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An American National Standard

Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems[1]

This standard is issued under the fixed designation F2389; 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 polypropylene (PP) piping system components made to metric sizes and IPS schedule 80 sizes, and pressure rated for water service and distribution supply (see Appendix X1). Included are criteria for materials, workmanship, dimensions and tolerances, product tests, and marking for polypropylene (PP) piping system components such as pipe, fittings, valves, and manifolds.

1.2 The components governed by this specification shall be permitted for use in water service lines, hot-and-cold water distribution, hydronic heating, and irrigation systems.

1.3 The pipe and fittings produced under this specification shall be permitted to be used to transport industrial process fluids, effluents, slurries, municipal sewage, etc. The user shall consult the manufacturer to determine whether the material being transported is compatible with the polypropylene piping system and will not affect the service life beyond limits acceptable to the user.

1.4 *Units*—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 *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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory ~~requirements~~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]

D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
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
D1600 Terminology for Abbreviated Terms Relating to Plastics
D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2749 Symbols for Dimensions of Plastic Pipe Fittings
D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
D4101 Classification System and Basis for Specification for Polypropylene Injection and Extrusion Materials
F412 Terminology Relating to Plastic Piping Systems
F2023 Test Method for Evaluating the Oxidative Resistance of Crosslinked Polyethylene (PEX) Pipe, Tubing and Systems to Hot Chlorinated Water

2.2 *International Organization for Standardization (ISO) Standards:*[3]

ISO 4065 Thermoplastics Pipes—Universal Wall Thickness Table

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.61 on Water.
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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] Available from International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.

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

ISO 9080 Plastics Piping and Ducting Systems—Determination of the Long-Term Hydrostatic Strength of Thermoplastics Materials in Pipe Form by Extrapolation
ISO 9393–2 Thermoplastics valves for industrial applications - Pressure test methods and requirements - Part 2: Test conditions and basic requirements
ISO 12162 Thermoplastics materials for pipes and fittings for pressure applications -- Classification, designation and design coefficient
ISO 13760 Plastic Pipe for the Conveyance of Fluid Under Pressure – Miners Rule – Calculation Method for Cumulative Damage
ISO 15874 Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)
ISO 15874-2 Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)—Part 2: Pipes
ISO 15874-3 Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)—Part 3: Fittings
ISO 15874-5 Plastics piping systems for hot and cold water installations — Polypropylene (PP) —Part 5: Fitness for purpose of the system
ISO/TS 15874-7 Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)—Part 7: Guidance for the Assessment of Conformity

2.3 *NSF International Standards:*
NSF/ANSI 14 Plastics Piping System Components and Related Materials[4]
NSF/ANSI 61 Drinking Water System Components—Health Effects[4]

2.4 *CEN Standard:*
prEN 10226-1 Pipe Threads Where Pressure Tight Joints are Made on the Threads—Part 1: Designation, Dimensions and Tolerances[5]

2.5 *American Society of Mechanical Engineers (ASME) Standard:*
B1.20.1 Pipe Threads, General Purpose, Inch[6]

2.6 *Plastic Pipe Institute (PPI) Technical Report:*
TR-4 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[7]

3. Terminology

3.1 *Definitions:*

3.1.1 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:*

3.2.1 *polypropylene random copolymer (PP-R) or polypropylene random copolymer with modified crystallinity and temperature resistance (PP-RCT), n*—a propylene plastic containing not more than 50% of another olefinic monomer (or monomers), having no functional group other than the olefinic group, and copolymerized with the propylene.

3.2.1.1 *Discussion*—

Polypropylene materials are described in detail in ISO 15874. The performance of PP-R and PP-RCT is distinguished by the minimum reference curves in ~~ISO15874.~~ ISO 15874. Historically, PP-RCT has referred to a polypropylene random copolymer with modified crystallinity that delivers performance characteristics referenced in ~~ISO15874.~~ ISO 15874. However, recent developments make it possible to attain the PP-RCT performance requirements other than through modification of crystallinity.

