



Designation: F3597 – 23

Standard Specification for MRS-Rated Metric- and Inch-sized Crosslinked Polyethylene (PEX) Pressure Pipe for Oil and Gas Producing Applications¹

This standard is issued under the fixed designation F3597; 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 crosslinked polyethylene (PEX) pipe that is outside diameter controlled in metric pipe sizes (DN 16 to 1000) and inch pipe sizes (NPS 3 to 54), and pressure rated (see [Appendix X1](#)) using the ISO MRS rating system. This specification is intended for PEX pipe made by various processes, as long as the PEX pipe made by that process meets all the requirements of this specification. Included are requirements and test methods for material, workmanship, UV protection, dimensions, hydrostatic sustained pressure, chemical resistance, minimum operating temperature, degree of crosslinking, squeeze-off, and hydrostatic burst pressure. Requirements for pipe markings are also given. The pipe covered by this specification is intended for pressure or non-pressure oil and gas producing applications such as conveying oil, dry or wet gas, gas gathering, multi-phase fluids, and non-potable oilfield water. This specification does not cover gas distribution applications.

NOTE 1—Gas gathering applications where the pipe size is greater than NPS 8 may be subject to PHMSA design, material, and installation requirements.

1.2 This specification also includes requirements for qualifying joints made using polyethylene electrofusion fittings (such as Specification [F3373](#)) and PEX pipe. Fittings to be used with PEX pipe manufactured to this specification are in Specification [F2829](#). Installation considerations are in [X2.2](#).

NOTE 2—NPS fittings should not be used for DN sized pipe, and DN sized fittings should not be used for NPS pipe.

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

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The

values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.4.1 For consistency with ISO 9080, MRS values shall only be in SI units for conversion to the pipe material designation (for example PEX material in pipe form with an MRS of 8 MPa is designated a PEX 80).

1.5 *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.*

1.6 *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

[D543 Practices for Evaluating the Resistance of Plastics to Chemical Reagents](#)

[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](#)

[D1603 Test Method for Carbon Black Content in Olefin Plastics](#)

¹ This specification is under the jurisdiction of ASTM Committee [F17](#) on Plastic Piping Systems and is the direct responsibility of Subcommittee [F17.68](#) on Energy Piping Systems.

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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.

- D2122** Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2290** Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe
- D2565** Practice for Xenon-Arc Exposure of Plastics Intended for Outdoor Applications
- D2765** Test Methods for Determination of Gel Content and Swell Ratio of Crosslinked Ethylene Plastics
- D4218** Test Method for Determination of Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique
- D5596** Test Method for Microscopic Evaluation of the Dispersion of Carbon Black in Polyolefin Geosynthetics
- F412** Terminology Relating to Plastic Piping Systems
- F2657** Test Method for Outdoor Weathering Exposure of Crosslinked Polyethylene (PEX) Tubing
- F2829** Specification for Metric- and Inch-Sized Fittings for Crosslinked Polyethylene (PEX) Pipe
- F3203** Test Method for Determination of Gel Content of Crosslinked Polyethylene (PEX) Pipes and Tubing
- F3373** Specification for Polyethylene (PE) Electrofusion Fittings for Outside Diameter Controlled Crosslinked Polyethylene (PEX) Pipe
- 2.2 *Federal Standard*.³
- FED-STD-123** Marking for Shipment (Civil Agencies)
- 2.3 *Military Standard*.³
- MIL-STD-129** Marking for Shipment and Storage
- 2.4 *ISO Standards*.⁴
- ISO 1167** Thermoplastics pipes, fittings and assemblies for the conveyance of fluids — Determination of the resistance to internal pressure — Part 1: General method
- ISO 3126** Plastics piping systems – Plastics components – Determination of dimensions
- ISO 9080** Plastics piping and ducting systems—Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation
- ISO 12162** Thermoplastics materials for pipes and fittings for pressure applications— Classification and designation—Overall service (design) coefficient
- ISO 13477** Thermoplastics pipes for the conveyance of fluids — Determination of resistance to rapid crack propagation (RCP) — Small-scale steady-state test (S4 test)
- ISO 13760** Plastics pipes for the conveyance of fluids under pressure — Miner’s rule ~ Calculation method for cumulative damage
- ISO 14531-1** Plastics pipes and fittings — Crosslinked polyethylene (PEX) pipe systems for the conveyance of gaseous fuels — Metric series — Specifications — Part 1: Pipes
- ISO 18553** Method for the assessment of the degree of pigment or carbon black dispersion in polyolefin pipes, fittings and compounds.

2.5 PPI Publications:⁵

PPI TR-3 HDB/HDS/PDB/SDB/MRS/CRS Policies - 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), and Categorized Required Strength (CRS) Ratings for Thermoplastic Piping Materials or Pipe

PPI TR-4 HDB/HDS/SDB/PDB/MRS/CRS Listed Materials, PPI Listing of Hydrostatic Design Basis (HDB), Hydrostatic Design Stress (HDS), Strength Design Basis (SDB), Pressure Design Basis (PDB), Minimum Required Strength (MRS), Categorized Required Strength (CRS) Ratings for Thermoplastic Piping Materials or Pipe

3. Terminology

3.1 *Definitions*—Unless otherwise specified, definitions, abbreviations and initials are in accordance with Terminology **F412** and Terminology **D1600**.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *minimum required strength (MRS), n*—the categorized lower prediction limit (LPL) of the long-term hydrostatic strength in the circumferential, or hoop direction as established by ISO 9080 and ISO 12162.

3.2.1.1 *Discussion*—MRS is determined only at 20 °C and 50 years. For a design temperature other than 20 °C or a design time other than 50 years, CRS is used in place of MRS, as discussed in 3.2.2.

3.2.2 *categorized required strength (CRS) or CRS_(θ,t), n*—the categorized lower prediction limit (LPL) of the long-term hydrostatic strength at a specified temperature and time as determined in accordance with ISO 9080 and ISO 12162.

3.2.2.1 *Discussion*—CRS is used for a design time other than 50 years or a design temperature other than 20 °C. An example of the use of CRS is provided in **Appendix X2**. The CRS for PEX pipe is only determined after the MRS is established. CRS times range from 5 years to 100 years, and CRS temperatures range from 0 °C to 93 °C.

3.2.3 *nominal diameter, DN, adj*—a designation for SI unit outside diameter controlled pipe sizes.

3.2.4 *nominal pipe size, NPS, adj*—a designation for inch-pound unit outside diameter controlled pipe sizes.

3.2.5 *overall design coefficient (C), n*—a factor with a value of at least 1.25, which takes into consideration material properties (C_M) and application service conditions (C_A), as well as properties of the components of a piping system other than

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

⁴ Available from International Organization for Standardization (ISO), ISO Central Secretariat, Chemin de Blandonnet 8, CP 401, 1214 Vernier, Geneva, Switzerland, <https://www.iso.org>.

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

TABLE 1 Material Designations For PEX Pipe

Pipe Material Designation	MRS (20 °C and 50 years) MPa
PEX 80	8.0
PEX 100	10.0