Designation: F2829/F2829M – 15

An American National Standard

Standard Specification for Metric- and Inch-Sized Crosslinked Polyethylene (PEX) Pipe Systems[1]

This standard is issued under the fixed designation F2829/F2829M; 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 performance requirements, test methods, and marking requirements for metric- and inch-sized system components (electrofusion and mechanical fittings) when joined with metric- or inch-sized PEX pipe (Specification F2788) as a system, intended for use up to and including a maximum working temperature of 200°F [93°C]. The following performance requirements are described for the fittings – 68°F [20°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 & general-purpose pipelines, potable water pipelines, and fire – extinguishing pipelines.

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 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.

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

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

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

[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.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

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

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

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

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 type of plastic derived from a polyethylene base resin in which adjacent chains of the polymer are joined to create covalent bonds.

4. Materials

4.1 *General*—PEX systems shall use crosslinked polyethylene pipe as described in Specification F2788.

4.2 *Electrofusion fittings*—PE electrofusion fittings shall only be used to join to PEX pipe for temperatures up to 140°F [60°C]. For higher temperatures, only PEX electrofusion fittings shall be used.

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

4.4 *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.

[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.

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] and by inch pipe sizes from 3 in. to 54 in. and metric pipe sizes from [16 mm to 1000 mm] 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 Specification F2788.

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].

6. Requirements

6.1 *Dimensions and Tolerances:*

6.1.1 The dimensions and tolerances of PE electrofusion and mechanical fittings used up to140°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.

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 are 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.

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 Practice D1898). In the case of no prior agreement, random samples selected by the testing laboratory shall be deemed adequate.

8. Retest and Rejection

8.1 If the results of any test(s) do not meet the requirements of this specification, the tests(s) shall be conducted again only by agreement between the purchaser and seller. Under such agreement, minimum requirements shall not be lowered, changed, or modified, nor shall specification limits be changed. If upon retest, failure occurs, the quantity of product represented by the test(s) does not meet the requirements of this specification.

9. Certification

9.1 Fittings for use in crosslinked polyethylene systems intended for use in the transport of potable water shall be evaluated and certified as safe for this purpose by a testing agency acceptable to the local health authority. The evaluation shall be in accordance with the requirements for chemical extraction, taste, and odor, that are no less restrictive than those included in NSF/ANSI 61 and NSF Standard No. 14Standard No. 14 Standards. The seal or mark of the laboratory making the evaluation shall be included on the fitting.

10. Marking

10.1 *Quality of Marking*—The marking shall be applied to fittings in such a manner that it remains legible (easily read) after installation and inspection.

10.1.1 Markings or symbols may be rolled, molded, hot-stamped, etched or applied by printing methods.

10.1.2 Where recessed marking is used, the marking shall not cause cracks or reduce the wall thickness below the minimum requirement in the specific standard specification for the fitting.

10.2 *Content of Marking:*

10.2.1 Manufacturer's name or trademark.

10.2.2 Certification mark or seal of the laboratory making the evaluation for this purpose.

10.2.3 This designation, F2829 or the specific standard specification for the fitting.

10.2.4 Nominal metric size or nominal inch pipe size.

10.2.5 A code number identifying the date of manufacture.

10.2.6 Material designation code for fitting construction material as listed in PPI TR-4 (for example, PE 4710, PE 100).

11. Quality Assurance

11.1 When the product is marked with this designation, F2829 or with the specific standard specification for the fitting, the manufacturer affirms that the product was manufactured, inspected sampled and tested in accordance with this specification and has been found to meet the requirements of this specification.

12. Keywords

12.1 metric PEX electrofusion joints; metric PEX joints; metric PEX pipe; metric PEX system

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT/MILITARY PROCUREMENT

These requirements apply only to federal/military procurement, not domestic sales or transfers.

S1.1 *Responsibility for Inspection*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. The producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless the purchaser disapproves. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

NOTE S1—In U. S. Federal contracts, the contractor is responsible for inspection.

S1.1.1 *Packaging and Marking for U.S. Government Procurement:*

S1.1.2 *Packaging*—Unless otherwise specified in the contract, the materials shall be packaged in accordance with the supplier's standard practice in a manner ensuring arrival at destination in satisfactory condition and which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification rules or National Motor Freight Classification rules.

S2.2 *Marking* —Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

NOTE S2—The inclusion of U.S. Government procurement requirements should not be construed as an indication that the U.S. Government uses or endorses the products described in this specification.

APPENDIXES

(Nonmandatory Information)

X1. APPENDIX

X1.1 Hydrostatic design stresses recommended by the Plastic Pipe Institute are used to pressure rate PEX plastic pipe. These design stresses are based on the 100,000-h hydrostatic strength of the pipe obtained in accordance with Test Method D2837. Additional information regarding the method of test and other criteria used in developing these hydrostatic design stresses may be obtained from the Plastics Pipe Institute. See Table X1.1 for SDR 9 example.

TABLE X1.1 Hydrostatic Design Stresses and Pressure Ratings for SDR 9 PEX Pipe for Hot Water Distribution Systems

Rated Temperature		Hydrostatic Design Stress		Pressure Rating for Water	
°F	°C	psi	[MPa]	psi	[MPa]
73.4	23	630	[4.32]	160	[1.10]
180	82	400	[2.76]	100	[0.69]
200	93	315	[2.17]	80	[0.56]

X1.2 Independent methods for determining the hydrostatic design stress of fittings have yet to be developed due to the complicating effects of fitting geometry. Instead, fittings and assembled systems carry an implied pressure rating equivalent to that of the corresponding pipe on the basis of actual equivalent hydrostatic performance of assembled systems for periods exceeding 10,000 h. The sustained pressure requirements of 6.2 for fittings tested as assembled systems are based on stress rupture data for pipe.

