



Standard Specification for Metric- and Inch-Sized Fittings for Crosslinked Polyethylene (PEX) Pipe¹

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1. Scope*

1.1 This specification covers performance requirements, test methods, and marking requirements for metric- and inch-sized fittings for use with Specification F2788, F2905/F2905M, and F2968/F2968M PEX pipe. The following performance requirements are described for the fittings – 73 °F [23 °C] hydrostatic strength, 176 °F [80 °C] hydrostatic strength, short-term internal pressure resistance, resistance to tensile loads, cohesive resistance for electrofusion fittings at both the minimum and maximum recommended temperatures, impact resistance for saddle fittings, and leak tightness and pull out tests for mechanical fittings. The metric- and inch-sized components covered by this specification are intended for the above-ground and buried pressure piping applications, such as industrial and general-purpose pipelines, potable water pipelines up to 140 °F (60 °C), fire – extinguishing pipelines.

1.2 Crosslinking requirements for PEX pipe are found in Specifications F2788, F2905/F2905M, and F2968/F2968M.

1.3 Requirements for materials, workmanship, and qualification testing performance are included.

1.4 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.

1.5 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text the SI units are shown in brackets. The values stated in each system may not be exact equivalents: therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

NOTE 1—Suggested hydrostatic design stresses and hydrostatic pressure ratings for pipe and fittings are listed in Appendix X1. Design, assembly, and installation considerations are discussed in Appendix X2. An optional performance qualification and an in-plant quality control program are recommended in Appendix X3.

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.10 on Fittings.

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1.6 The following safety hazards caveat pertains only to the test method 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.*

1.7 *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:²

- D618 Practice for Conditioning Plastics for Testing
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D1898 Practice for Sampling of Plastics (Withdrawn 1998)³
- D2749 Symbols for Dimensions of Plastic Pipe Fittings
- 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
- F1055 Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
- F2788 Specification for Metric and Inch-sized Crosslinked Polyethylene (PEX) Pipe
- F2905/F2905M Specification for Crosslinked Polyethylene (PEX) Line Pipe For Oil and Gas Producing Applications
- F2968/F2968M Specification for Black Crosslinked Polyethylene (PEX) Pipe, Fittings and Joints For Gas Distribution Applications

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 Federal Standard:⁴

Fed Std. No. 123 Marking for Shipment (Civil Agencies)

2.3 Military Standard:⁴

MIL-STD-129 Marking for Shipment and Storage

2.4 NSF Standard:⁵

Standard No. 14 for Plastic Piping Components and Related Materials

NSF/ANSI 61 Drinking Water System Components -- Health Effects

2.5 ISO Standards:⁶

ISO 4427-3 Plastic piping systems – Polyethylene (PE) pipes and fittings for water supply – fittings

ISO 4427-5 Plastic piping systems – Polyethylene (PE) pipes and fittings for water supply – fitness for purpose of the system

ISO 15875-3 – Plastic piping systems for hot and cold water installations – Crosslinked polyethylene (PE-X) – fittings

ISO 15875-5 – Plastic piping systems for hot and cold water installations – Crosslinked polyethylene (PE-X) – fitness for purpose of the system

2.6 Plastic Pipe Institute:⁷

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

2.7 NACE Standard:⁸

MR0175 Petroleum and natural gas industries – Materials for use in H₂S-containing environments in oil and gas production

sized DN fittings shall be used for metric-sized pipe and only inch-sized NPS fittings shall be used for inch-sized pipe. Metallic mechanical fittings used in sour service applications (> 4 ppm of H₂S) shall comply with NACE MR0175.

NOTE 2—Contact the fitting manufacturer for suitability of PEX fittings used in the particular application.

4.2 Electrofusion fittings:

4.2.1 For polyethylene (PE) electrofusion fittings that are deemed suitable for joining to PEX pipe by the pipe manufacturer, the pipe manufacturer shall qualify the PE electrofusion fitting by testing joints made between the PE electrofusion fitting and PEX pipe, and assuring that these joints meet the performance requirements of the PE electrofusion fitting standard (for example, Specification **F1055**).

4.2.2 PE electrofusion assemblies, using PEX pipe joined with PE electrofusion fittings, shall be limited to the maximum temperature listed for the HDS rating, such as 140 °F [60 °C], for the PE material.

