Designation: F2764/F2764M − 18a

Standard Specification for 6 to 60 in. [150 to 1500 mm] Polypropylene (PP) Corrugated Double and Triple Wall Pipe and Fittings for Non-Pressure Sanitary Sewer Applications[1]

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.

1. Scope*

1.1 This specification covers requirements and test methods for corrugated double and triple wall polypropylene pipe and fittings. The nominal inside diameters covered are 6 to 60 in. [150 to 1500 mm].

1.2 The requirements of this specification are intended to provide pipe and fittings 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 annular corrugated wall and an essentially smooth interior wall (that is, double wall) (Fig. 1) and pipe and fittings with an annular corrugated wall and an essentially smooth interior and exterior wall (that is, triple wall) (Fig. 2).

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, health, and environmental practices and determine the applicability of regulatory 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]

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
D578/D578M Specification for Glass Fiber Strands
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 Practice 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 Classification System and Basis for Specification for

[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 Nov. 1, 2018. Published January 2019. Originally approved in 2010. Last previous edition approved in 2018 as F2764/F2764M–18. DOI:10.1520/F2764_F2764M–18A.

[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**

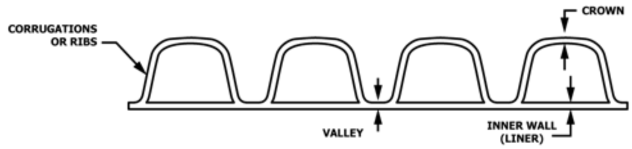

FIG. 1 Typical Corrugated Double Wall Pipe

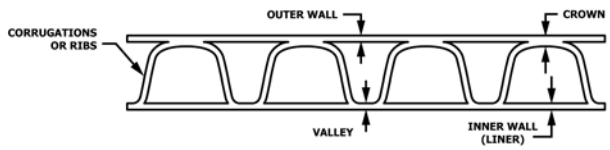

FIG. 2 Typical Corrugated Triple Wall Pipe

Polypropylene Injection and Extrusion Materials

D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique

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

2.5 *NCHRP (National Cooperative Highway Research Program) Report:*[5]

NCHRP Report 631 Updated Test and Design Methods for Thermoplastic Drainage Pipe

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 *double wall pipe, n*—In this case, the profile pipe wall construction provides an interior liner in the waterway and includes corrugations, which can be either solid (with a liner) or hollow (with no liner), that helps brace the pipe against diametrical deformation. The corrugation wall is exposed to the soil side of the pipe and is its exterior wall.

3.2.2 *triple wall pipe, n*—In this case, the triple pipe wall construction provides an interior wall in the waterway, an exterior wall to the soil, and includes corrugations, which can be either solid (with a liner) or hollow (with no liner), that helps brace the pipe against diametrical deformation.

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 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. Compounds that have higher performance properties shall be permitted provided the density of the base resin shall not exceed 0.0343 lb/in^3 (0.950 g/cm^3) and all other product requirements are met. Conditioning sampling, preparation, and testing of molded specimens shall be in accordance with the requirements in Specification D4101. For slow crack-growth resistance of the pipe corrugation, and inner and exterior walls, PP compounds 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. The minimum long-term (50-year) design values for modulus of elasticity and tensile strength for the PP compounds shall be 27 000 psi [186 MPa] and 1,000 psi [7.0 MPa], respectively.

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

[5] The National Academies of Sciences, Engineering, and Medicine 500 Fifth Street, NW Washington, DC 20001 http://www.national-academies.org

TABLE 1 Polypropylene Compound Properties

Property	ASTM Test Method	Units [SI Units]	Minimum Value
Melt Flow Rate	D1238	g/10 min	0.15 @ 230 °C
Density	D792, D1505	lb/in^3 [g/cm^3]	0.0325 [0.900]
Tensile Strength at Yield	D638	psi [N/mm^2]	3500 [24]
Elongation at Yield	D638	% (%)	5 [5]
Flexural Modulus (1% secant)	D790B	psi [N/mm^2]	175 000 [1,200]
IZOD Impact Strength (73.0 °F [23.0 °C])	D256	ft-lb/in [J/m]	8 [427]
Oxidative-Induction Time (392 °F [200 °C])	D3895	min	25
Long-Term Modulus of Elasticity (50-yr)	D2990	psi [MPa]	27 000 [186]
Long-Term Tensile Strength (50-yr)	D2990	psi [MPa]	1000 [7]

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 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 *Optional Bell Retaining Bands or External Wraps*—Monolithically formed bands or stiffening wraps 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 corrosion resistant materials such as fiberglass (Specification D578/D578M) or stainless steel (Specification A666). All metallic mechanical devices, including castings and bolt assemblies used to mechanically restrain the bell shall be constructed of corrosion resistant stainless steel materials meeting the physical properties and chemical composition requirements of A666, Type 302 through Type 316.

