



Standard Specification for Polyethylene (PE) Electrofusion Fittings for Outside Diameter Controlled Crosslinked Polyethylene (PEX) Pipe¹

This standard is issued under the fixed designation F3373; 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 polyethylene (PE 4710) electrofusion fittings for use with outside diameter-controlled crosslinked polyethylene (PEX) pipe, covered by Specifications [F2788/F2788M](#), [F2905/F2905M](#) and [F2968/F2968M](#). As stated in these PEX pipe standards, the PEX pipes joined to these PE 4710 electrofusion fittings have an HDB of 1250 psi or 1600 psi at 73 °F (23 °C) per Test Method [D2837](#). Requirements for all metric-sized and inch-sized fittings for use with PEX pipe, made in accordance to these three pipe standards, are specified in Specification [F2829/F2829M](#).

1.2 The maximum allowable operating temperature of electrofusion fittings made in accordance with this standard is limited to the highest temperature at which the HDB of the PE 4710 has been determined. When joined to PEX pipe having a higher temperature HDB, the maximum use temperature for the PE/PEX joint is limited to the elevated temperature HDB rating of the PE material in the fitting

NOTE 1—PEX and PE 4710 materials can have different elevated temperature ratings, and when joined together, the lower maximum elevated temperature rating will limit the maximum operating temperature. Per [Table 1](#), the required PE 4710 material must have an HDB at 140 °F (60 °C), but may have an HDB at 180 °F (82 °C). PEX pipes generally have HDB ratings at 180 °F (82 °C) or 200 °F (93 °C) or both. When joined to PEX pipe, PE 4710 electrofusion fittings made in accordance with this standard may limit the maximum operating temperature to 140 °F (60 °C) where the PE 4710 material used does not have an optional higher temperature HDB rating.

1.3 Requirements for materials, workmanship, and qualification testing performance are included. The PE electrofusion fitting manufacturer shall assure that fittings produced in accordance with this specification comply with all the requirements of this specification. If a PEX pipe manufacturer deems that their pipe is suitable for joining to polyethylene (PE) electrofusion fittings, the PEX pipe manufacturer shall qualify their PEX pipe by testing joints made with these PE electrofusion fittings, and assuring that the joints meet the performance requirements of this specification.

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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1.4 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.

1.5 The following safety hazards caveat pertains only to the test method portion, Section 9, 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.*

1.6 *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

- [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](#)
- [D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products](#)
- [D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials](#)
- [F412 Terminology Relating to Plastic Piping Systems](#)
- [F905 Practice for Qualification of Polyethylene Saddle-Fused Joints](#)
- [F1473 Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins](#)

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.

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

TABLE 1 Specification D3350 Classification Requirements and Properties of Polyethylene Electrofusion Fitting Materials

Physical Properties	Cell Classification and Properties for PE 4710 Material
Density	4
Melt Index	4
Flexural Modulus	>5
Tensile Strength	>5
Slow Crack Growth Resistance (Test Method F1473)	7
Hydrostatic Strength Classification	4
Specification D3350 Additive Code	C or E
Minimum HDB at 73 °F (23 °C), psi (MPa)	1600 (11.03)
Minimum HDS at 73 °F (23 °C), psi (MPa)	1000 (6.95)
Minimum HDB at 140 °F (60 °C), psi (MPa)	1000 (6.95)
Minimum HDB at 180 °F (82 °C), psi (MPa) – if applicable	800 (5.51)

[F2788/F2788M Specification for Metric and Inch-sized Crosslinked Polyethylene \(PEX\) Pipe](#)

[F2829/F2829M Specification for Metric- and Inch-Sized Fittings for Crosslinked Polyethylene \(PEX\) Pipe](#)

[F2905/F2905M Specification for Crosslinked Polyethylene \(PEX\) Line Pipe For Oil and Gas Producing Applications](#)

[F2968/F2968M Specification for Crosslinked Polyethylene \(PEX\) Pipe for Gas Distribution Applications](#)

2.2 *PPI Standards*.³

[PPI TN-17 Crosslinked Polyethylene \(PEX\) Tubing Piping Materials or Pipe](#)

[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](#)

[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](#)

2.3 *ISO Standards*.⁴

[ISO 13954 Plastics pipe and fittings – Peel decohesion test for polyethylene \(PE\) electrofusion assemblies of nominal diameter greater than or equal to 90 mm](#)

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard*:

³ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

⁴ 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>.

