



Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems¹

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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 and health practices and determine the applicability of regulatory requirements prior to use.*

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](#) 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) Tubing and Systems to Hot Chlorinated Water

2.2 International Organization for Standardization (ISO) Standards:

[ISO 3127](#) Thermoplastic Pipes—Determination of Resistance to External Blows—Round the Clock Method³

[ISO 4065](#) Thermoplastics Pipes—Universal Wall Thickness Table³

[ISO 9080](#) Plastics Piping and Ducting Systems—Determination of the Long-Term Hydrostatic Strength of Thermoplastics Materials in Pipe Form by Extrapolation³

[ISO 9393-2](#) Thermoplastics valves for industrial applications - Pressure test methods and requirements - Part 2: Test conditions and basic requirements

[ISO 15874-2:2002](#) Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)—Part 2: Pipes³

[ISO 15874-3:2002](#) Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)—Part 3: Fittings³

[ISO/TS 15874-7](#) Plastics Piping Systems for Hot and Cold Water Installations—Polypropylene (PP)—Part 7: Guidance for the Assessment of Conformity³

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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>.

2.3 NSF International Standards:

NSF/ANSI 14 Plastics Piping System Components and Related Materials⁴

NSF/ANSI 61 Drinking Water System Components—Health Effects⁴

2.4 European Norm:

prEN 10226-1 Pipe Threads Where Pressure Tight Joints are Made on the Threads—Part 1: Designation, Dimensions and Tolerances⁵

2.5 American Society of Mechanical Engineers (ASME) Standard:

B1.20.1 Pipe Threads, General Purpose, Inch⁶

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 Materials⁷

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)*, *n*—a propylene plastic containing not more than 50 % of another olefinic monomer (or monomers), having no functional group other than the olefinic group, copolymerized with the propylene.

3.2.1.1 *Discussion*—This term is also used for finished compound which comprises the PP-R 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. 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.

⁴ Available from the Deutsches Institut für Normung, Burggrafenstrasse 6, 10787 Berlin, Germany.

⁵ Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, <http://www.nsf.org>.

⁶ European Committee for Standardization, 36, rue de Stassart, B-1050 Brussels.

⁷ Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, <http://www.plasticpipe.org>.

5. Materials and Manufacture

5.1 The pipe and fittings shall be polypropylene material of type PP-R in accordance with Specification D4101. Clean rework material, of the same PP-R 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).

5.3 The density of the unreinforced, natural color PP material shall not exceed 56.9 lbf/ft³ (912 kg/m³), when tested in accordance with Test Method D1505 or Test Method D792.

5.4 *Minimum Required Strength (MRS)*—The PP material used in the pipe and fittings shall have an MRS value of 1160 psi (8.0 MPa) or 1450 psi (10.0 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_{0,t})*—The PP material used in the pipe and fittings shall have a CRS_{0,t} value of 280 psi (1.93 MPa) based on testing in accordance with ISO 9080 and classification of the lower confidence limit (σ_{LCL}) at 180°F (82°C) and 50 years.

5.6 *Minimum Pressure Rating*—The minimum pressure rating of the pipe shall be 160 psi (1.1 MPa) at 73°F (23°C) and 100 psi (0.69 MPa) at 180°F (82°C) for hot-and-cold distribution and 160 psi (1.1 MPa) at 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 1—The Plastics Pipe Institute (PPI) publishes listings of minimum required strength (MRS) and categorized required strength (CRS_{0,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.

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.



Documents

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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 **7.2.4**.

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.

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 Impact Strength—When tested in accordance with ISO 3127, 9 of 10 specimens shall pass at the impact level specified in **Table 9** at a test temperature of $32 \pm 2^\circ\text{F}$ ($0 \pm 1^\circ\text{C}$).

8.4 Thermal Stability and Oxidative Induction Time (OIT)—Pipe and fittings shall meet the requirements of **8.4.1**—thermal stability by hydrostatic testing, and **8.4.2**—oxidative induction time.

8.4.1 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 10**. If an assembly fails at a joint, the fitting material shall be permitted to be retested in pipe form.

8.4.2 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 **8.4.1** or a pipe sample of the same formulation containing no rework.

NOTE 2—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.

8.5 Hydrostatic Pressure Tests—When tested in accordance with **9.1**, at the hoop stresses and temperatures given in **Table 11**, assemblies of pipe and fittings shall not fail during the test period specified.

8.6 Thermocycling—Plastic-to-metal transition fittings, intended to be used at temperatures above 113°F (45°C) shall not separate or leak during or after being thermocycled 1000 times between the temperatures of 60°F and 180°F (16°C and 82°C). Transition fittings which meet the thermal cycling requirements of ISO 15874-5 for the intended application class are exempt from this requirement. Fittings shall be assembled with pipe per the manufacturer's instructions, and tested in accordance with **9.2**.

8.7 Oxidative Stability in Potable Chlorinated Water Applications—PP piping intended for use in the transport of potable water shall have a minimum extrapolated time-to-time failure of 50 years when tested and evaluated in accordance with **9.3**.

9. Test Methods

9.1 Hydrostatic Tests—Test pipe and fitting assemblies in accordance with Test Method **D1598**, at the hoop stresses and

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.	
1/2	0.840	(21.34)	± 0.004	(± 0.10)	0.015	(0.38)	0.147	(3.73)	+0.020 (+0.51)
3/4	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)
1-1/2	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)