3.2.1.2 *Discussion*—

This term is also used for finished compound which comprises the PP-R or PP-RCT resin and additives such as colorants, UV inhibitors, and stabilizers. Polypropylene random copolymers containing more than one additional monomer are often referred to as "terpolymers."

3.2.2 *plastic-to-metal transition fittings, n*—a fitting designed to provide a means of connection between the PP piping system and metal piping systems such as steel pipe and copper tubing. The fittings include a means of taking into account the differences in thermal expansion of the materials and maintaining a pressure-tight seal over the intended use temperature range.

[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 European Committee for Standardization (CEN), Avenue Marnix 17, B-1000, Brussels, Belgium, http://www.cen.eu.
[6] Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, http://www.asme.org.
[7] Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.

4. Classification

4.1 *General*—This specification covers PP piping systems made from PP materials (PP-R) in various dimension ratios and pressure ratings.

4.2 *Thermoplastic Pipe Series and Schedule*—This specification covers PP pipe made in schedule 80 IPS sizes and metric sizes in accordance with ISO 4065.

5. Materials and Manufacture

5.1 The pipe and fittings shall be polypropylene material of type PP-R or PP-RCT in accordance with Specification D4101. Clean rework material, of the same PP-R or PP-RCT resin generated from the manufacturer's own pipe or fitting production, shall be permitted to be used provided the pipe or fittings produced meet all requirements of this specification.

5.2 For pipe compound, the melt flow rate (MFR) shall not exceed 10.8 grain/10 min (0.7 g/10 min), when tested in accordance with Test Method D1238 using conditions of 4.76 lbm (2.16 kg) at ~~446°F (230°C).~~446 °F (230 °C).

5.3 The density of the unreinforced, natural color PP-R and PP-RCT material shall not exceed 56.9 lbm/ft^3 (912 kg/m^3), when tested in accordance with Test Method D1505 or Test Method D792.

5.4 *Minimum Required Strength (MRS)*—The PP-R material used in the pipe and fittings shall have an MRS value of 1160 psi (8.0 MPa) or 1450 psi (10.0 MPa) and the PP-RCT material used in the pipe and fittings shall have an minimum MRS value of 1624 psi (11,2 MPa) based on testing in accordance with ISO 9080 and classification of the lower confidence limit (σ_{LCL}) at 50 years in accordance with ISO 12162.

5.5 *Categorized Required Strength ($CRS_{\theta,t}$)*—The ~~PP~~PP-R material used in the pipe and fittings shall have a minimum $CRS_{23\ °C,\ 50\ years}$ value of ~~280~~457 psi ~~(1.93 MPa)~~ (3.15 MPa) and the PP-RCT material used in the pipe and fittings shall have minimum $CRS_{70\ °C,\ 50\ years}$ value of 725 psi (5 MPa) in accordance with ISO 12162, based on testing in accordance with ISO 9080 and classification of the lower confidence limit ~~(σ(σLCL)$_{LCL}$)~~ at ~~180°F (82°C)~~158 °F (70 °C) and 50 years.

NOTE 1—The CRS values required in 5.5 are a requirement of the standard. However, CRS values involving other temperatures and extrapolation times may be determined for design by following the methodology for the categorized required strength in ISO 12162 and ISO 9080 including the extrapolation time factors.

5.6 *Minimum Pressure Rating*—The minimum pressure rating of the pipe shall be 160 psi (1.1 MPa) at ~~73°F (23°C)~~73 °F (23 °C) and 100 psi (0.69 MPa) at ~~180°F (82°C)~~180 °F (82 °C) for hot-and-cold distribution and 160 psi (1.1 MPa) at ~~73°F (23°C)~~73 °F (23 °C) for cold water service.

5.7 *Threads*—Fittings shall be permitted to be threaded by use of metal inserts molded into the fitting.