3.2.1 *electrofusion, n*—a heat fusion joining process for fittings that have a heat source as an integral part of the fitting. Joining occurs when, in accordance with a specified procedure, electric energy is applied to the heat source during the procedure.

3.2.2 *fusion interface, n*—the surface in the heat fusion process where the plastic materials of the products being joined bond together.

3.2.3 *fusion zone length, n*—the total length of the melted material in the fitting cross-section under evaluation.

4. Materials and Manufacture

4.1 *Material requirements*—PE 4710 compounds suitable for use in the manufacture of electrofusion fittings under this specification shall meet the classification requirements of Specification D3350 as shown in Table 1, and shall meet the Specification D3350 requirements for brittleness temperature, thermal stability and tensile elongation. The material compound shall also have HDB and HDS ratings at 73 °F (23 °C) and HDB ratings at 140 °F (60 °C) or higher in accordance with Test Method D2837 and PPI TR-3 policies, and these PE material compounds shall be listed by a listing agency, such as PPI in TR-4, as PE4710 in accordance with policies and procedures no less restrictive than those in PPI TR-3.

4.2 *Additive Classes*—PE 4710 compounds meeting Specification D3350 code C, shall have 2.0 to 3.0 percent carbon black. PE 4710 compounds meeting Specification D3350 code E shall be colored with UV stabilizer.

4.3 *Rework Material*—Clean polyethylene material that met 4.1 and 4.2 before processing, free of any wire or contaminants, and generated from the fitting manufacturer's own production, shall be acceptable for use by the same manufacturer, provided that the fittings produced conform to the requirements of this specification. Rework material shall be blended with virgin material that complies with 4.1 and 4.2.

4.4 *Heating Mechanism*—The heat mechanism shall be of materials and design not detrimental to the performance of the fitting or the pipe to which it is intended to be joined. Heating mechanisms, such as wires or materials other than polyethylene, shall not exit the fitting in an area exposed to internal pressure. Heat mechanisms shall be of a design that ensures that wire terminations are toward the outer edges of the fusion zone length and away from the pressure containing area. Examples of acceptable and unacceptable wire terminations are shown in Figs. 1-5.

5. Performance Requirements

5.1 The following requirements are for electrofusion fitting joint designs, single or dual coil, and body designs that have been joined using the fitting manufacturer's recommended joining procedures. Each PE electrofusion fitting body size, body design and joint design shall meet the requirements in this section when joined to PEX pipe that complies with Specification F2788/F2788M, F2905/F2905M or F2968/F2968M. Fittings intended for use in the distribution of natural gas or liquid petroleum gas shall also meet the requirements of Specification F2968/F2968M.