4.2.3 For higher temperatures, only PEX electrofusion fittings, made in accordance with ISO 15875-3, shall be used. The material used to manufacture these fittings shall have an HDB or CRS listed at the maximum recommended temperature

4.3 PE electrofusion and mechanical fittings joined to PEX pipe for temperatures up to 140 °F [60 °C] shall meet the applicable requirements for materials and manufacture in applicable fitting standards, such as Specification **F1055**, ISO 4427-3 and ISO 4427-5, PEX electrofusion fittings and mechanical fittings joined to PEX pipe for temperatures up to 200 °F [93 °C] shall meet the applicable requirements for materials and manufacture in applicable fitting standards, such as ISO 15875-3 and ISO 15875-5.

4.4 Fittings containing metallic components and intended for sour gas service applications (> 50 ppm of H₂S) shall comply with NACE MR0175.

4.5 *Certification*—PEX fittings used for the distribution of potable water shall be products approved for that service by the regulatory bodies having such jurisdiction. These products shall be tested for that service by a nationally recognized and accredited testing laboratory and shall bear the certification mark of the testing agency.

5. Classification

5.1 *Fittings*—This specification classifies fittings intended for use in systems with PEX pipe, by a maximum continuous use temperature that shall be 200 °F [93 °C] or 140 °F (60 °C) for potable water, and by inch pipe sizes from NPS 3 to NPS 54 and metric pipe sizes from DN 16 to 1000 on the basis of meeting the performance requirements for fittings as outlined in Specification **F1055**, ISO 4427-3 and ISO 15875-3. Fittings shall be compatible with pipe made to the requirements of Specifications **F2788**, **F2905/F2905M**, **F2968/F2968M**.

5.2 PE electrofusion fittings (Specification **F1055** or ISO 4427-3) shall only be used for temperatures up to 140 °F [60 °C]. PEX electrofusion fittings (ISO 15875-3) may be used for temperatures up to 200 °F [93 °C].

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 *crosslinked polyethylene, n*—a polyethylene material that has undergone a change in molecular structure through processing whereby a majority of the polymer chains are chemically linked.

3.2.1.1 *Discussion*—ASTM standards for PEX pipe require a gel content level of 65 % to 89 % or 70 % to 89 %, depending on the type of crosslinking.

4. Materials

4.1 *General*—PEX fittings made in accordance with this specification are intended for use with Specifications **F2788**, **F2905/F2905M**, or **F2968/F2968M** PEX pipe. Only metric-

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

⁵ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48105, <http://www.nsf.org>.

⁶ Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, <http://www.iso.ch>.

⁷ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

⁸ Available from NACE International (NACE), 15835 Park Ten Pl., Houston, TX 77084, <http://www.nace.org>.

6. Requirements

6.1 Dimensions and Tolerances:

6.1.1 The dimensions and tolerances of PE electrofusion and mechanical fittings used up to 140 °F [60 °C] shall meet the specific requirements contained in Specification **F1055** and ISO 4427-3. The dimensions and tolerances of PEX electrofusion fittings and mechanical fittings for temperatures up to 200 °F [93 °C] shall meet the specific requirements contained in ISO 15875-3. Fittings shall be compatible with pipe made to the requirements of Specification **F2788**, **F2905/F2905M**, or **F2968/F2968M**.

6.2 *Electrofusion Joints*—All electrofusion joints shall meet all the performance requirements as specified in Specification **F1055**, ISO 4427-3, and ISO 4427-5 for temperatures up to 140 °F [60 °C], or ISO 15875-3 and ISO 15875-5 for temperatures up to 200 °F [93 °C]. Performance tests for electrofusion joints between PEX pipe and PE electrofusion fittings shall follow the relevant standard to which the EF fitting complies, either Specification **F1055** or ISO 4427-3. The following are examples of the performance requirements as described in these ASTM and ISO standards for electrofusion fittings – 68 °F [20 °C] or 73 °F [23 °C] hydrostatic strength, 176 °F [80 °C] hydrostatic strength, short-term internal pressure resistance, resistance to tensile loads, cohesive resistance for electrofusion saddle and socket fittings at both the minimum and maximum recommended temperatures, impact resistance for saddle fittings.

