

2.4 *Military Standard*.<sup>3</sup>

**MIL-STD-129** Marking for Shipment and Storage

2.5 *ISO Standards*.<sup>4</sup>

**ISO 1167** Thermoplastics pipes, fittings and assemblies for the conveyance of fluids -- Determination of the resistance to internal pressure -- Part 1: General method

**ISO R 161-1690** Pipes of Plastic Materials for the Transport of Fluids (Outside Diameters and Nominal Pressures) Part 1, Metric Series

**ISO 17455** Plastics piping systems -- Multilayer pipes -- Determination of the oxygen permeability of the barrier pipe

2.6 *PPI Standards*.<sup>5</sup>

**PPI TR-3** Policies and Procedures for Developing Recommended Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB) and Minimum Required Strength (MRS) Ratings 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 *Definitions*—Definitions are in accordance with Terminology **F412**, and abbreviations are in accordance with Terminology **D1600**, unless otherwise specified. The abbreviation for crosslinked polyethylene is PEX.

3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *barrier layer, n*—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 *crosslinked polyethylene, n*—molecular polyethylene chains chemically connected through irradiation with high-energy electron beams, or chemical agents such as organic peroxides or silanes.

3.2.3 *hydrostatic design stress (HDS), n*—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. For this standard, the design factor is equal to 0.50.

$$\begin{aligned} HDS &= HDB \times DF \\ &= HDB \times 0.05 \quad (\text{For this standard}) \end{aligned} \quad (1)$$

3.2.4 *hydrostatic design basis (HDB)*—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**.

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

3.2.5 *hydrostatic strength equivalency (HSE), n*—a pressure testing evaluation methodology where hydrostatic testing is conducted on PEX tubing that is constructed with a barrier layer in the middle or outside wall of the tubing, and is constructed with PEX material that has an established HDB. HSE methodology is applied where the barrier layer reduces the thickness of the HDB rated PEX material in the wall such that the PEX wall thickness excluding the barrier layer(s) is slightly less than 0.070 in. (1.78 mm).

3.2.6 *HSE-DR, n*—an identifying term for the tubing where the minimum PEX wall thickness falls below 0.070 in. (1.78 mm), yet the tubing, as constructed, still meets the pressure rating requirements of this specification as demonstrated by HSE evaluation testing.

3.2.7 *pressure rating (PR)*—the estimated maximum water pressure the tube is capable of withstanding continuously with a high degree of certainty that failure of the tube will not occur.

3.2.7.1 *Discussion*—If both  $\frac{5}{8}$  NTS and  $\frac{3}{4}$  NTS tubing are used in the same system, the pressure rating of the system is limited to the pressure rating of the  $\frac{3}{4}$  NTS tubing.

3.2.8 *relation between dimensions, hydrostatic design stress, and pressure rating*—the following expression, commonly known as the ISO equation, 6 is used in this specification to relate dimensions, hydrostatic design stress, and pressure rating:

$$\begin{aligned} 2SP &= (D_o / t) - 1 \\ \text{or} \\ 2SP &= R - 1 \end{aligned} \quad (2)$$

where:

$S$  = hydrostatic design stress, psi (MPa),  
 $P$  = pressure rating, psi (or MPa),  
 $D_o$  = average outside diameter, in. (mm),  
 $t$  = minimum wall thickness, in. (mm), and  
 $R$  = dimension ratio, DR.

<sup>2</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>3</sup> Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

<sup>4</sup> 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>.

<sup>5</sup> Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.