



Designation: F2764/F2764M – 11a^{ε2}

Standard Specification for 30 to 60 in. [750 to 1500 mm] Polypropylene (PP) Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications¹

This standard is issued under the fixed designation F2764/F2764M; 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.

^{ε1} NOTE—Revised designation to correspond with units statement in November 2013.

^{ε2} NOTE—Table 1 headings were editorially added in July 2014.

1. Scope*

1.1 This specification covers requirements and test methods for triple wall polypropylene pipe and fittings. The nominal inside diameters covered are 30 to 60 in. [750 to 1600 mm].

1.2 The requirements of this specification are intended to provide pipe and fittings suitable for underground use for non-pressure sanitary 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 essentially smooth interior wall, an essentially smooth exterior wall and an annular corrugated profile middle wall (Fig. 1).

1.4 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 applies only to 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
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
D4389 Specification for Finished Glass Fabrics Woven From Rovings

¹ This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.62 on Sewer.

Current edition approved May 1, 2011. Published May 2011. Originally approved in 2010. Last previous edition approved in 2011 as F2764-11. DOI:10.1520/D2764_F2764M-11AE01.

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.

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

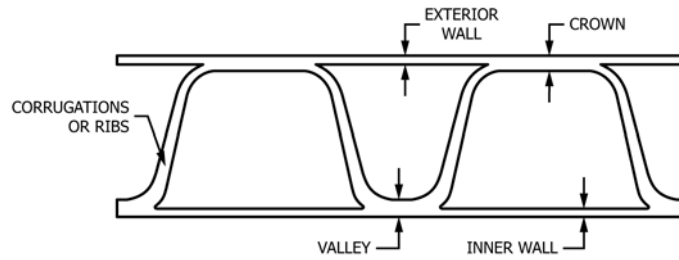


FIG. 1 Typical Triple Wall Pipe Profile

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

F2136 Test Method for Notched, Constant Ligament-Stress (NCLS) Test to Determine Slow-Crack-Growth Resistance of HDPE Resins or HDPE Corrugated Pipe

2.2 AASHTO Standards:³

LRFD, Section 12 AASHTO LRFD Bridge Design Specifications Section 12 – Buried Structures and Tunnel Liners

2.3 Federal Standard:⁴

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

2.4 Military Standard:⁴

MIL-STD-129 Marking for Shipment and Storage

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 Fitting type(s):

4.1.5.1 Size and type of fittings, including mainline and branch diameters, and

4.1.5.2 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 triple wall pipe and fittings shall have the minimum properties as shown in Table 1. Polypropylene compounds shall be comprised of the base polypropylene virgin resin and all additives, colorants, UV inhibitors and stabilizers. Conditioning sampling, preparation, and testing of molded specimens shall be accordance with the requirements in Specification D4101. For slow crack-growth resistance of the pipe corrugation, and inner and exterior walls, PP resins shall be evaluated using the notched constant ligament stress (NCLS) test according to the procedure described in 7.7.1. The average failure time of the five test specimens shall exceed 100 h with no single test specimen’s failure time less than 71 h. Compounds shall be tested and validated on an annual basis or for any new formulations.

5.2 Color and Ultraviolet Stabilization for Pipe and 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

3. Terminology

3.1 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 triple wall, n—In this case, the triple pipe wall construction provides an interior wall in the waterway, an exterior wall to the soil, and includes ribs, corrugations, or other shapes, which can be either solid or hollow, that helps brace the pipe against diametrical deformation.

³ Available from 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 Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.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 @ 230°C | 1.50 @ 230°C |
| 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) | 4,500 (31) |
| Elongation at Yield | D638 | % (%) | 5 (5) | 25 (25) |
| Flexural Modulus (1% secant) | D790B | psi (N/mm ²) | 175,000 (1,200) | 275,000 (1,900) |
| IZOD Impact Strength (730°F [230°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 |

Test Method **D4218**. Colored polypropylene compounds shall be protected from Ultraviolet (UV) degradation with UV stabilizers.

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 of the gasket or on the pipe.

5.6 Bell Retaining Bands—Monolithically formed bands in or on the external wall of the bell, when used, shall provide tensile restraint to bell expansion due to gasket insertion or internal hydrostatic pressure in accordance with **6.6.4**. These bands shall be made of corrosive resistant materials such as fiberglass (Specification **D4389**) or stainless steel (Specification **A666**).

