Designation: D3261 – 16

Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing[1]

This standard is issued under the fixed designation D3261; 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.

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

1. Scope*

1.1 This specification covers polyethylene (PE) butt fusion fittings for use with polyethylene pipe (IPS, DIPS, and ISO) and tubing (CTS). Included are requirements for materials, workmanship, dimensions, marking, sustained pressure, and burst pressure.

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.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

D2513 Specification for Polyethylene (PE) Gas Pressure Pipe, Tubing, and Fittings

D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials

F412 Terminology Relating to Plastic Piping Systems

F2206 Specification for Fabricated Fittings of Butt-Fused Polyethylene (PE)

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[3]

2.3 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage[3]

2.4 *National Sanitation Foundation Standard:*

Standard No. 14 for Plastic Piping Components and Related Materials[4]

2.5 *Plastic Pipe Institute*[5]

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 Pipe7

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.

3.2 *Definitions:*

3.2.1 *butt fusion fitting, n*—a fitting have one or more outlets that can be butt fusion joined to pipe, tubing, or fitting.

3.2.2 *dimension ratio (DR) for thermoplastic pipe*—the ratio of diameter to wall thickness. For this specification it is calculated by dividing the specified outside diameter by the specified wall thickness of the fitting at its area of fusion. DRs are rounded and do not calculate exactly.

4. Classification

4.1 *General*—This specification covers butt fusion fittings intended for use with polyethylene pipe and tubing.

4.1.1 Fittings covered by this specification are molded or machined from extruded or molded stock. Fittings covered by this specification may be produced by joining together one or

[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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[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] DLA Document Services Building 4/D 700 Robbins Avenue Philadelphia, PA 19111-5094 http://quicksearch.dla.mil/

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

[5] 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**

more fittings meeting this specification using butt or saddle heat fusion joining methods. Fittings that are butt fusion joined to a length of pipe or tubing (a pup) meeting the end-use system specification are acceptable.

4.1.2 Fittings fabricated by other types of thermal welding methods, such as extrusion welding, hot-air welding, and ultrasonic welding are not included in this specification.

4.1.3 Fittings fabricated with mitered heat fusion joints are covered by Specification F2206, and are not included in this specification

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

5. Ordering Information

5.1 When ordering fittings under this specification, the following should be specified:

5.1.1 Polyethylene compound (material designation or trade name)

5.1.2 Style of fitting (tee, 90° ell, and the like)

5.1.3 Size:

5.1.3.1 Nominal diameter.

5.1.3.2 CTS, IPS, DIPS, or schedule.

5.1.3.3 Dimension ratio number or schedule number.

6. Materials

6.1 *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 inTable 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.

6.2 *Color and Ultraviolet (UV) Stabilization*—Polyethylene material compounds shall meet Specification Table 1 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.

6.3 *Rework Material*—Clean polyethylene compound from the manufacturer's own production that met 6.1 and 6.2 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.

7. Requirements

7.1 *Dimensions and Tolerances:*

7.1.1 *Outside Diameter*—Nominal outside diameters of butt fusion fittings shall conform to the nominal iron pipe size (IPS), ductile iron pipe size (DIPS)or copper tubing size (CTS) dimensions at area of fusion. These dimensions and tolerances shall be as shown in Table 2, Table 3, Table 4 and of this specification.

7.1.2 *Inside Diameter (CTS Fittings Only)*—Inside diameters of butt fusion fittings for tubing at area of fusion shall conform to the dimensions of the tubing being joined. The dimensions and tolerances for the fittings are shown in Table 5.

7.1.3 *Wall Thickness*—The wall thicknesses of butt fusion fittings shall not be less than the minimum specified for the pipe or tubing. The wall thicknesses and tolerances at the area of fusion shall be as shown in Table 5, Table 6, Table 7, and Table 8 of this specification.

7.1.4 *Measurements*—These shall be made in accordance with Test Method D2122 for roundable pipe.

7.1.5 *Design Dimensions*—Overall fitting dimensions may be as preferred from a design standpoint by the manufacturer and accepted by the purchaser consistent with 7.1.3.