5.7.1 Metal threads shall be constructed of brass or stainless steel inserts molded into the fitting.

5.7.2 Threads shall not be molded or fabricated directly into the polypropylene plastic.

5.8 The piping compound shall be permitted to include colorants, antioxidants, reinforcing materials and additives necessary for the finished product. The modified material and finished product shall meet all requirements of this specification.

NOTE 2—The Plastics Pipe Institute (PPI) publishes listings of minimum required strength (MRS) and categorized required strength ($CRS_{\theta,t}$) ratings for thermoplastic piping materials in Technical Report No. 4 (TR-4). ISO/TS 15874-7 provides guidance on evaluating the effect of additives on long-term strength of the pipe and fittings material.

5.9 *PEX Adapters*—The PEX fitting ends of PP to PEX transition fittings shall meet the material requirements of the corresponding PEX fitting standard.

6. Workmanship, Finish, and Appearance

6.1 The pipe and fittings shall be free of visible cracks, holes, foreign inclusions, blisters and other known injurious defects. The pipe and fittings shall be uniform in color, opacity, density and other physical properties.

7. Dimensions and Tolerances

7.1 *Pipe Dimensions*—Pipe dimensions shall meet the requirements in 7.1.1 and 7.1.2.

7.1.1 *Outside Diameters*—The outside diameters and tolerances shall be as shown in Table 1 (IPS Sch. 80), or Tables 2 and 3 (metric series), when measured in accordance with Test Method D2122. For diameters not shown in these tables, the tolerance shall be the same percentage of outside diameter as those for the closest listed diameter.

7.1.2 *Wall Thicknesses*—The wall thicknesses and tolerances shall be as shown in Table 1, or Tables 2 and 3, when measured in accordance with Test Method D2122. For wall thicknesses (DR's) not shown in these tables, the minimum wall thickness shall be as calculated using the DR and outside diameter, and the tolerance on the wall thickness shall be the same percentage of the calculated minimum wall thickness as for the closest listed minimum wall thickness.

7.1.3 *Threaded Pipe*—Pipe covered by this specification shall not be threaded.

7.2 *Fittings Dimensions*—Fittings dimensions shall meet the requirements in 7.2.1 through 7.2.6.

TABLE 1 IPS Schedule 80 OD and Wall Thickness

Nominal Pipe Size	Average Outside Diameter, OD, in.		Tolerance on OD, in.		Out-of-roundness (max–min)		Minimum Wall Thickness, in.		Tolerance on Wall Thickness, in.	
½	0.840	(21.34)	±0.004	(±0.10)	0.015	(0.38)	0.147	(3.73)	+0.020	(+0.51)
¾	1.050	(26.67)	±0.004	(±0.10)	0.020	(0.51)	0.154	(3.91)	+0.020	(+0.51)
1	1.315	(33.40)	±0.005	(±0.13)	0.025	(0.64)	0.179	(4.55)	+0.021	(+0.53)
1-½	1.900	(48.26)	±0.006	(±0.15)	0.030	(0.76)	0.200	(5.08)	+0.024	(+0.61)
2	2.375	(60.33)	±0.006	(±0.15)	0.035	(0.89)	0.218	(5.54)	+0.026	(+0.66)
3	3.500	(88.90)	±0.008	(±0.20)	0.040	(1.02)	0.300	(7.62)	+0.036	(+0.91)
4	4.500	(114.30)	±0.009	(±0.23)	0.050	(1.27)	0.337	(8.56)	+0.040	(+1.02)
6	6.625	(168.28)	±0.011	(±0.28)	0.050	(1.27)	0.432	(10.97)	+0.052	(+1.32)

