



# Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter- Controlled Polyethylene Pipe and Tubing<sup>1</sup>

This standard is issued under the fixed designation D2683; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification covers polyethylene socket-type fittings for use with outside diameter-controlled polyethylene pipe as specified by Specifications [D3035](#) and [D2513](#). Requirements for materials, workmanship, dimensions, and pressure performance are included. Where applicable in this specification, “pipe” shall mean “pipe and tubing.”

1.2 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.

1.3 The following safety hazards caveat pertains only to the test method portion, Section 8, 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.*

1.4 *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:<sup>2</sup>

- [D618](#) Practice for Conditioning Plastics for Testing
- [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

<sup>1</sup> 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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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- [D1600](#) Terminology for Abbreviated Terms Relating to Plastics
- [D2122](#) Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- [D2513](#) Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings
- [D3035](#) Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
- [D3350](#) Specification for Polyethylene Plastics Pipe and Fittings Materials
- [F412](#) Terminology Relating to Plastic Piping Systems
- [F2620](#) Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
- 2.2 *Federal Standard:*
  - [Fed. Std. No. 123](#) Marking for Shipment (Civil Agencies)<sup>3</sup>
- 2.3 *Military Standard:*
  - [MIL-STD-129](#) Marking for Shipment and Storage<sup>3</sup>
- 2.4 *Plastic Pipe Institute*<sup>4</sup>
  - [PPI TR-3](#) Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe<sup>7</sup>
  - [PPI TR-4](#) HDB/SDB/PDB/MRS Listed Materials, 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 Definitions are in accordance with Terminology [F412](#) and abbreviations are in accordance with Terminology [D1600](#), unless otherwise specified. The abbreviation of polyethylene plastic is PE.

3.2 *standard thermoplastic pipe dimension ratio (SDR)*—the ratio of pipe outside diameter to wall thickness. It is

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

<sup>4</sup> Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

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

calculated by dividing the average outside diameter of the pipe by the minimum wall thickness.

**4. Classification**

4.1 This specification covers polyethylene fittings of the socket type made as specified in 5.1 and 5.2

4.1.1 Fittings covered by this specification are normally molded. In-line fittings such as couplings, unions, bushings, caps, nipples, etc., may be extruded or machined from extruded stock. Special fittings such as transition fittings and tapping teets shall be assembled and fabricated in accordance with procedures agreed upon between the manufacturer and the purchaser.

4.1.2 Fittings covered by this specification are intended to be joined by heat fusion to PE pipe.

4.1.3 Fittings intended for use in the distribution of natural gas or petroleum fuels shall also meet the requirements of Specification D2513.

**5. Materials**

5.1 *Polyethylene Compound*—Polyethylene material compounds suitable for use in the manufacture of fittings under this specification shall meet Specification D3350 and shall meet the Specification D3350 classification and property requirements in Table 1, and shall have PPI TR-4 HDB and HDS listings at 73°F (23°C) and HDB listings 140°F (60°C) in accordance with Table 1.

5.2 *Color and Ultraviolet (UV) Stabilization*—Polyethylene material compounds shall meet Specification D3350 code C or E. Code C material compounds shall have 2 to 3 percent carbon black. Code E material compounds shall be colored with UV stabilizer.

5.3 *Rework Material*—Clean polyethylene compound from the manufacturer’s own production that met 5.1 and 5.2 as virgin material is suitable for remolding into fittings, either alone or blended with new compound of the same cell classification or material designation. Fittings containing the rework material shall meet the material and product requirements of this specification.

**6. Requirements**

6.1 *Dimensions and Tolerances:*

6.1.1 Fittings, sockets, dimensions, and tolerances shall be as shown in Table 2 and Table 3 when measured in accordance with 8.4. For reducing fittings, socket and inside diameter minimums for the appropriate size shall apply.

6.1.1.1 *Laying Lengths*—Laying lengths shall be in accordance with manufacturer’s specifications.