7.1.6 *Special Sizes*—Where existing system conditions or special local requirements make other diameters or dimension ratios necessary, other sizes or dimension ratios, or both, shall be acceptable for engineered applications when mutually agreed upon by the customer and the manufacturer, if the fitting is manufactured from plastic compounds meeting the material requirements of this specification, and the strength and design requirements are calculated on the same basis as those used in this specification. For diameters not shown in Table 2, Table 3 or Table 4, the tolerance shall be the same percentage as that shown in the corresponding tables for the next smaller listed size. Minimum wall thickness for these special sizes shall not be less than the minimum wall specified for the pipe or tubing the fitting is designed to be used with. The maximum wall

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[A]	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)

[A] See 6.2.

[B] Listing required; consult manufacturer for listed value.

TABLE 2 IPS Sizing System Outside Diameters and Tolerances for Fittings for Use with Polyethylene Pipe, in.

Nominal Pipe Size	Average Outside Diameter at Area of Fusion[A]	Tolerance
½	0.840	±0.008
¾	1.050	±0.008
1	1.315	±0.010
1¼	1.660	±0.010
1½	1.900	±0.010
2	2.375	±0.010
3	3.500	±0.012
4	4.500	±0.015
6	6.625	±0.018
8	8.625	±0.025
10	10.750	±0.027
12	12.750	±0.036
14	14.000	±0.063
16	16.000	±0.072
18	18.000	±0.081
20	20.000	±0.090
21.5	21.500	±0.097
22	22.000	±0.099
24	24.000	±0.108
28	28.000	±0.126
32	32.000	±0.144
36	36.000	±0.162
42	42.000	±0.189
48	48.000	±0.216

[A] Defined as measured ¼ to ½ in. (6.4 to 12.7 mm) from fitting outlet extremity.

TABLE 3 DIPS Sizing System Outside Diameters and Tolerances for Fittings for Use with Polyethylene Pipe, in.

Nominal Pipe Size	Average Outside Diameter at Area of Fusion	Tolerance[A]
3	3.96	±0.016
4	4.80	±0.022
6	6.90	±0.031
8	9.05	±0.041
10	11.10	±0.050
12	13.20	±0.059
14	15.30	±0.069
16	17.40	±0.078
18	19.50	±0.088
20	21.60	±0.097
24	25.80	±0.116
30	32.000	±0.144
36	38.30	±0.172
42	44.50	±0.200
48	50.80	±0.229

[A] Defined as measured ¼ to ½ in. (6.4 to 12.7) from fitting outlet extremity.

thickness allowed shall not be greater than 20 % thicker than the specified minimum wall, and shall be determined by 10.4.3 of this specification.

7.2 *Pressure Test Requirements :*

7.2.1 *Short-Term Rupture Strength for Fittings* ½ to 12 in. and 90 to 315 mm, Nominal Diameter—The minimum short-term rupture strength of the fitting and fused pipe or tubing shall not be less than the minimum short-term rupture strength of the pipe or tubing in the system when tested in accordance with 10.5.3. These minimum pressures shall be as shown in Table 9 of this specification. Test specimens shall be prepared for testing in the manner described in 10.5.1 of this specification. The test equipment, procedures, and failures definitions shall be as specified in Test Method D1599.

TABLE 4 ISO Sizing System (ISO 161/1) Outside Diameters and Tolerances for Fit for Use with Polyethylene Pipe, mm

Nominal Pipe Size	Average Outside Diameter at Area of Fusion	
	Min	Max[A]
90	90.0	90.8
110	110.0	111.0
160	160.0	161.4
200	200.0	201.8
250	250.0	252.3
280	280.0	282.5
315	315.0	317.8
355	355.0	358.2
400	400.0	403.6
450	450.0	454.1
500	500.0	504.5
560	560.0	565.0
630	630.0	635.7
710	710.0	716.4
800	800.0	807.2
900	900.0	908.1
1000	1000.0	1009.0
1200	1200.0	1210.8
1400	1400.0	1412.6
1600	1600.0	1614.4

[A] Specified in ISO 3607.

7.2.2 *Short-Term Strength for Fittings 14 to 48 in. and 355 to 1600 mm, Nominal Diameter*—Fittings shall not fail when tested in accordance with 10.5.4. The minimum pressure shall be as shown in Table 9 of this specification. Test specimens shall be prepared for testing in the manner described in 10.2 of this specification. The test equipment and procedures shall be as specified in Test Method D1599.

7.2.3 *Sustained Pressure*—The fitting and fused pipe or tubing shall not fail, as defined in Test Method D1598, when tested at the time, pressures, and test temperatures selected from test options offered in Table 10. The test specimens shall be prepared for testing in the manner prescribed in 10.5.1.