TABLE 2 Metric Sizes OD

Nominal Size	Outside Diameter, OD					
	Minimum Average OD, in.		Maximum Average OD, in.		Maximum Out-of-roundness, in.	
16	0.630	(16.0)	0.642	(16.3)	0.016	(0.4)
20	0.787	(20.0)	0.799	(20.3)	0.016	(0.4)
25	0.984	(25.0)	0.996	(25.3)	0.016	(0.4)
32	1.260	(32.0)	1.272	(32.3)	0.020	(0.5)
40	1.575	(40.0)	1.591	(40.4)	0.020	(0.5)
50	1.969	(50.0)	1.988	(50.5)	0.024	(0.6)
63	2.480	(63.0)	2.504	(63.6)	0.024	(0.6)
75	2.953	(75.0)	2.980	(75.7)	0.039	(1.0)
90	3.543	(90.0)	3.579	(90.9)	0.039	(1.0)
110	4.331	(110.0)	4.370	(111.0)	0.039	(1.0)
125	4.921	(125.0)	4.969	(126.2)	0.051	(1.3)
140	5.512	(140.0)	5.563	(141.3)	...	...
160	6.299	(160.0)	6.358	(161.5)	...	...
200	7.874	(200.0)	7.953	(202.0)	...	...
250	9.842	(250.0)	9.941	(252.5)	...	...
280	11.023	(280.0)	11.142	(283.0)	...	...
315	12.401	(315.0)	12.528	(318.2)	...	...
355	13.976	(355.0)	14.118	(358.6)	...	...

7.2.1 *Threads*—Taper threads for joining fittings shall comply with the requirements of ASME B1.20.1 for NPT metal thread inserts or prEN 10226-1 for metric threads. Threads used by the manufacturer to join component parts of a fitting together shall meet the manufacturer's specifications.

7.2.2 *Laying Lengths*—Laying lengths shall be in accordance with the manufacturer's specifications.

7.2.3 *Socket-fused Fittings*—Dimensions for socket-fused fittings shall be in accordance with Tables 4 and 5 (IPS Sch 80) or Tables 6 and 7 (metric series). Socket depth shall be measured from the face of the socket entrance to the face of the pipe stop at the socket bottom.

7.2.4 *Electrofusion Fittings*—Dimensions for electrofusion fittings shall be in accordance with manufacturer's specifications.

7.2.5 *Valves and Flanges*—Dimensions for valves and flanges shall be in accordance with the manufacturer's specifications.

7.2.6 *PEX Adapters*—The PEX fitting ends of PP to PEX transition fittings shall meet the dimensional requirements of the corresponding PEX fitting standard.

8. Requirements

8.1 *Longitudinal Reversion*—When tested in accordance with ISO 15874-2, at the conditions given in Table 8, the mean relative change in pipe length shall not exceed 2 %.

8.2 *Melt Flow Rate (MFR) of Pipe and Fittings*—When tested in accordance with D1238, the MFR of specimens taken from the finished pipe or fittings shall be within 30 % of the MFR of the compound used to produce the pipe or fitting. Two specimens shall be tested, and both shall pass.

8.3 *Thermal Stability and Oxidative Induction Time (OIT)*—Pipe and fittings shall meet the requirements of 8.3.1–thermal stability by hydrostatic testing, and 8.3.2–oxidative induction time.

8.3.1 When tested in accordance with Test Method D1598, pipe and fittings shall not fail at the pressure corresponding to the pipe circumferential stresses and times given in Table 9 for PP-R and PP-RCT. If an assembly fails at a joint, the fitting material shall be permitted to be retested in pipe form.

8.3.2 The oxidative induction time (OIT) shall be determined on pipe and fittings in accordance with Test Method D3895. Two specimens shall be tested and the average OIT of the two shall be at least 80 % of the OIT of the virgin material compound. For those materials which require final blending at the extruder (masterbatch/resin), the 80% OIT requirement shall be based on the OIT of the pipe sample which has also passed the hydrostatic testing of 8.3.1 or a pipe sample of the same formulation containing no rework.