6.1.2 The maximum angular variation of any opening shall not be more than 2° off the true centerline axis.

6.1.3 The minimum wall thickness of fittings shall be 125 % of the minimum wall thickness of the pipe with which they are designed to be joined. For reducing fittings, the smallest size wall thickness shall be 125 % of the smallest pipe wall.

6.2 *System Pressure Test Requirements:*

6.2.1 *Short-Term Rupture Strength*—The minimum short-term rupture strength of the fitting and fused pipe shall not be less than the minimum short-term rupture strength of the pipe or tubing in the system when tested in accordance with 8.5.2. The test pressures shall be as shown in Table 4. Test specimens shall be prepared for testing as described in 8.5.1.

6.2.2 *Sustained Pressure*—The fitting(s) and fused pipe or tubing shall not fail (as defined in the Descriptions of Terms Section of Test Method D1598) at the test pressures given in Table 5 when tested in accordance with 8.5.3. To ensure uniformity in preparation of assemblies for sustained pressure evaluation, all test joints shall be made in accordance with heat fusion practices found in Practice F2620.

**7. Workmanship, Finish, and Appearance**

7.1 The manufacture of these fittings shall be in accordance with good commercial practice so as to produce fittings meeting the requirements of this specification. Fittings shall be homogeneous throughout and free of cracks, holes, foreign inclusions, or injurious defects. The fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

**8. Test Methods**

8.1 *Conditioning*—Condition the test specimens at 73 ± 3.6 °F (23 ± 2 °C) for 40 h minimum prior to test in accordance with Procedure A of Methods D618, for those tests where conditioning is required and in all cases of disagreement.

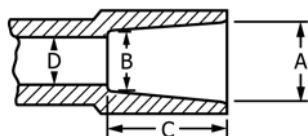
**TABLE 1 Specification D3350 Classification of Polyethylene Fittings Materials**

| Physical Properties                      | Cell Classification and Properties for Polyethylene Pipe Materials |            |            |            |            |             |            |             |
|------------------------------------------|--------------------------------------------------------------------|------------|------------|------------|------------|-------------|------------|-------------|
|                                          | PE2606                                                             | PE2706     | PE2708     | PE3608     | PE3708     | PE3710      | PE4708     | PE4710      |
| Density                                  | 2                                                                  | 2          | 2          | 3          | 3          | 3           | 4          | 4           |
| Melt Index                               | 3 or 4                                                             | 3 or 4     | 3 or 4     | 4          | 4          | 4           | 4          | 4           |
| Flexural modulus                         | ≥4                                                                 | ≥4         | ≥4         | ≥4         | ≥4         | ≥4          | ≥4         | ≥5          |
| Tensile Strength                         | ≥3                                                                 | ≥3         | ≥3         | ≥4         | ≥4         | ≥4          | ≥4         | ≥4          |
| Slow crack growth resistance (F1473)     | 6                                                                  | 7          | 7          | 6          | 7          | 7           | 7          | 7           |
| Hydrostatic strength classification      | 3                                                                  | 3          | 3          | 4          | 4          | 4           | 4          | 4           |
| Color and UV Stabilizer <sup>A</sup>     | C or E                                                             | C or E     | C or E     | C or E     | C or E     | C or E      | C or E     | C or E      |
| HDB at 140°F (60°C), PPI TR-4, psi (MPa) | B                                                                  | B          | B          | B          | B          | B           | B          | B           |
| HDB at 73°F (23°C), PPI TR-4, psi (MPa)  | 630 (4.34)                                                         | 630 (4.34) | 800 (5.52) | 800 (5.52) | 800 (5.52) | 1000 (6.90) | 800 (5.52) | 1000 (6.90) |

<sup>A</sup>See 5.2.

<sup>B</sup>Listing required; consult manufacturer for listed value.