8. Workmanship, Finish, and Appearance

8.1 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 other injurious defects. The fittings shall be as uniform as commercially practicable in color, opacity, density, and other physical properties.

9. Sampling

9.1 Parts made for sale under this specification should be sampled at a frequency appropriate for the end use intended. When the fittings are to be installed under a system specification (such as Specification D2513 for gas), the minimum requirements of that specification must be satisfied.

10. Test Methods

10.1 *General*—The test methods in this specification cover fittings to be used with pipe and tubing for gas, water, and other engineered piping systems. Test methods that are applicable from other specifications will be referenced in the paragraph pertaining to the particular test. Certain special test methods

TABLE 5 Diameter, Wall Thickness, and Tolerances for Fittings for Use with Plastic Tubing

Tubing Type in. (mm)	Nominal Tubing Size, in.	Diameter at Area of Fusion[A]				Minimum Wall Thickness, in. (mm)
		Outside, in. (mm)		Inside, in. (mm)		
		Average	Tolerance	Average	Tolerance	
0.062 (1.57)	½ CTS	0.625 (15.88)	±0.010 (±0.26)	0.495 (12.58)	±0.004 (±0.10)	0.062 (1.58)
	¾ CTS	0.875 (22.22)	± 0.010 (±0.26)	0.745 (18.92)	...	...
0.090 (2.29)	½ CTS	0.625 (15.88)	±0.010 (±0.26)	0.437 (11.10)	±0.004 (±0.10)	0.090 (2.28)
	¾ CTS	0.875 (22.22)	±0.010 (±0.26)	0.687 (17.44)	±0.004 (±0.10)	0.090 (2.28)
	1 CTS	1.125 (28.58)	±0.013 (±0.34)	0.937 (23.80)	±0.005 (±0.12)	0.090 (2.28)
	1¼ CTS	1.375 (34.92)	±0.013 (±0.34)	1.187 (30.14)	±0.005 (±0.12)	0.090 (2.28)
DR 11	¾ CTS	0.875 (22.22)	±0.010 (±0.26)	0.715 (18.16)	±0.004 (±0.10)	0.077 (1.96)
	1 CTS	1.125 (28.58)	±0.013 (±0.34)	0.915 (23.24)	±0.005 (±0.12)	0.101 (2.56)
	1¼ CTS	1.375 (34.92)	±0.013 (±0.34)	1.125 (28.58)	±0.005 (±0.12)	0.121 (3.08)
	1½ CTS	1.625 (41.23)	±0.013 (±0.34)	1.321 (33.55)	±0.005 (±0.12)	0.148 (3.76)
	2 CTS	2.125 (53.98)	±0.013 (±0.34)	1.731 (43.97)	±0.005 (±0.12)	0.193 (4.90)
DR 9.3	½ CTS	0.625 (15.88)	±0.010 (±0.26)	0.483 (12.26)	±0.004 (±0.10)	0.067 (1.70)
	¾ CTS	0.875 (22.22)	±0.010 (±0.26)	0.679 (17.24)	±0.004 (±0.10)	0.094 (2.38)
	1 CTS	1.125 (28.58)	±0.013 (±0.34)	0.873 (22.18)	±0.005 (±0.12)	0.121 (3.08)
	1¼ CTS	1.375 (34.92)	±0.013 (±0.34)	1.069 (27.16)	±0.005 (±0.12)	0.148 (3.76)
	1½ CTS	1.625 (41.23)	±0.013 (±0.34)	1.267 (32.18)	±0.005 (±0.12)	0.175 (4.45)
	2 CTS	2.125 (53.98)	±0.013 (±0.34)	1.659 (42.14)	±0.005 (±0.12)	0.228 (5.79)
DR9	1½ CTS	1.625 (41.23)	±0.013 (±0.34)	1.255 (31.85)	±0.005 (±0.12)	0.181 (4.60)
	2 CTS	2.125 (53.98)	±0.013 (±0.34)	1.645 (41.78)	±0.005 (±0.12)	0.236 (5.99)
DR7	1½ CTS	1.625 (41.23)	±0.013 (±0.34)	1.153 (29.29)	±0.005 (±0.12)	0.232 (5.89)
	2 CTS	2.125 (53.98)	±0.013 (±0.34)	1.509 (38.33)	±0.005 (±0.12)	0.304 (7.72)

[A] Defined as measured ¼ to ½ in. (6.4 to 12.7 mm) from fitting outlet extremity.