5.6.1 The D578/D578M fiberglass roving or chopped strand shall be an E or S type glass, free of any alkali, dirt or other impurities. The band shall consist of overlapping continuous or chopped filament fiber strand and not a fabric.

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 manufacturer'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. Additionally, at or below the average deflection limit defined in Eq 1 and Eq 2 for dual wall and

TABLE 2 Pipe Stiffness and Pipe Dimensions

Pipe Inside Diameter[A]		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/in	[kPa]	in.	[mm]	in.	[mm]	in.	[mm]	in.	[mm]
6	[150]	5.61	[142]	+0.04/-0.04	+1.0/-1.0	46	[317]	0.040	[1.0]	...	...	...	...	...	...
8	[200]	7.70	[196]	+0.05/-0.05	+1.1/-1.1	46	[317]	0.045	[1.1]	...	...	...	...	...	...
10	[250]	9.70	[246]	+0.06/-0.06	+1.4/-1.4	46	[317]	0.050	[1.3]	...	...	...	...	...	...
12	[300]	11.90	[302]	+010/-0.10	+2.5/-2.5	46	[317]	0.054	[1.4]	...	...	...	...	...	...
15	[375]	14.85	[377]	+0.15/-0.15	+3.8/-3.8	46	[317]	0.065	[1.7]	...	...	...	...	...	...
18	[450]	17.93	[455]	+0.17/-0.17	+4.3/-4.3	46	[317]	0.075	[1.9]	...	...	...	...	...	...
21	[530]	20.75	[527]	+0.17/-0.17	+4.3/-4.3	46	[317]	0.077	[2.0]	...	...	...	...	...	...
24	[600]	23.90	[607]	+0.23/-0.23	+5.8/-58	46	[317]	0.086	[2.2]	...	...	...	...	...	...
30	[750]	29.79	[757]	+0.24/-0.24	+6.1/-6.1	46	[317]	0.108	[2.7]	...	...	...	...	...	...
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]

[A] The triple wall profile wall pipe are only available in sizes 30 in. [750 mm] to 60 in. [1500 mm]. Double wall profile pipe are available in sizes 6 in. [150 mm] to 30 in. [750 mm]. At 30 in. [750 mm] diameter, where the dimensions for the outer liner thickness are defined, all the associated dimensions shall only pertain to the triple wall profile pipe .

triple wall profiles, respectively, the specimen shall be considered as failing this test when the load does not increase continuously with increasing deflection.

Buckling Defection Limit:

Double Wall:

$$\Delta = 1.07\% \cdot \left(\frac{D}{0.5(D_o - D_i)} \right) \quad (1)$$

Triple Wall:

$$\Delta = 1.29\% \cdot \left(\frac{D}{0.5(D_o - D_i)} \right) \quad (2)$$

where:

Δ	=	minimum buckling deflection limit (%)
D	=	mean diameter (centroid) of pipe (in [mm])
$0.5\,(D_o - D_i\,)$	=	height of the corrugation (outside diameter minus inside diameter) (in [mm])

NOTE 5—Eq 1 and Eq 2 are based on the results from NCHRP Report 631 and is defined as being derived from the standard parallel plate test equation and modified for polypropylene. The values for the diameter measurements are based on each producer's specific corrugation dimensions.

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 Fittings shall be fabricated by the pipe manufacturer from pipe made in accordance with this standard. Fittings fabricated from double-wall pipe shall be used with double-wall pipe. Fittings fabricated from triple-wall pipe shall be used with triple-wall pipe. Fitting material shall comply with 5.1, 5.2 and 5.3.

6.6.1.1 Fittings shall be tested in an installation orientation, shall be uniformly supported (body and outlet(s)) by the lower plate, and uniformly loaded (body and outlet(s)) by the upper plate. Fittings shall meet or exceed a vertical load equivalent to the 5% deflection stiffness in accordance with Table 2 for pipe to which the fitting is to be joined. The equivalent maximum load shall be the 5% deflection stiffness in accordance with Table 2 unit load (psi/in or [kPa /mm]) multiplied by the length of the fitting (run plus branch(es) as applicable) that is loaded by the upper plate. Testing shall be for equivalent load, not deflection. Acceptance criteria shall be in accordance with 6.4.

NOTE 6—Installation orientation means that the fitting testing orientation is as though it were installed in a pipeline, for example, an elbow or tee with the directional outlet(s) to the side. In accordance with an established quality program, fittings should be tested to only qualify the overall design and integrity of the unit. As unique structures, testing of every angle orientation is not necessary.

6.6.1.2 The fitting body in an installation orientation shall be impact tested in accordance with 7.6. Acceptance criteria shall be in accordance with 6.5.

6.6.2 The joining system(s) between pipe and between pipe and fittings shall be of a design that preserves pipeline slope and alignment during construction and prevents separation at the joints while maintaining watertight requirements in accordance with 6.6.3. Fittings shall be tested in an installation orientation, shall be uniformly supported (body and outlet(s)) by the lower plate, and uniformly loaded (body and outlet(s)) by the upper plate.