TABLE 2 Fittings for Outside Diameter-Controlled Polyethylene Pipe<sup>A</sup>



| Nominal Pipe Size, in., | A Socket Entrance Diameter <sup>B</sup> |                                          |                      | B Socket Bottom Diameter <sup>C,D</sup> |                                          |                      | C                 | D                |                   |
|-------------------------|-----------------------------------------|------------------------------------------|----------------------|-----------------------------------------|------------------------------------------|----------------------|-------------------|------------------|-------------------|
|                         | Average Diameter                        | Tolerance on Diameter                    | Maximum Out-of-Round | Average Diameter                        | Tolerance on Diameter                    | Maximum Out-of-Round | Socket Depth, min | Inside Diameter  |                   |
|                         |                                         |                                          |                      |                                         |                                          |                      |                   | min              | max               |
| 1/2                     | 0.810<br>(20.57)                        | +0.005<br>(+0.127)<br>-0.010<br>(-0.254) | ±0.008<br>(±0.203)   | 0.804<br>(20.42)                        | +0.005<br>(+0.127)<br>-0.026<br>(-0.660) | ±0.008<br>(±0.203)   | 0.625<br>(15.88)  | 0.648<br>(16.46) | 0.804<br>(20.42)  |
| 3/4                     | 1.020<br>(25.91)                        | ±0.008<br>(±0.203)                       | ±0.010<br>(±0.254)   | 1.012<br>(25.70)                        | +0.008<br>(+0.203)<br>-0.012<br>(-0.305) | ±0.010<br>(±0.254)   | 0.625<br>(15.88)  | 0.814<br>(20.68) | 1.020<br>(25.91)  |
| 1                       | 1.275<br>(32.38)                        | ±0.008<br>(±0.203)                       | ±0.010<br>(±0.254)   | 1.267<br>(32.18)                        | +0.008<br>(+0.203)<br>-0.012<br>(-0.305) | ±0.010<br>(±0.254)   | 0.687<br>(17.4)   | 1.020<br>(25.91) | 1.275<br>(32.38)  |
| 1 1/4                   | 1.620<br>(41.15)                        | ±0.008<br>(±0.203)                       | ±0.012<br>(±0.305)   | 1.612<br>(40.94)                        | +0.008<br>(+0.203)<br>-0.016<br>(-0.406) | ±0.012<br>(±0.305)   | 0.875<br>(22.22)  | 1.301<br>(33.04) | 1.620<br>(41.15)  |
| 1 1/2                   | 1.860<br>(47.24)                        | ±0.010<br>(±0.254)                       | ±0.012<br>(±0.305)   | 1.849<br>(46.96)                        | +0.010<br>(+0.254)<br>-0.020<br>(-0.508) | ±0.012<br>(±0.305)   | 0.875<br>(22.22)  | 1.496<br>(38.0)  | 1.859<br>(47.22)  |
| 2                       | 2.335<br>(59.31)                        | ±0.010<br>(±0.254)                       | ±0.012<br>(±0.305)   | 2.324<br>(59.03)                        | +0.010<br>(+0.254)<br>-0.020<br>(-0.508) | ±0.012<br>(±0.305)   | 0.875<br>(22.22)  | 1.885<br>(47.88) | 2.334<br>(59.28)  |
| 3                       | 3.455<br>(87.76)                        | ±0.015<br>(±0.381)                       | ±0.015<br>(±0.381)   | 3.439<br>(87.35)                        | +0.015<br>(+0.381)<br>-0.025<br>(-0.635) | ±0.015<br>(±0.381)   | 1.000<br>(25.4)   | 2.780<br>(70.61) | 3.454<br>(87.73)  |
| 4                       | 4.450<br>(113.03)                       | ±0.015<br>(±0.381)                       | ±0.015<br>(±0.381)   | 4.434<br>(112.62)                       | +0.015<br>(+0.381)<br>-0.035<br>(-0.889) | ±0.015<br>(±0.381)   | 1.125<br>(28.58)  | 3.575<br>(90.80) | 4.449<br>(113.00) |

<sup>A</sup> Minimum dimensions have zero negative tolerance. The sketches and designs of fittings are illustrative only. Entrance chamfer or radius is optional.

<sup>B</sup> Measured at top of socket wall taper, just below entrance radius.