TABLE 6 IPS Sizing System Wall Thickness and Tolerance at the Area of Fusion for Fittings for Use with Polyethylene Pipe, in.[A,B,C]

Nominal Pipe Size	Minimum Wall Thickness										
	SCH 40	SCH 80	SDR 21	SDR 17	SDR 13.5	DR 10	DR 11.5	SDR 11	DR 9.3	SDR 9	DR7
½	0.109	0.147	...	...	...	...	...	0.076	0.090	...	0.120
¾	0.113	0.154	...	...	...	...	...	0.095	0.113	0.117	0.150
1	0.133	0.179	...	...	...	...	...	0.119	0.142	0.146	0.188
1¼	0.140	0.191	...	...	...	0.166	...	0.151	0.179	0.184	0.237
1½	0.145	0.200	...	...	...	...	...	0.173	0.204	0.211	0.271
2	0.154	0.218	...	...	...	...	...	0.216	0.256	0.264	0.339
3	0.216	0.300	...	...	0.259	...	0.305	0.318	0.377	0.389	0.500
4	0.237	0.337	...	0.264	0.333	...	0.392	0.409	0.484	0.500	0.643
6	0.280	0.432	0.316	0.390	0.491	...	0.576	0.603	0.713	0.736	0.946
8	0.322	...	0.410	0.508	0.639	...	0.750	0.785	0.928	0.958	1.232
10	0.365	...	0.511	0.633	0.797	...	0.935	0.978	1.156	1.194	1.536
12	0.406	...	0.608	0.750	0.945	...	1.109	1.160	1.371	1.417	1.821
14	...	...	0.667	0.824	...	...	...	1.273	1.505	1.556	2.000
16	...	...	0.762	0.941	...	...	...	1.455	1.720	1.778	2.286
18	...	...	0.857	1.059	...	...	...	1.636	1.935	2.000	2.571
20	...	...	0.952	1.176	...	...	...	1.818	2.151	2.222	2.857
21.5	...	...	1.024	1.265	...	...	...	...	...	...	3.071
22	...	...	1.048	1.294	...	...	...	2.000	2.366	2.444	3.143
24	...	...	1.143	1.412	...	...	...	2.182	2.581	...	3.429
28	...	...	1.333	1.647	...	...	...	2.545	...	...	4.000
32	...	...	1.524	1.882	...	...	...	2.909	...	...	4.571
36	...	...	1.714	2.118	...	...	...	...	...	...	5.143
42	...	...	2.000	2.471	...	...	...	...	...	...	6.000
48	...	...	2.286	...	...	...	...	...	...	...	6.857

[A] Tolerance +20 %, −0 %.
[B] For those SDR groups having overlapping thickness requirements, a manufacturer may represent their product as applying to the combination (for example, 11.0/11.5) so long as their product falls within the dimensional requirements of both DR's.
[C] For wall thicknesses not listed the minimum wall thickness may be calculated by the average outside diameter/SDR rounded up to the nearest 0.001 in.

applicable to this specification only are explained in the appropriate paragraph.

10.2 *Conditioning*—Unless otherwise specified, condition the specimens prior to test at 73.4 ± 3.6°F (23 ± 2°C) for not less than 6 h in air, or 1 h in water, for those tests where conditioning is required and in all cases of disagreement. Newly molded fittings shall be conditioned 40 h prior to test.

10.3 *Test Conditions*—Conduct the tests at the standard laboratory temperature of 73.4 ± 3.6°F (23 ± 2°C) unless otherwise specified.

TABLE 7 ISO Sizing System Wall Thickness and Tolerance at the Area of Fusion for Fittings for Use with Polyethylene Pipe, mm[A,B,C]