X1.3 The hydrostatic design stresses are not suitable for materials that show a negative departure from a straight line plot of log versus stress versus log time to failure. All of the data available to date on PEX pipe materials and fitting assemblies, tested in accordance with Test Method D2837, meet this requirement. Experience of the industry indicates that PEX piping systems made from components meeting the requirements of this specification give satisfactory service under normal conditions at these temperature-pressure ratings.

X2. DESIGN, ASSEMBLY, AND INSTALLATION CONSIDERATIONS

X2.1 Assembly

X2.1.1 *Compression-Type Fittings:* Assemble in accordance with the manufacturer's instructions. Compression-type fittings are likely to include inserts and ferrules, or O-rings which form an essential part of the fittings assembly and should not be omitted.

X2.1.2 *Insert Fittings:* A number of techniques have been developed where a fitting is firmly secured to PEX pipe. The fitting is placed inside the tube and a tool is employed to crimp a metallic lock ring around the pipe outside diameter adjacent to the fitting. This provides a mechanical lock with the pipe being wedged securely between the ring and the insert fitting.

X2.1.3 *Mechanical Fittings:* A number of fitting systems have been developed that can be described as mechanical compression-type joining. They are comprised of fittings that provide a seal on the outer surface of PEX pipe. The actual sealing is affected by the following methods:

X2.1.3.1 *Cold Flaring:* Utilize a cold flaring tool, wherein the pipe outside diameter is expanded mechanically. The expanded or flared end is then secured between a fitting. Flare configuration may vary depending on the particular tool employed. The flared surface generally serves as the sealing area between the pipe and fitting.

(1) Elastomeric cone with threaded nut.

(2) Ferrule with a threaded nut. The above compression-type fittings should be assembled in accordance with the manufacturer's recommendations.

X2.1.3.2 *Electrofusion Fittings:* Assemble in accordance with the manufacturer's instructions. For applications up to 140°F [60°C], electrofusion fittings are made from polyethylene. For higher temperature applications, electrofusion fittings are made from a PEX material.

X2.1.4 The manufacturer should be consulted regarding authorized fittings for use with PEX pipe.

X2.2 Installation

X2.2.1 *Storage and Handling:* PEX fittings should be stored under cover to avoid unnecessary dirt accumulation and long-term exposure to sunlight. Care should be used in handling to ensure that unnecessary abuse, such as dropping on concrete, nicking or denting, is avoided.

X2.2.2 *Pressure Testing:* A pressure test with water at 100 psi [0.69 MPa] on the system excluding the hot water heater is advisable to test for fitting leakage.

X2.2.3 *Soldering in the Area:* Soldered metal fittings should not be made closer than 18 in. [460 mm] to an installed plastic-to-metal adapter in the same water line.

X3. OPTIONAL PERFORMANCE QUALIFICATION AND IN-PLANT QUALITY-CONTROL PROGRAM FOR PEX PIPING SYSTEM COMPONENTS

X3.1 Scope

X3.1.1 The following program covers performance qualification and in-plant quality control for component design and manufacture respectively to provide reasonable assurance that PEX components supplied under this specification shall consistently meet its requirements.

X3.2 Performance Qualifications

X3.2.1 Performance qualification tests shall be run initially on each component design, size, and formulation in accordance with the requirements of this specification. The test results shall be independently certified and shall be made available to the purchaser on request.

X3.3 In-Plant Quality Control

X3.3.1 *Material*—The pipe material shall be PEX as defined in Section 4 of this specification. The manufacturer shall so certify.

X3.3.2 *Quality-Control Testing*—Pipe and fitting quality-control tests shall be run for each extrusion line or mold cavity in accordance with the requirements of this specification at a frequency agreed upon between the purchaser and the manufacturer. The program outlined in Table X3.1 is recommended. The test results shall be recorded and filed for inspection on request. Should a component fail to meet the specification in any test, production should be sampled back to the previous acceptable test result and tested to determine which components produced in the interim do not meet the requirement. Components that do not meet the requirements of this specification shall be rejected. See Table Table X3.2.

TABLE X3.1 Suggested Quality-Control Program

Component	Property	Frequency	Requirement
Fitting	Dimensions	hourly	6.2[A,B]
	Burst pressure	daily	6.3[A,B]

[A]Specification F2788 for crosslinked polyethylene (PEX) pipe.
[B]This specification, F2829.

X3.3.3 *Marking*—Fittings shall be marked to identify the manufacturer and shall be coded or placed in dated containers to show the date of manufacture.

TABLE X3.2 Type Test Program

Component	Property	Requirement
Fittings	sustained pressure	6.2[A,B]
	Thermocycling	6.3[A,B]
	Potable water	NSF 14

[A]Specification F2788 for crosslinked polyethylene (PEX) pipe.
[B]This specification, F2829.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (F2829–10) that may impact the use of this standard.

(1) Added inch pipe sizes.
(2) Added requirement that pipe and fittings shall be the same dimensions–inch-to-inch and metric-to-metric.
(3) Revised upper pipe size range for metric pipe from 630 mm to 1000 mm to be consistent with Specification F2788.