<sup>C</sup> Dimensions of tools should be checked for consistency with fittings used. Socket bottom diameter must be equal to or smaller than entrance diameter.

<sup>D</sup> Measured at bottom of socket wall taper, just above bottom radius.

8.2 Test Conditions—Conduct tests at the standard laboratory temperature of 73 ± 3.6 °F (23 ± 2 °C).

8.3 Sampling—Select at random sufficient quantity of fittings from each lot of shipment and test to determine that the basic properties and dimensions are in conformance with this specification.

NOTE 1—For individual orders or specifications, only those tests and numbers of tests specifically agreed upon between the purchaser and the manufacturer need be conducted.

8.4 Dimensions—Measure in accordance with Test Method D2122.

8.4.1 Maximum out-of-round tolerance on sockets applies to the actual measured average inside diameter.

NOTE 2—Example—In the 1-in. IPS size, if the actual measured average inside socket entrance diameter was 1.281 in. (32.54 mm) then the extreme measured diameters due to ovality can be 1.291 in. (32.79 mm) maximum and 1.271 in. (32.28 mm) minimum when the out-of-round tolerance is ±0.010 in. (2.54 mm).

8.5 Pressure Test:

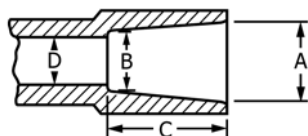
8.5.1 Prepare test assemblies in such a manner that each, whether individual fittings or groups of fittings, is a system incorporating at least one length of pipe or tubing and one or more fittings in addition to end closures. Fuse all fittings' outlets with the appropriate size pipe or tubing. One piece of pipe in the system shall have a minimum length equal to five pipe diameters.

8.5.2 Short-Term Rupture Test—The test equipment, procedures, and failure definition shall be as specified in Test Method D1599. Increase the hydrostatic pressure at a uniform rate such that the specimen fails between 60 and 70 s from the start of the test. Minimum failure pressures are shown in Table 4.

8.5.3 Sustained Pressure Test—Prepare six fitting specimens as prescribed in 8.5.1

8.5.3.1 Sustained pressure tests shall be conducted in accordance with Table 5 and Test Method D1598 using water as the

TABLE 3 Fittings for Outside Diameter-Controlled Polyethylene Tubing<sup>A</sup>



| Nominal Tubing Size, in. | A Socket Entrance Diameter <sup>B</sup> |                                        |                      | B Socket Bottom Diameter <sup>C,D</sup> |                                        |                      | C                 | D                |                  |
|--------------------------|-----------------------------------------|----------------------------------------|----------------------|-----------------------------------------|----------------------------------------|----------------------|-------------------|------------------|------------------|
|                          | Average Diameter                        | Tolerance on Diameter                  | Maximum Out-of-Round | Average Diameter                        | Tolerance on Diameter                  | Maximum Out-of-Round | Socket Depth, min | min              | max              |
|                          | in. (mm)                                |                                        |                      |                                         |                                        |                      |                   |                  |                  |
| 1/2                      | 0.585<br>(14.86)                        | +0.010<br>(+0.25)<br>-0.007<br>(-0.18) | ±0.010<br>(±0.25)    | 0.575<br>(14.61)                        | +0.010<br>(+0.25)<br>-0.007<br>(-0.18) | ±0.010<br>(±0.25)    | 0.625<br>(15.88)  | 0.500<br>(12.70) | 0.585<br>(14.86) |
| 3/4                      | 0.835<br>(21.21)                        | ±0.010<br>(±0.25)                      | ±0.010<br>(±0.25)    | 0.825<br>(20.96)                        | ±0.010<br>(±0.25)                      | ±0.010<br>(±0.25)    | 0.625<br>(15.88)  | 0.750<br>(19.05) | 0.835<br>(21.21) |
| 1                        | 1.075<br>(27.30)                        | ±0.008<br>(±0.20)                      | ±0.008<br>(±0.20)    | 1.070<br>(27.18)                        | +0.008<br>(+0.20)<br>-0.012<br>(-0.30) | ±0.008<br>(±0.20)    | 0.625<br>(15.88)  | 0.850<br>(21.59) | 1.078<br>(27.38) |
| 1 1/4                    | 1.330<br>(33.78)                        | ±0.008<br>(±0.20)                      | ±0.010<br>(±0.25)    | 1.322<br>(33.58)                        | ±0.008<br>(±0.20)                      | ±0.010<br>(±0.25)    | 0.687<br>(17.45)  | 1.250<br>(31.75) | 1.330<br>(33.78) |