Nominal Pipe Size	Minimal Wall Thickness					
	DR 41	DR 32.5	DR 26	DR 21	DR 17	DR 11
90	...	...	3.5	4.3	5.3	8.2
110	...	3.4	4.2	5.2	6.5	10.0
160	...	4.9	6.2	7.6	9.4	14.5
200	...	6.2	7.7	9.5	11.8	18.2
250	...	7.7	9.6	11.9	14.7	22.7
280	...	8.6	10.8	13.3	16.5	25.5
315	....	9.7	12.1	15.0	18.5	28.6
355	...	10.9	13.7	16.9	20.9	32.3
400	...	12.3	15.4	19.0	23.5	36.4
450	...	13.8	17.3	21.4	26.5	...
500	...	15.4	19.2	23.8	29.4	...
560	...	17.2	21.5	26.7	32.9	...
630	...	19.4	24.2	30.0	37.1	...
710	...	21.8	27.3	33.8	41.8	...
800	...	24.6	30.8	38.1	47.1	...
900	...	27.7	34.6	42.9	...	...
1000	24.4	30.8	38.5	47.6	...	...
1200	29.3	36.9	46.2	...	...	...
1400	34.1	43.1	...	...	...	...
1600	39.0	49.2	...	...	...	...

[A] Tolerance +20 %, −0 %.
[B] For those SDR groups having overlapped thickness requirements, a manufacturer may represent their product as applying to the combination (for example, 11.0/11.5) so long as their product falls within the dimensional requirements of both DR's.
[C] For wall thicknesses not listed the minimum wall thickness may be calculated by the average outside diameter/SDR rounded up to the nearest 0.001.

10.4 *Dimensions and Tolerances:*

10.4.1 *Outside Diameter*—Measure the outside diameter of the fittings at the area of fusion in accordance with the Wall Thickness section of Method D2122 by use of a circumferential tape readable to the nearest 0.001 in. (0.02 mm).

10.4.2 *Inside Diameter (CTS Fittings Only)*—Use a stepped plug gage to determine the inside diameter of the CTS end of the fitting. The plug gage shall be of the go/no go type and shall have ½-in. (12.7-mm) land lengths cut to the minimum inside diameter and maximum inside diameter. A fitting is unacceptable (no go) if it fits snugly on the minimum inside diameter land of the gage or if it fits loosely on the maximum diameter land of the gage.

10.4.3 *Wall Thickness*—Make a series of measurements using a cylindrical anvil tubular micrometer or other accurate device at closely spaced intervals to ensure that minimum and maximum wall thicknesses to the nearest 0.001 in. (0.02 mm) have been determined. Make a minimum of six measurements at each cross section.

10.5 *Pressure Testing:*

10.5.1 *Preparation of Specimens for Pressure Testing*—Prepare test specimens 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. Fuse all fitting outlets with the appropriate size pipe or tubing. At least one piece of pipe or tubing in the system shall have a minimum length equal to five pipe diameters.

10.5.2 *Sustained Pressure Test:*

10.5.2.1 Sustained pressure tests shall be conducted in accordance with Table 10 and Test Method D1598 using water as the pressurizing medium. The "test sample" shall be three specimens. Select one Table 10 Condition for the material designation and test the three specimen test sample.

10.5.2.2 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 10 Condition. For Table 10 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 10 Condition of lower stress and longer minimum average time before failure for the material designation. For Table 10 Condition 6 no retest is permissible. Brittle failure of any specimen before the Table 10 "minimum average time before failure" constitutes failure to meet this requirement and no retest is allowed.

10.5.2.3 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.

10.5.3 *Minimum Hydrostatic Burst Pressure for Fittings* ½ to 12 in. and 90 to 315 mm, Nominal Diameter—The test equipment, procedures, and failure definitions shall be as specified in Test Method D1599. The hydrostatic pressure shall be increased at a uniform rate such that the specimen fails between 60 and 70 s from start of test. Minimum failure pressures are shown in Table 9.

10.5.4 *Minimum Hydrostatic Pressure for Fittings 14 to 48 in. and 355 to 1600 mm, Nominal Diameter*—The test equipment and procedures shall be as specified in Test Method D1599. The hydrostatic pressure shall be increased at a uniform rate such that the test pressure is reached within 60 to 70 s from the start of the test. No failure should occur in the sample during the test period.

11. Product Marking

11.1 Fittings shall be marked with the following:

11.1.1 This designation: "ASTM D3261,''

11.1.2 Manufacturer's name or trademark,

11.1.3 Material designations (such as PE2708 or PE4710),

NOTE 1—Earlier editions of Specification D3261 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.

11.1.4 Date of manufacture or manufacturing code,

11.1.5 Size.

TABLE 8 DIPS Sizing System Wall Thickness and Tolerance at the Area of Fusion for Fittings for Use with Polyethylene Pipe, in.[A,B,C]

Nominal Pipe Size	Minimum Wall Thickness							
	SDR 32.5	DR 26	DR 21	SDR 17	DR 13.5	SDR 11	SDR 9	SDR 7
3	0.122	0.153	0.189	0.233	0.294	0.360	0.440	0.566
4	0.148	0.185	0.229	0.283	0.356	0.437	0.534	0.686
6	0.213	0.266	0.329	0.406	0.512	0.628	0.767	0.946
8	0.279	0.348	0.431	0.533	0.670	0.823	1.006	1.293
10	0.342	0.427	0.529	0.653	0.823	1.009	1.234	1.586
12	0.407	0.508	0.629	0.777	0.978	1.200	1.467	1.886
14	0.471	0.589	0.729	0.900	1.134	1.391	1.700	2.186
16	0.536	0.670	0.829	1.024	1.289	1.582	1.934	2.486
18	0.600	0.750	0.929	1.147	1.445	1.773	2.167	2.786
20	0.665	0.831	1.029	1.271	1.600	1.964	2.400	3.086
24	0.794	0.993	1.229	1.518	1.912	2.346	2.867	3.686
30	0.985	1.231	1.524	1.883	2.371	2.909	3.556	4.571
36	1.179	1.473	1.824	2.253	2.837	3.482	4.256	5.471
42	1.370	1.712	2.119	2.618	3.297	4.046	4.945	6.357
48	1.563	1.954	2.419	2.989	3.763	4.619	5.645	7.257

[A] Tolerance +20 %, 0 %.
[B] For those SDR groups having overlapping thickness requirements, a manufacturer may represent their product as applying to the combination (for example, 11.0/11.5) so long as their product falls within the dimensional requirements of both DR's.
[C] For wall thicknesses not listed the minimum wall thickness may be calculated by the average outside diameter/SDR rounded up to the nearest 0.001

TABLE 9 Burst Pressure Requirements at 73.4°F for Common Fitting Sizes[A]

Wall Thickness, DR, or Schedule	Nominal Diameter	Minimum Pressure, psi (MPa)	Minimum Pressure, Density 3 or 4 Materials psi (MPa)
DR 7	ALL[B]	833 (5.744)	967 (6.667)
SDR 9	ALL[B]	625 (4.309)	725 (4.999)
DR 9.3	ALL[B]	602 (4.151)	699 (4.820)
SDR 11	ALL[B]	500 (3.448)	580 (3.999)
DR 11.5	ALL[B]	476 (3.282)	552 (3.806)
DR 15.5	ALL[B]	345 (2.379)	400 (2.758)
SDR 17	ALL[B]	313 (2.158)	363 (2.503)
SDR 21	ALL[B]	250 (1.724)	290 (2.000)
DR 26	ALL[B]	200 (1.379)	232 (1.600)
DR 32.5	ALL[B]	159 (1.096)	184 (1.269)
0.062 in. (1.575 mm)	½ CTS	551 (3.799)	639 (4.406)
0.062 in. (1.575 mm)	¾ CTS	381 (2.627)	442 (3.048)
0.062 in. (1.575 mm)	1 CTS	292 (2.013)	639 (4.406)
0.090 in. (2.286 mm)	½ CTS	841 (5.799)	976 (6.730)
0.090 in. (2.286 mm)	¾ CTS	573 (3.951)	665 (4.585)
0.090 in. (2.286 mm)	1 CTS	435 (2.999)	504 (3.475)
0.090 in. (2.286 mm)	1¼ CTS	350 (2.413)	406 (2.799)
SCH 40	½ IPS	746 (5.144)	865 (5.964)
SCH 40	¾ IPS	603 (4.158)	699 (4.820)
SCH 40	1 IPS	563 (3.882)	653 (4.502)
SCH 40	1¼ IPS	461 (3.179)	534 (3.682)
SCH 40	1½ IPS	413 (2.848)	479 (3.303)
SCH 40	2 IPS	347 (2.393)	402 (2.772)
SCH 40	3 IPS	326 (2.268)	381 (2.672)
SCH 40	4 IPS	278 (1.917)	322 (2.220)
SCH 40	6 IPS	221 (1.524)	256 (1.765)
SCH 40	8 IPS	194 (1.338)	225 (1.551)
SCH 40	10 IPS	176 (1.214)	204 (1.407)
SCH 40	12 IPS	164 (1.131)	191 (1.317)
SCH 40	16 IPS	164 (1.129)	190 (1.309)
SCH 40	20 IPS	154 (1.060)	178 (1.230)

[A] Fiber stress of 2520 psi (17.4 MPa) for PE2406 and PE3408.
[B] Refers to IPS, DIPS and ISO diameters shown in Table 2, Table 3 and Table 4.