TABLE 3 Metric Sizes Wall Thickness

Nominal Size	Minimum Wall Thickness																					
	DR = 17.6				DR = 17				DR = 11			DR = 7.3			DR = 6			DR = 5				
	Min Wall, in.		Tolerance, in.		Min Wall, in.		Tolerance, in.		Min Wall, in.		Tolerance, in.	Min Wall, in.		Tolerance, in.	Min Wall, in.		Tolerance, in.	Min Wall, in.		Tolerance, in.		
16	...	...	...	...	...	...	...	...	0.071	(1.8)	+0.020 (+0.50)	0.087	(2.2)	+0.020 (+0.50)	0.106	(2.7)	+0.020 (+0.50)	0.130	(3.3)	+0.020	(+0.50)
20	...	...	...	...	...	...	...	...	0.075	(1.9)	+0.009 (+0.23)	0.110	(2.8)	+0.013 (+0.34)	0.134	(3.4)	+0.016 (+0.41)	0.161	(4.1)	+0.019	(+0.49)
25	...	...	...	...	...	...	...	...	0.091	(2.3)	+0.011 (+0.28)	0.138	(3.5)	+0.017 (+0.42)	0.165	(4.2)	+0.020 (+0.50)	0.201	(5.1)	+0.024	(+0.61)
32	...	...	...	...	...	...	...	...	0.114	(2.9)	+0.014 (+0.35)	0.173	(4.4)	+0.021 (+0.53)	0.213	(5.4)	+0.026 (+0.65)	0.256	(6.5)	+0.031	(+0.78)
40	...	...	...	...	...	...	...	...	0.146	(3.7)	+0.017 (+0.44)	0.217	(5.5)	+0.026 (+0.66)	0.264	(6.7)	+0.032 (+0.80)	0.319	(8.1)	+0.038	(+0.97)
50	...	...	...	...	...	...	...	...	0.181	(4.6)	+0.022 (+0.55)	0.272	(6.9)	+0.033 (+0.83)	0.327	(8.3)	+0.039 (+1.00)	0.398	(10.1)	+0.048	(+1.21)
63	...	...	...	...	...	...	...	...	0.228	(5.8)	+0.027 (+0.70)	0.339	(8.6)	+0.041 (+1.03)	0.413	(10.5)	+0.050 (+1.26)	0.500	(12.7)	+0.060	(+1.52)
75	...	...	...	...	...	...	...	...	0.268	(6.8)	+0.032 (+0.82)	0.406	(10.3)	+0.049 (+1.24)	0.492	(12.5)	+0.059 (+1.50)	0.594	(15.1)	+0.071	(+1.81)
90	...	...	...	...	...	...	...	...	0.323	(8.2)	+0.039 (+0.98)	0.484	(12.3)	+0.058 (+1.48)	0.591	(15.0)	+0.071 (+1.80)	0.713	(18.1)	+0.086	(+2.17)
110	...	...	...	...	...	...	...	...	0.394	(10.0)	+0.047 (+1.20)	0.594	(15.1)	+0.071 (+1.81)	0.720	(18.3)	+0.086 (+2.20)	0.870	(22.1)	+0.104	(+2.65)
125	...	...	...	...	...	...	...	...	0.449	(11.4)	+0.054 (+1.37)	0.673	(17.1)	+0.081 (+2.05)	0.819	(20.8)	+0.098 (+2.50)	0.988	(25.1)	+0.119	(+3.01)
140	...	...	...	...	...	...	...	...	0.500	(12.7)	+0.060 (+1.52)	0.756	(19.2)	+0.091 (+2.30)	0.917	(23.3)	+0.110 (+2.80)	1.106	(28.1)	+0.133	(+3.37)
160	...	...	...	...	...	...	...	...	0.575	(14.6)	+0.069 (+1.75)	0.862	(21.9)	+0.103 (+2.63)	1.047	(26.6)	+0.126 (+3.19)	1.264	(32.1)	+0.152	(+3.85)
200	...	...	...	...	...	...	...	...	0.716	(18.2)	+0.083 (+2.1)	1.079	(27.4)	+0.122 (+3.1)	1.311	(33.3)	+0.154 (+3.9)	1.575	(40.0)	+0.181	(+4.6)
250	...	...	...	...	...	...	...	...	0.894	(22.7)	+0.102 (+2.6)	1.346	(34.2)	+0.157 (+4.0)	1.642	(41.7)	+0.189 (+4.8)	1.968	(50.0)	+0.220	(+5.6)
280	0.626	(15.9)	+0.071	(+1.8)	0.653	(16.6)	+0.075	(+1.9)	1.000	(25.4)	+0.110 (+2.8)	...	...	...	...	...	...	...	...	...	...	...
315	0.705	(17.9)	+0.079	(+2.0)	0.736	(18.7)	+0.083	(+2.1)	1.126	(28.6)	+0.122 (+3.1)	...	...	...	...	...	...	...	...	...	...	...
355	0.791	(20.1)	+0.091	(+2.3)	0.831	(21.1)	+0.094	(+2.4)	1.268	(32.2)	+0.138 (+3.5)	...	...	...	...	...	...	...	...	...	...	...