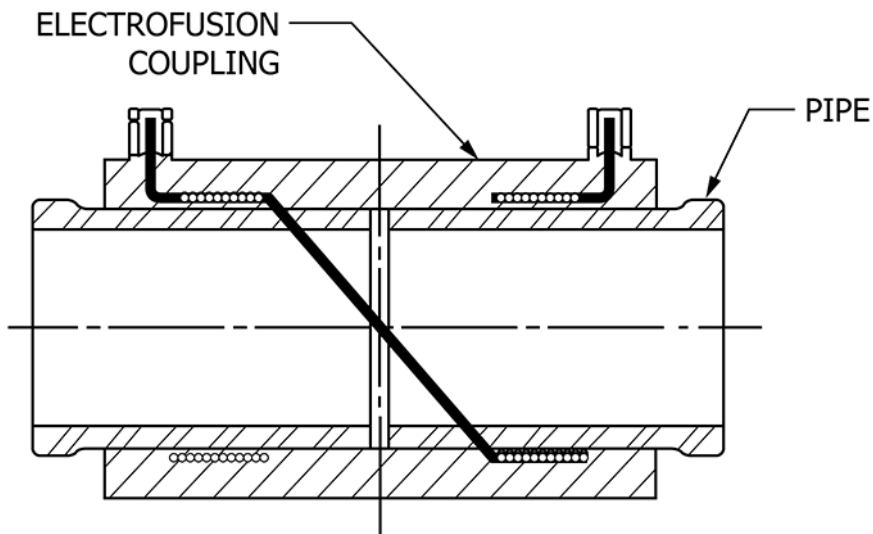


FIG. 1 Correct Wire Termination Coupling—Single Coil

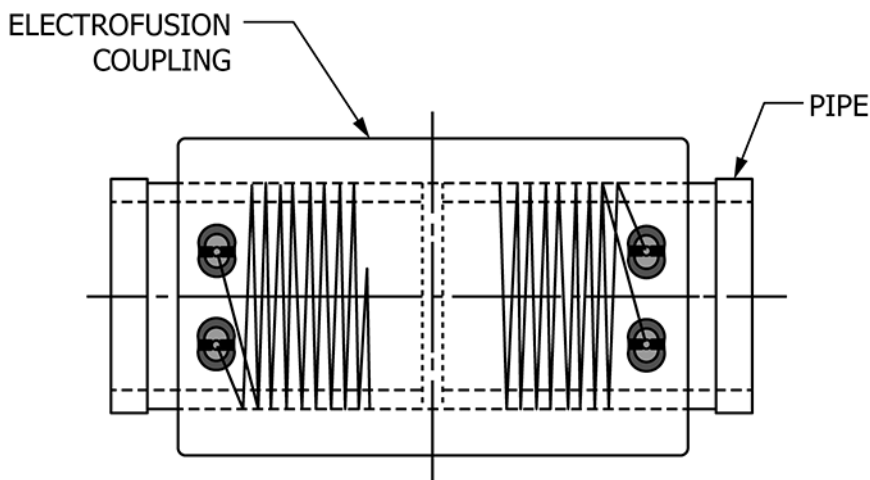


FIG. 2 Correct Wire Termination Coupling—Dual Coil

5.1.1 Any revisions to the electrofusion fitting body or joint design or processing by the manufacturer after the initial testing requires retesting to ensure these requirements can still be met.

NOTE 2—The user of these PE electrofusion fittings should contact the PEX pipe manufacturer to assure that joints between these PE electrofusion fittings and their type of PEX pipe meet the performance requirements of this specification.

5.1.2 Assemblies shall be limited to operating at the highest temperature at which the PE material used to make the fitting has an HDB rating per 4.1.

5.1.3 It is not intended that every PE electrofusion body design and body size be tested for compliance with these requirements. In general, testing the smaller and larger fitting configurations that are not more than 3 standard sizes different (such as NPS 2 to NPS 6) shall be acceptable for determining compliance of the intermediate sizes in the range. However, in determining the similarity or difference between various body designs (coupling, elbow, cross, wye, etc) resistance to internal

pressure stress concentrations, and resistance coil design and size shall be taken into account.

NOTE 3—For example, internal pressure fitting body stress concentrations between a coupling and a wye may differ significantly; whereas, internal pressure stress concentrations between a tee and a saddle may be similar. Likewise a single or dual coil design may be suitable for some body designs but not others, and scaling may be affected by outlet size.

5.1.4 Saddle fittings shall be joined in accordance with manufacturer’s recommendations to PEX main pipe. The PEX main pipe shall be perforated through the saddle branch outlet in accordance with manufacturer’s recommendations to the maximum perforation hole size recommended and shall be tested with branch outlet(s) joined using the manufacturer’s procedure to lengths of PEX pipe material for which the manufacturer recommends the use of his fitting. Lengths of PEX pipe joined to saddle fitting outlets shall be in accordance with 8.3.1.

5.2 Pressure Requirements: