



Designation: **F2881–11** ~~F2881 – 11~~ **(Reapproved 2015)**

Standard Specification for 12 to 60 in. [300 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications¹

This standard is issued under the fixed designation F2881; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers requirements and test methods for dual wall polypropylene pipe and fittings. The nominal inside diameters covered are 12 to 60 in. [300 to 1500 mm].

1.2 The requirements of this specification are intended to provide pipe and fittings suitable for underground use for ~~nonpressure~~ non-pressure storm sewer systems. Pipe and fittings produced in accordance with this specification shall be installed in compliance with Practice **D2321**.

1.3 This specification covers pipe and fittings with an interior smooth wall and an annular corrugated profile outer wall (**Fig. 1**).

1.4 *Units*—The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.5 The following precautionary statement caveat pertains only to the test method portion, Section 7, 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 and health practices and determine the applicability of regulatory limitations prior to use.*

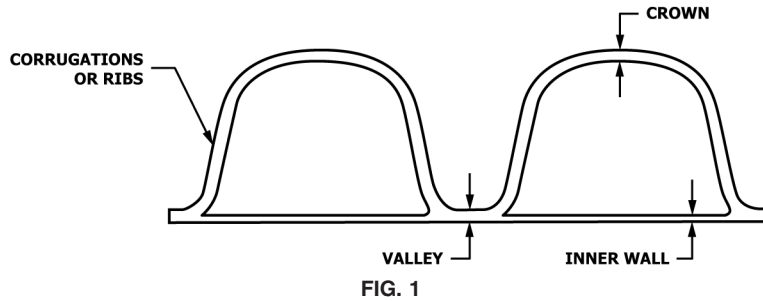
2. Referenced Documents

2.1 ASTM Standards:²

- A666 Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics
- D618 Practice for Conditioning Plastics for Testing
- D638 Test Method for Tensile Properties of Plastics
- D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
- 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
- D1600 Terminology for Abbreviated Terms Relating to Plastics
- D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
- D2321 Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D2412 Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading
- D2444 Test Method for Determination of the Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)
- D2990 Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
- D3212 Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
- D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry

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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.



- [D4101 Specification for Polypropylene Injection and Extrusion Materials](#)
- [D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique](#)
- [D4389M Specification for Finished Glass Fabrics Woven From Rovings](#)
- [D6992 Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method](#)
- [F412 Terminology Relating to Plastic Piping Systems](#)
- [F477 Specification for Elastomeric Seals \(Gaskets\) for Joining Plastic Pipe](#)
- 2.2 *AASHTO Standard*.³
- [LRFD, Section 12 AASHTO LRFD Bridge Design Specifications Section 12 – Buried Structures and Tunnel Liners](#)
- [M288 Geotextile Specification for Highway Applications](#)
- 2.3 *Federal/Military Standards*.⁴
- [Fed. Std. No. 123 Marking for Shipment \(Civil Agencies\)](#)
- [MIL-STD-129 Marking for Shipment and Storage](#)

3. Terminology

- 3.1 *Definitions*—Definitions are in accordance with Terminology [F412](#) and abbreviations are in accordance with Terminology [D1600](#), unless otherwise specified. The abbreviation for polypropylene is PP.
- 3.2 *Definitions of Terms Specific to This Standard*:
 - 3.2.1 *dual wall, n*—In this case, the dual pipe wall construction provides an interior wall in the waterway and includes ribs, corrugations, or other shapes, which can be either solid or hollow, that helps brace the pipe against diametrical deformation.
 - 3.2.2 *silt-tight joint, n*—Joint that prevents the passage of silt or soil, does not restrict water passage.
 - 3.2.3 *water-tight joint, n*—Joint that restrains the passage of water to not exceed a specified limit.

4. Ordering Information

- 4.1 Orders for product made to this specification shall include the following information to adequately describe the desired product:
 - 4.1.1 This ASTM designation and year of issue,
 - 4.1.2 Diameters,
 - 4.1.3 Total footage of each pipe diameter involved,
 - 4.1.4 Pipe laying length,
 - 4.1.5 Joint requirements
 - 4.1.6 *Fitting type(s)*:
 - 4.1.6.1 Size and type of fittings, including mainline and branch diameters, and
 - 4.1.6.2 Number of fittings per diameter.

5. Materials and Manufacture

5.1 *Pipe and Fabricated Fittings—Polypropylene Compounds*—Polypropylene compounds used in the manufacture of the dual wall pipe and fittings shall have the minimum properties as shown in [Table 1](#). Polypropylene compounds shall be comprised of the base unfilled copolymer polypropylene virgin resin and all additives, colorants, UV inhibitors and stabilizers. Conditioning, sampling, preparation and testing of molded specimens shall be in accordance with the requirements in Specification [D4101](#). Compounds shall be tested and validated on an annual basis or for any new formulations.

³ Available from www.transportation.org, American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.
⁴ Available from <http://quicksearch.dla.mil>, Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>, 19111-5094, <http://quicksearch.dla.mil>.



TABLE 1 Polypropylene Compound Properties

Property	ASTM Test Method	Units (SI Units)	Minimum Value	Maximum Value
Melt Flow Rate	D1238	g/10 min	0.25 at 230°C	1.50 at 230°C
Density	D792, D1505	lb/in. ³ (g/cm ³)	0.0325 (0.900)	0.0343 (0.950)
Density	D792, D1505	lb/in. ³ (g/cm ³)	0.0325 (0.900)	0.0343 (0.950)
Tensile Strength at Yield	D638	psi (N/mm ²)	3,500 (24)	5,000 (34)
Tensile Strength at Yield	D638	psi (N/mm ²)	3500 (24)	5000 (34)
Elongation at Yield	D638	% (%)	5 (5)	25 (25)
Flexural Modulus (1% secant)	D790 Procedure B	psi (N/mm ²)	175,000 (1,200)	325,000 (2,250)
Flexural Modulus (1% secant)	D790 Procedure B	psi (N/mm ²)	175 000 (1200)	325 000 (2250)
IZOD Impact Strength (73°F (23°C))	D256	ft-lb/in. ² (kJ/m ²)	23.8 (50)	No Break
IZOD Impact Strength (73°F (23°C))	D256	ft-lb/in. ² (kJ/m ²)	23.8 (50)	No Break
Oxidative-Induction Time (392°F (200°C))	D3895	min	25	200
Oxidative-Induction Time (392°F (200°C))	D3895	min	25	200

NOTE 1—Stress-cracking has not been shown to be a concern with polypropylene resins, so no slow-crack growth test protocol has been developed for assessing it.

5.2 *Color and Ultraviolet Stabilization for Pipe and Fabricated Fittings*—The pipe shall be colored or black. Black polypropylene compounds shall have between 2.0 and 3.0 percent carbon black when tested in accordance with the procedures in Test Method D4218. Colored polypropylene compounds shall be protected from Ultraviolet (UV) degradation with UV stabilizers.

NOTE 2—Pipe users should consult with the pipe manufacturer about the outdoor exposure life of the product under consideration.

5.3 *Rework Plastic*—Clean polypropylene rework plastic, generated from the manufacturer's own production of the product and having the same minimum physical properties, may be used by the manufacturer, provided that the pipe produced meets all the requirements of this specification.

5.4 *Elastomeric Seal Materials*—Elastomeric compounds and thermoplastic elastomeric compounds used in the manufacture of sealing rings or gaskets shall meet the requirements of Specification F477.

5.5 *Lubricant*—The lubricant used for assembly of gasketed joints shall have no detrimental effect on the gasket or the pipe.

5.6 *Optional Bell Retaining Bands*—Bell retaining bands, if used, shall meet the requirements in 6.6.4 and shall be made of corrosive resistant materials such as fiberglass (Specification D4389D4389/D4389M) or stainless steel (Specification A666).

5.6.1 The Specification D4389D4389/D4389M fiberglass roving shall be an E type glass, free of any alkali, dirt or other impurities. The band shall consist of a continuous, overlapping filament fiber and not a fabric.

NOTE 3—Compound and material properties are typically tested to validate a formulation; they are not routine quality assurance tests. Users requiring such testing for quality assurance purposes should insert these criteria in their project specifications.