<sup>A</sup> Minimum dimensions have zero negative tolerance. The sketches and designs of fittings are illustrative only. Entrance chamfer or radius is optional.

<sup>B</sup> Measured at top of socket wall taper, just below entrance radius.

<sup>C</sup> Dimensions of tools should be checked for consistency with fittings used. Socket bottom diameter must be equal to or smaller than entrance diameter.

<sup>D</sup> Measured at bottom of socket wall taper, just above bottom radius.

TABLE 4 Quick Burst Minimum Hoop Stress Requirements for Water At 73°F (23°C) for SDR-PR PE Plastic Pipe Fittings<sup>A, B</sup>

| Material                        | psi  | (MPa)   |
|---------------------------------|------|---------|
| Density Class 2 materials       | 2500 | (17.24) |
| Density Class 3 and 4 materials | 2900 | (20.00) |

<sup>A</sup> For outside diameter controlled pipe, calculate internal test pressure in accordance with the following formula:

$$P = \frac{2S}{\left(\frac{D_o}{t} - 1\right)}$$

Where:

- P = test pressure, psig (kPa)
- S = test pressure hoop stress, psi. (kPa)
- D<sub>o</sub> = measured outside diameter, in. (mm), and
- t = measured minimum wall thickness, in (mm)

<sup>B</sup>Fiber Stress listed are to be calculated on the pipe being used in the test, not the fitting.

pressurizing medium. The “test sample” shall be three specimens. Select one Table 5 Condition for the material designation and test the three specimen test sample.

8.5.3.2 Passing results are (a) non-failure for all three specimens at a time equal to or greater than the “minimum average time before failure”, or (b) not more than one ductile specimen failure and the average time before failure for all three specimens shall be greater than the specified “minimum average time before failure” for the selected Table 5 Condition. For Table 5 Conditions 1 through 5: if more than one ductile failure occurs before the “minimum average time before failure”, it is permissible to conduct one retest at a Table 5 Condition of lower stress and longer minimum average time before failure for the material designation. For Table 5 Condition 6 no retest is permissible. Brittle failure of any specimen

before the Table 5 “minimum average time before failure” constitutes failure to meet this requirement and no retest is allowed.

8.5.3.3 Provision for retest (if needed). The retest sample shall be three specimens of the same pipe or tubing size and material designation from the same time frame as the “test sample”. For the retest, any specimen failure before the “minimum average time before failure” at the retest condition of lower stress and longer minimum average time before failure constitutes failure to meet this requirement.

## 9. Packaging and Package Marking

9.1 Fittings shall be marked with the following:

9.1.1 Manufacturer’s name or trademark,

9.1.2 Material designation (such as, PE 27086, PE 3608, or PE 4710),

NOTE 3—Earlier editions of Specification D2683 included PE material designations PE2406, PE3406, PE3407 and PE3408. Changes to Specification D3350 and PPI TR-3 led to changes in thermoplastic material designation codes, resulting in material designation PE2406 being superseded by material designations PE2606 and PE2708, material designation PE3406 being superseded by PE3606, material designation PE3407 being discontinued, and material designation PE3408 being superseded by material designations PE3608, PE3708, PE3710, PE4708 and PE4710. Recognizing that a period of time is necessary for the dissemination of information and to update specifications and literature, during the transitional period, product markings that include both older and newer materials designations, for example PE2406/PE2606, may occur.

9.1.3 Fittings intended for the transport of potable water shall include the seal or mark of the laboratory making the evaluation for this purpose,

9.1.4 Size, and

9.1.5 This designation number, D2683.