TABLE 4 IPS Sch 80 Socket-weld Fittings

Nominal Size	Socket Entrance, A						Socket Bottom, B					
	Average, in.		Tolerance on Average, in.		Maximum Out-of-roundness, in.		Average, in.		Tolerance on Average, in.		Maximum Out-of-roundness, in.	
½	0.840	(21.34)	±0.010	(±0.25)	0.012	(0.30)	0.794	(20.17)	±0.005	(±0.13)	0.012	(0.30)
¾	1.050	(26.67)	±0.010	(±0.25)	0.012	(0.30)	1.000	(25.40)	±0.007	(±0.18)	0.012	(0.30)
1	1.311	(33.30)	±0.010	(±0.25)	0.016	(0.41)	1.258	(31.95)	±0.007	(±0.18)	0.012	(0.30)
1-½	1.898	(48.21)	±0.012	(±0.30)	0.016	(0.41)	1.830	(46.48)	±0.007	(±0.18)	0.015	(0.38)
2	2.383	(60.53)	±0.012	(±0.30)	0.016	(0.41)	2.308	(58.62)	±0.007	(±0.18)	0.015	(0.38)
3	3.513	(89.23)	±0.012	(±0.30)	0.040	(1.02)	3.427	(87.05)	±0.010	(±0.25)	0.020	(0.51)
4	4.522	(114.86)	±0.015	(±0.38)	0.040	(1.02)	4.417	(112.19)	±0.010	(±0.25)	0.020	(0.51)
6	6.656	(169.06)	±0.032	(±0.81)	0.050	(1.27)	6.512	(165.40)	±0.012	(±0.30)	0.040	(1.02)

TABLE 5 IPS Sch 80 Socket-weld Fittings

Nominal Size	Socket depth, C				Wall Thickness			
	Min, in.		Max, in.		Socket, E, Min, in.		Body, F, Min, in.	
½	0.835	(21.21)	0.865	(21.97)	0.147	(3.73)	0.185	(4.70)
¾	0.960	(24.38)	0.990	(25.15)	0.154	(3.91)	0.195	(4.95)
1	1.085	(27.56)	1.115	(28.32)	0.179	(4.55)	0.225	(5.72)
1-½	1.335	(33.91)	1.365	(34.67)	0.200	(5.08)	0.250	(6.35)
2	1.460	(37.08)	1.490	(37.85)	0.218	(5.54)	0.275	(6.99)
3	1.830	(46.48)	1.860	(47.24)	0.300	(7.62)	0.375	(9.53)
4	2.205	(56.01)	2.235	(56.77)	0.337	(8.56)	0.420	(10.67)
6	2.955	(75.06)	2.985	(75.82)	0.432	(11.0)	0.540	(13.72)