6. General Requirements

6.1 *Workmanship*—The pipe and fittings shall be homogeneous throughout and be as uniform as commercially practical in color, opacity, and density. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity. The ends shall be cut cleanly and squarely through valleys.

6.1.1 Visible defects, cracks, creases, splits, in pipe are not permissible.

6.2 *Dimensions and Tolerance:*

6.2.1 *Nominal Size*—The nominal size for the pipe and fittings shall be the inside diameter shown in Table 2.

6.2.2 *Laying Length*—The pipe shall be supplied in any laying length agreeable to both the owner and the manufacturer. Laying length shall not be less than 99%–99% of stated quantity when measured in accordance with 7.3.2.

6.2.3 *Minimum Wall, Crown, Valley and Liner Thickness*—The minimum thickness of pipe sections shall meet the requirements given in Table 2 when measured in accordance with 7.3.3.

NOTE 4—The outside diameters and the corrugation pitch of products manufactured to this specification are not specified; therefore, compatibility between pipe and fittings made to this specification from different manufacturers should be verified.

6.3 *Pipe Stiffness*—Minimum pipe stiffness at 5%–5% deflection shall meet the requirements given in Table 2 when tested in accordance with 7.4.

NOTE 5—The 5%–5% deflection criterion, which was selected for testing convenience, is not a limitation with respect to in-use deflection. The engineer is responsible for establishing the acceptable deflection limit.

6.4 *Pipe Flattening*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of the outer and inner wall, or combinations thereof, when tested in accordance with 7.5.

6.5 *Pipe Impact Strength*—There shall be no evidence of splitting, cracking, breaking, separation of seams, separation of the outer and inner wall, or combinations thereof, when conditioned in accordance with 7.1 and tested in accordance with 7.6 and examined under normal light and the unaided eye. The minimum pipe impact strength at 73°F (23°C) shall be 140 ft-lbf (190 J).



TABLE 2 Pipe Stiffness and Pipe Dimensions

Pipe Inside Diameter		Inside Diameter Tolerances		Minimum Pipe Stiffness at 5 % Deflection		Minimum Inner Liner Thickness		Minimum Valley Thickness		Minimum Crown Thickness	
in.	[mm]	in.	[mm]	lb/in/in	[kPa]	in.	[mm]	in.	[mm]	in.	[mm]
12	[300]	± 0.12	[± 3.0]	70	[482]	0.045	[1.1]	0.103	[2.6]	0.052	[1.3]
15	[400]	± 0.15	[± 3.8]	60	[413]	0.050	[1.3]	0.126	[3.2]	0.068	[1.7]
18	[450]	± 0.18	[± 4.6]	56	[386]	0.055	[1.4]	0.132	[3.4]	0.074	[1.9]
24	[600]	± 0.24	[± 6.1]	50	[344]	0.060	[1.5]	0.144	[3.7]	0.093	[2.4]
30	[750]	± 0.30	[± 7.6]	46	[317]	0.065	[1.7]	0.148	[3.8]	0.108	[2.7]
36	[900]	± 0.36	[± 9.1]	40	[275]	0.070	[1.8]	0.153	[3.9]	0.132	[3.4]
42	[1050]	± 0.42	[± 10.7]	35	[241]	0.070	[1.8]	0.158	[4.0]	0.160	[4.1]
48	[1200]	± 0.48	[± 12.2]	30	[206]	0.072	[1.8]	0.179	[4.6]	0.165	[4.2]
48	[1200]	± 0.48	[± 12.2]	30	[206]	0.072	[1.8]	0.179	[4.6]	0.165	[4.2]
54	[1350]	± 0.54	[± 13.7]	26	[175]	0.078	[2.0]	0.194	[4.9]	0.178	[4.5]
60	[1500]	± 0.60	[± 15.2]	25	[170]	0.085	[2.2]	0.215	[5.5]	0.180	[4.6]

NOTE 6—Discoloration or “whitening” of the pipe during pipe flattening and impact tests is normal and does not represent a failure criteria for either test.

6.6 Fabricated Fittings and Joining Systems:

6.6.1 Only fabricated fittings and joining systems supplied or recommended by the pipe manufacturer shall be used. Fabricated fittings shall be installed in accordance with the manufacturer’s recommendations and meet the same material requirements as the pipe.

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