NOTE 1—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 Minimum Inside Diameter—The minimum inside diameter shall be as shown in **Table 2**, when measured in accordance with section **7.3.3**. In no case shall the manufac-

turer’s stated inside diameter minus the tolerance in **Table 2** be less than the required minimum inside diameter.

NOTE 2—The manufacturer’s stated inside diameter is the nominal diameter plus or minus the inside diameter tolerances. The minimum inside diameter is the smallest diameter the pipe can be with these tolerances and is used for the hydraulic design of the pipe.

NOTE 3—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.

6.2.3 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 % of stated quantity when measured in accordance with **7.3.2**.

6.2.4 Minimum Wall, Crest, 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**.

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

NOTE 4—The 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).

6.6 Fittings and Joining Systems:

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

NOTE 5—Fittings may be fabricated from the pipe by a variety of processes including hot plate welding, spin welding or other processes.

TABLE 2 Pipe Stiffness and Pipe Dimensions

| Pipe Inside Diameter | | Minimum Inside Diameter | | Inside Diameter Tolerances | | Minimum Pipe Stiffness at 5 % Deflection | Minimum Inner Liner Thickness | Minimum Outer Liner Thickness | Minimum Valley Thickness | Minimum Crown Thickness | | | | |
|----------------------|--------|-------------------------|--------|----------------------------|-----------|--|-------------------------------|-------------------------------|--------------------------|-------------------------|-------|-------|-------|-------|
| in. | [mm] | in. | [mm] | in. | [mm] | lb/in [kPa] | in. | [mm] | in. | [mm] | in. | [mm] | | |
| 30 | [750] | 29.62 | [752] | +0.18/- 0.18 | +4.6/-4.6 | 46 [317] | 0.070 | [1.8] | 0.070 | [1.8] | 0.081 | [2.1] | 0.115 | [2.9] |
| 36 | [900] | 35.40 | [899] | +0.21/- 0.21 | +5.3/-5.3 | 46 [317] | 0.095 | [2.4] | 0.095 | [2.4] | 0.109 | [2.8] | 0.165 | [4.2] |
| 42 | [1050] | 41.31 | [1049] | +0.22/- 0.22 | +5.6/-5.6 | 46 [317] | 0.105 | [2.7] | 0.105 | [2.7] | 0.121 | [3.1] | 0.165 | [4.2] |
| 48 | [1200] | 47.31 | [1201] | +0.27/- 0.27 | +6.9/-6.9 | 46 [317] | 0.105 | [2.7] | 0.105 | [2.7] | 0.126 | [3.2] | 0.170 | [4.3] |
| 54 | [1350] | 53.32 | [1354] | +0.27/- 0.27 | +6.9/-6.9 | 46 [317] | 0.105 | [2.7] | 0.105 | [2.7] | 0.131 | [3.3] | 0.170 | [4.3] |
| 60 | [1500] | 59.30 | [1506] | +0.31/- 0.31 | +7.9/-7.9 | 46 [317] | 0.105 | [2.7] | 0.105 | [2.7] | 0.137 | [3.5] | 0.210 | [5.3] |

6.6.2 The joining system(s) shall be of a design that preserves alignment during construction and prevents separation at the joints while maintaining watertight requirements in accordance with 6.6.3.

6.6.3 Pipe and fittings shall have a watertight bell/spigot joint that complies with the laboratory tests defined and described in Specification D3212 and utilizes a gasket that complies with the requirements of Specification F477. Note that special provisions must be taken in order to join field cut pipe that meets the requirements of Specification D3212. Any component used in the joining material shall be resistant to effluents being carried in the pipe.

6.6.4 Monolithic retaining bands utilized for the bells on joining systems shall have a structural tensile resistance of twice the operational pressure of the pipeline, but no less than 21.6 psi, when tested in accordance with 6.6.3. In lieu of a full Specification D3212 joint test, it shall be acceptable to exert only the bell to the internal pressure by either mechanical or hydrostatic means for the appropriate test time in Specification D3212. Bell retaining bands, when used, shall show no signs of cracking, separation, splitting or delamination from the pipe during this test.

6.6.5 A joint proof-of-design test shall be conducted in accordance with 7.10. This test is a one time validation test for the specific pipe diameter, gasket and joint configuration supplied by the manufacturer.