TABLE 6 Metric Series Socket-weld Fittings

Nominal Size	Socket Entrance, A						Socket Bottom, B					
	Minimum Average Diameter, in.		Maximum Average Diameter, in.		Maximum Out-of-roundness, in.		Minimum Average Diameter, in.		Maximum Average Diameter, in.		Maximum Out-of-roundness, in.	
16	0.598	(15.20)	0.610	(15.50)	0.016	(0.40)	0.594	(15.10)	0.606	(15.40)	0.016	(0.40)
20	0.756	(19.20)	0.768	(19.50)	0.016	(0.40)	0.748	(19.00)	0.760	(19.30)	0.016	(0.40)
25	0.953	(24.20)	0.965	(24.50)	0.016	(0.40)	0.941	(23.90)	0.957	(24.30)	0.016	(0.40)
32	1.224	(31.10)	1.240	(31.50)	0.020	(0.50)	1.217	(30.90)	1.232	(31.30)	0.020	(0.50)
40	1.535	(39.00)	1.551	(39.40)	0.020	(0.50)	1.528	(38.80)	1.543	(39.20)	0.020	(0.50)
50	1.925	(48.90)	1.945	(49.40)	0.024	(0.60)	1.917	(48.70)	1.937	(49.20)	0.024	(0.60)
63	2.437	(61.90)	2.461	(62.50)	0.024	(0.60)	2.425	(61.60)	2.445	(62.10)	0.024	(0.60)
75	2.925	(74.30)	2.949	(74.90)	0.039	(1.00)	2.878	(73.10)	2.902	(73.70)	0.039	(1.00)
90	3.516	(89.30)	3.539	(89.90)	0.039	(1.00)	3.461	(87.90)	3.484	(88.50)	0.039	(1.00)
110	4.307	(109.40)	4.331	(110.00)	0.039	(1.00)	4.240	(107.70)	4.264	(108.30)	0.039	(1.00)
125	4.898	(124.40)	4.921	(125.00)	0.039	(1.00)	4.827	(122.60)	4.850	(123.20)	0.039	(1.00)

TABLE 7 Metric Series Socket-weld Fittings

Nominal Size	Socket Depth, C				Wall Thickness			
	Min, in.		Max, in.		Socket, E, Min, in.		Body, F, Min, in.	
16	0.524	(13.30)	0.622	(15.80)	0.121	(3.06)	0.161	(4.08)
20	0.571	(14.50)	0.669	(17.00)	0.145	(3.69)	0.194	(4.92)
25	0.630	(16.00)	0.728	(18.50)	0.167	(4.25)	0.223	(5.67)
32	0.713	(18.10)	0.811	(20.60)	0.212	(5.38)	0.282	(7.17)
40	0.807	(20.50)	0.906	(23.00)	0.256	(6.50)	0.341	(8.67)
50	0.925	(23.50)	1.024	(26.00)	0.335	(8.50)	0.446	(11.33)
63	1.079	(27.40)	1.177	(29.90)	0.413	(10.50)	0.551	(14.00)
75	1.181	(30.00)	1.319	(33.50)	0.492	(12.50)	0.656	(16.67)
90	1.299	(33.00)	1.496	(38.00)	0.591	(15.00)	0.787	(20.00)
110	1.457	(37.00)	1.732	(44.00)	0.723	(18.38)	0.965	(24.50)
125	1.575	(40.00)	1.850	(47.00)	0.822	(20.88)	1.096	(27.83)

NOTE 3—Initial qualification of changes to materials that have met the requirements of this section may be evaluated based on limited hydrostatic testing and comparison of OIT values.

8.4 *Hydrostatic Pressure Tests*—When tested in accordance with 9.1, at the hoop stresses and temperatures given in Table 10, assemblies of pipe and fittings shall not fail during the test period specified.

8.5 *Thermocycling*—Plastic-to-metal transition fittings, intended to be used at temperatures above ~~113°F (45°C)~~113 °F (45 °C) shall not separate or leak during or after being thermocycled 1000 times between the temperatures of ~~60°F~~60 °F and ~~180°F (16°C~~180 °F (16 °C and ~~82°C).~~82 °C). Transition fittings which meet the thermal cycling requirements of ISO 15874-5 for the