11.2 Where the physical size of the fitting does not allow complete marking, marking may be omitted in the following sequence: size, date of manufacture, material designation, manufacturer's name or trademark.

11.3 Where recessed marking is used, take care not to reduce the wall thickness below the minimum specified.

12. Quality Assurance

12.1 When the product is marked with this designation, D3261, 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.

TABLE 10 Elevated Temperature Sustained Pressure Test Requirements[A,B]

Condition	Test Temperature, ºF (ºC)B	PE2606, PE2706, PE2708 PE3608 PE3708, PE4708		PE3710, PE4710	
		Test Pressure Hoop Stress,[A] psi (kPa)[B]	Minimum Average Time Before Failure, Hours[B]	Test Pressure Hoop Stress,[A] psi (kPa)[B]	Minimum Average Time Before Failure, Hours[B]
1	176 (80)	670 (4620)	170	750 (5170)	200
2	176 (80)	650 (4480)	340	730 (5020)	400
3	176 (80)	630 (4345)	510	705 (4870)	600
4	176 (80)	610 (4210)	680	685 (4715)	800
5	176 (80)	590 (4070)	850	660 (4565)	1000
6	176 (80)	580 (4000)	1000	640 (4415)	1200

[A] A Calculate internal test pressure in accordance with

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

Where:

P = test pressure, psig (kPa)
S = test pressure hoop stress, psi. (kPa)
D_O = measured outside diameter, in. (mm), and
t = measured minimum wall thickness, in (mm)

[B] Test temperature tolerance ±3.6ºF (±2ºC). Test pressure tolerance ±5 psi (±35 kPa); test pressure hoop stress values are rounded to the nearest 5 psi or 5 kPa. Note: Table 10 conditions are based on PE validation requirements per PPI TR-3 with Condition 6 being 85% of Condition 1 test pressure hoop stress and six times greater minimum average time before failure. Conditions 2 through 5 are linear stress and time interpolations between Conditions 1 and 6. The intent of multiple conditions is to maintain equivalent performance criteria, but provide for retest in the event of ductile failure. The test pressure hoop stress levels for Conditions 2-5 are linear interpolations for arbitrarily chosen time increments. An equivalent performance requirement, however, may be determined by arbitrarily choosing a test pressure hoop stress between Conditions 1 and 6 and linearly interpolating the minimum average time before failure. For example for PE3710 and PE4710 material, at 670 psi test pressure hoop stress, the minimum average time before failure would be 927 hours (200 + (750 – 670) x ((1200 – 200) / (750 – 640)) = 927).

13. Keywords

13.1 butt fusion fittings; fittings; polyethylene fittings; polyethylene pipe; polyethylene tubing

SUPPLEMENTARY REQUIREMENTS

GOVERNMENT / MILITARY PROCUREMENT

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

S1. *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 S1.1—In U.S. federal contracts, the contractor is responsible for inspection.

S2. *Packaging and Marking for U.S. Government Procurement:*

S2.1 *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 S2.1—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.

ADDITIONAL SUPPLEMENTARY REQUIREMENTS

This requirement applies whenever a Regulatory Authority or ser calls for the product to be used to convey or to be in contact with potable water.

S3. *Potable Water Requirement*—Products intended for contact with potable water shall be evaluated, tested, and certified for conformance with ANSI/NSF Standard 61 or the health effects portion of NSF Standard 14 by an acceptable certifying organization when required by the regulatory authority having jurisdiction.

SUMMARY OF CHANGES

Committee F17 has identified the location of selected changes to this standard since the last issue (D3261 – 15) that may impact the use of this standard. (Approved November 1, 2016.)

(1) Revised 2.1, added reference to Specification F2206.
(2) Added 3.2.1 definition for butt fusion fitting. Renumbered 3.2 to 3.2.2.
(3) Revised 4.1.1, 4.1.2, and added new 4.1.3. Renumbered 4.1.4.

Committee F17 has identified the location of selected changes to this standard since the last issue (D3261 – $12^{\varepsilon 1}$) that may impact the use of this standard. (Approved December 15, 2015.)

(1) Revised Table 5 to include additional sizes.