6.7 *Creep Rupture Strength*—Specimens fabricated in the same manner and composed of the same materials as the finished pipe shall have a 50-year creep rupture tensile strength at 73°F (23°C) not less than 1000 psi (7 MPa), when determined in accordance with 7.8.

6.8 *Creep Modulus*—Specimens fabricated in the same manner and composed of the same materials as the finished pipe shall have a 50-year tensile creep modulus at 73°F (23°C) at the stress level of 500 psi (3.5 MPa) not less than 27,000 psi (186 MPa). The creep modulus shall be determined in accordance with 7.9.

NOTE 6—The 50-year creep rupture strength and 50-year creep modulus values, determined by the test methods in 7.8 and 7.9, are used to define the slope of the logarithmic regression curves to describe the required material properties sampled from the product. They are not to be interpreted as service life limits.

6.9 *Installation Requirements*—The pipe manufacturer shall provide the purchaser with the requirements for the proper installation of the pipe and the minimum and maximum allowable cover height for specific traffic and non-traffic loading conditions. The installation requirements shall be based on Practice D2321 with a design that satisfies the safety factors specified in the AASHTO LRFD, Section 12, Bridge Design Specifications for Thermoplastic Pipe for earth and live loads, with consideration for impact and multiple vehicle presences.

6.10 *Structural Data*—If requested by the purchaser, the pipe manufacturer shall provide data to enable verification of structural design safety factors, including pipe profile geometry, wall centroid, wall area, wall moment of inertia, and material strain limits.

7. Test Methods

7.1 Conditioning:

7.1.1 *Referee Testing*—When conditioning is required for referee tests, condition the specimens in accordance with Procedure A of Practice D618 at $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$] for not less than 40 h prior to test. Conduct tests under the same conditions of temperature. The selection of the sample or samples of the pipe and fittings shall be as agreed upon between the owner and the seller. In case of no prior agreement, any sample selected by the testing laboratory shall be deemed permitted.

7.1.2 *Quality Control Testing*—Condition specimens for a minimum of 4 h prior to test in air or 1 h in water at $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$] without regard to relative humidity.

7.2 *Test Conditions*—Conduct tests other than those for routine quality control purposes in the standard laboratory atmosphere of $73.4 \pm 3.6^\circ\text{F}$ [$23 \pm 2^\circ\text{C}$], in the referenced test method or in this specification

7.3 Dimensions:

7.3.1 *Inside Diameter*—Measure the inside diameter in accordance with Test Method D2122.

7.3.2 *Laying Length*—Measure pipe length in accordance with Test Method D2122. These measurements may be taken at ambient temperature.

7.3.3 *Minimum Inside Diameter, and Wall, Crown, Valley and Liner Thickness*—Measure the thickness of each wall component in accordance with Test Method D2122. Each specimen shall be cut perpendicular to the seam line of the pipe. This circumferential cut shall be made directly through a corrugation allowing a plain view of the inner wall 360° around the circumference in order to obtain a minimum of eight measurements in accordance with Test Method D2122. Each specimen shall also be cut along the axis of the seam line to measure the longitudinal profiles for two full corrugation periods to obtain a minimum of eight measurements for each section thickness.

7.4 *Pipe Stiffness*—Select a minimum of three pipe specimens and test for pipe stiffness $F/\Delta y$, as described in Test Method D2412, except for the following conditions:

7.4.1 The test specimens shall be 24-in. [609 mm] in length but shall not be less than three full corrugations. The exact length shall be an integer multiple of the corrugation pitch.

7.4.2 Locate the first specimen in the loading machine between two corrugations parallel to the loading plates. The specimen must lay flat on the plate within $\frac{1}{8}$ in. (3 mm). Use the first location as a reference point for rotation of 90°. Rotate the second specimen 450 and 900. Test each specimen in one position only.

7.4.3 The deflection indicator shall be readable and accurate to +0.001 in. (+0.02 mm).

7.4.4 The parallel plates must exceed the samples in length.

7.5 *Flattening*—Flatten the three test specimens from 7.4 between parallel plates until the pipe inside diameter is reduced by 40 %. The rate of loading shall be 2 in./min [50 mm/min]. It is acceptable to run the flattening test in conjunction with the pipe stiffness test at a loading rate of 0.5 ± 0.02 in./min [12.5 ± 0.5 mm/min] in accordance with Test Method D2412. The