6.3 *Mechanical Joints*—All mechanical fitting joints made between metric-sized PEX pipe and metric-sized mechanical fittings shall meet the performance requirements as specified in ISO 4427-3 and ISO 4427-5 for temperatures up to 140 °F [60 °C], or ISO 15875-3 and ISO 15875-5 for temperatures up to 200 °F [93 °C]. The following performance requirements are described in these ISO standards for mechanical fittings – 68 °F [20 °C] hydrostatic strength, 176 °F [80 °C] hydrostatic strength, short-term internal pressure resistance, resistance to tensile loads, impact resistance for saddle fittings, leak tightness under internal pressure, leak tightness under internal pressure when subjected to bending, external pressure test, and resistance to pull out under constant longitudinal force.

6.4 Fittings:

NOTE 3—Swaged fittings per 6.4.2 and fabricated fittings per 6.4.5 and 6.4.6 may not be allowed for gas distribution applications in some countries.

6.4.1 *PEX Elbow*—PEX pipe hot bent to produce a PEX elbow (also known as a sweep elbow) shall meet the performance requirements of Specifications **F2788**, **F2905/F2905M** or **F2968/F2968M**, after the PEX pipe is bent to form a PEX elbow. PEX elbows that do not meet minimum performance requirements for the PEX pipe from which they were made shall be de-rated. The pressure rating marked on the PEX elbow shall be reduced to align with their lower performance test results. The manufacturer shall also perform tests to confirm that the PEX elbow will not revert back to its original shape after the hot bend process.

6.4.2 *PEX Reducer*—PEX pipe that is swaged to produce a PEX reducer shall meet the performance requirements of

Specifications **F2788**, **F2905/F2905M** or **F2968/F2968M**, after the PEX pipe is swaged to form a PEX reducer. PEX reducers that do not meet minimum performance requirements for the PEX pipe from which they were made shall be de-rated. The pressure rating marked on the PEX reducer shall be reduced to align with their lower performance test results. The manufacturer shall also perform tests to confirm that the PEX reducer will not revert back to its original shape after the swage process.

6.4.3 *Reinforced Electrofusion Coupler*—coupler shall be reinforced (metal, glass fibers, polymers, etc) for use with thick wall PEX pipe, and tested according to the manufacturer's recommendations to assure they meet the performance requirements of this specification.

6.4.4 *Flange Coupler*—coupler shall be manufactured and tested according to the manufacturer's recommendations, and shall meet the same performance requirements specified for mechanical joints in this standard. Flanges shall have a back-up ring for tightening, as per the manufacturer's recommendations.

6.4.5 Fabricated PE fitting:

6.4.5.1 If a PE fitting is fabricated using a miter butt fusion, the fitting's proposed derating shall be tested in accordance with ISO 4427-5 Section 4.4. The manufacturer shall mark the maximum allowable pressure rating on the fitting.

6.4.5.2 If the PE fitting is fabricated using standard butt fusion, the fitting shall be tested in accordance with ISO 4427-5, Section 4.4.

6.4.5.3 PE fabricated fittings shall only be used up to the maximum temperature allowed for the PE material, and the fitting shall be marked with the maximum allowable temperature.

6.4.6 Fabricated PEX fitting:

6.4.6.1 If PEX fitting is fabricated using a miter butt fusion, the fitting's proposed derating shall be tested in accordance with ISO 4427-5 Section 4.4 for PE. The manufacturer shall mark the maximum allowable pressure rating on the fitting.

6.4.6.2 If PEX fitting is fabricated using standard butt fusion, the fitting shall be tested in accordance with ISO 4427-5 for PE.

6.4.6.3 PEX fabricated fittings are made from PE pipe or low cross-linked PEX pipe. After fabrication, the crosslink level of the PEX fabricated fitting shall meet the crosslink requirements of Specifications **F2788**, **F2905/F2905M** or **F2968/F2968M**.

7. Test Methods

7.1 *Conditioning*—The test specimens should be conditioned at 70 to 77 °F [23 ± 2 °C] and 50 ± 5 % relative humidity for not less than 40 h prior to test in accordance with Practice **D618**, for those tests where conditioning is required.

7.2 *Test Conditions*—Conduct the tests in the standard laboratory atmosphere of 70 to 77 °F [23 ± 2 °C] and 50 ± 5 % relative humidity, unless otherwise specified in the test methods or in this specification.

7.3 *Sampling*—A sufficient quantity of fittings, as agreed upon by the purchaser and the seller, shall be selected and tested to determine conformance with this specification (see