



Standard Specification Fabricated Fittings of Crosslinkable Polyethylene (CX-PE)¹

This standard is issued under the fixed designation F3525/F3525M; 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 establishes requirements for fabricated fittings intended for use with outside-diameter controlled CX-PE pipe and tubing. These fittings are manufactured by heat-fusion joining shape-modified CX-PE components prepared from pipe, molded fittings, sheet, billet, or block. Included are requirements for materials, design, workmanship, minimum dimensions, marking, test methods, and quality control.

1.2 Pressure rating of the fabricated-fitting design is beyond the scope of this standard and shall be established by the fitting manufacturer.

1.3 Fittings manufactured in accordance with this specification are primarily intended to be joined to CX-PE pipes and used in CX-PE piping systems that are commissioned in accordance with a pipe manufacturer recommended commissioning practice. In addition, fittings manufactured in accordance with this specification that are $\geq 65\%$ crosslinked prior to installation can meet the additional requirements of Specification F2829.

1.4 The pressure rating determined for a fitting will result in the fittings' equivalent dimension ratio (EDR). The EDR specified by the fitting manufacturer is the DR of the piping system for which the fabricated fitting is intended to be joined. This standard specifies that fittings be fabricated from pipe sections of a lower DR than pipe that the fabricated fitting is intended to be joined to. This standard follows the pattern of Specification F2206 which specifies that the wall thickness of fabricated multiple segment elbow fittings shall be a minimum of 22 % more than the pipe to be joined to for example.

NOTE 1—Increased wall thickness alone is not necessarily sufficient to produce fittings adequate for use. Increased wall thickness without consideration of proper material placement can be detrimental to performance. Finite element analysis studies have shown that abrupt changes in fitting wall sections, such as between a heavy socket hub and body wall, concentrates stress at the transition point. Normal stresses from flex, pressure, expansion, and contraction in a plastic piping system can break a fitting at this point. Short transitions from 22 % thicker fittings to pipe

or tubing create a similar condition.

1.5 Design of fabricated fittings is outside of the scope of this standard. Requirements related to thicknesses and taper angles are intended to differentiate potentially good, fabricated fittings from fittings with a high risk of failure. Users of the standard are advised that for large or made-to-order fittings, minimal testing is required by this standard, and it may be insufficient itself to identify improperly designed and produced fittings made in accordance with this standard. The design and production of fittings made in accordance with this standard shall be performed by a fabricator with appropriate training, equipment and knowledge of fitting design and production.

1.6 Pipe used to fabricate fittings in accordance with this specification shall be produced in accordance with pipe manufacturer specifications.

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

1.8 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Non-conformance with this practice is possible if values from the two systems are combined. Values in parentheses are conversions that are appropriately rounded for accuracy and precision; that are not exact equivalents, and that are for non-mandatory informational purposes.

1.9 The following safety hazards caveat pertains only to the pressure test requirements 6.3 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.*

1.10 *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.*

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.

Current edition approved Nov. 1, 2021. Published November 2021. DOI: 10.1520/E3525_F3525M-21

2. Referenced Documents

2.1 ASTM Standards:²

- D638** Test Method for Tensile Properties of Plastics
- 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
- F412** Terminology Relating to Plastic Piping Systems
- F2206** Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)
- F2829** Specification for Metric- and Inch-Sized Fittings for Crosslinked Polyethylene (PEX) Pipe
- F2880** Specification for Lap-Joint Type Flange Adapters for Polyethylene Pressure Pipe in Nominal Pipe Sizes $\frac{3}{4}$ in. to 65 in.
- F2928** Practice for Specimens and Testing Conditions for Testing Polyethylene (PE) Pipe Butt Fusions Using Tensile and Hydrostatic Test Methods
- F3183** Practice for Guided Side Bend Evaluation of Polyethylene Pipe Butt Fusion Joint
- F3203** Test Method for Determination of Gel Content of Crosslinked Polyethylene (PEX) Pipes and Tubing
- F3507** Practice for Butt-Fusion Joining of Crosslinkable Polyethylene (CX-PE) Pipe and Tubing

2.2 Other Standards:

- AWWA C906-15** Polyethylene (PE) Pressure Pipe and Fittings, 4 in. Through 65 in. (100 mm Through 1650 mm), for Waterworks³
- FED-STD 123G** Marking for Shipment (Civil Agencies)⁴
- Military Standard 129P** Military Marking for Shipment and Storage⁴

3. Terminology

3.1 Definitions and abbreviations used are in accordance with Terminology **F412** and with Terminology **D1600**, unless otherwise specified.

3.2 Definitions:

3.2.1 *crosslinkable polyethylene, (CX-PE), n*—polyethylene compound that has been chemically modified so that crosslinks will form when the compound is exposed to heat and moisture at the same time, with the possibility of the final crosslinking taking place after installation of pipe made from CX-PE compound.

3.2.1.1 *Discussion*—CX-PE pipe is minimally crosslinked and is best butt fused before the level of crosslinking reaches 30 %. When pipe made from CX-PE reaches a level of

crosslinking ≥ 65 % it is considered crosslinked pipe. The pipe manufacturer measures the crosslinking level of CX-PE by performing a gel content test.

3.2.2 *equivalent dimension ratio (EDR), n*—the DR of the pipe to which the fabricated fitting is permitted to be joined.

3.2.2.1 *Discussion*—A fabricated fitting made in accordance with this standard will have a thicker wall than the pipe to which it is intended to be joined. Fitting ends are to be machined so that the fitting end matches the dimensional specifications of the pipe to which it is to be joined. Greater fitting body thickness is necessary to assure that the fittings have adequate strength in service.

3.2.3 *fitting end(s), n*—the end(s) of the fabricated fitting intended for field joining by the installer.

3.2.4 *fabricated fitting, n*—a fitting constructed from manufactured CX-PE components or materials.

4. Ordering Information

4.1 When ordering fittings under this specification include the following information:

4.1.1 CX-PE compound (material designation or trade name). The material designation shall match the pipe that the fabricated fitting is intended to be joined to.

4.1.2 Style of fitting (for example: 3-piece tee, 5-segment 90° ell, etc.).

4.1.3 *Size:*

4.1.3.1 Nominal size of end connections.

4.1.3.2 End configurations (for example, metric or inch, socket, or flange).

4.1.3.3 System DR.

5. Material

5.1 CX-PE materials allowed for use in fittings produced in accordance with this specification shall be in accordance with the manufacturer's fabricated-fitting design specifications.

5.2 CX-PE pipe used in the production of fittings in accordance with this specification shall meet the requirements of the applicable CX-PE pipe specification.

5.3 Flange adaptors used in the production of fabricated fittings in accordance with this specification shall meet purchaser requirements.

NOTE 2—Dimensions of CX-PE flange adaptors should be in accordance with Specification **F2880**. A CX-PE flange adaptor specification using dimensions and tolerances like those specified in Specification **F2880** is expected to be developed later.

5.4 Sheet, block or plate stock used in the production of fabricated fittings shall be produced from the same material designation of CX-PE compound. (See 4.1.1.)

NOTE 3—Manufacturers should use appropriate quality assurance procedures to ensure that sheet, block, and plate are free from voids, laminations, foreign inclusions, cracks, and other injurious defects. Manufacturers should also store all CX-PE pipe, sheet, block, or plate stock in as cool and dry a location as possible before fabrication. Storage should be for a minimal amount of time and should avoid exposure to UV weathering.

5.5 CX-PE pipe, sheet, block, or plate stock used to fabricate fittings per this specification shall be produced from the

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

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