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An American National Standard

Standard Specification for Glass Fiber Reinforced Polyethylene (PE-GF) Spiral Wound Large Diameter Pipe[1]

This standard is issued under the fixed designation F2720/F2720M; 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 materials, dimensions, workmanship, joining systems, and marking for large diameter, 12 in. [300 mm] and larger, inside diameter controlled glass fiber reinforced polyethylene (PE-GF) spiral wound pipe with electrofusion joints. The piping is intended for new construction and renewal of existing piping systems used for the transport of water, slurries, municipal sewage, domestic sewage, effluents, etc., in pressure systems.

NOTE 1—Pipe produced to this specification should be installed in accordance with Practice D2774 or Guide F1668, where applicable, and with the manufacturer's recommendations.

1.2 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text the SI units are shown in brackets. 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.

1.3 All pipes produced under this specification are pressure-rated.

1.4 This specification includes criteria for choice of raw material and test methods for evaluation of raw material, together with performance requirements and test methods for determining conformance with the requirements.

1.5 In referee decisions, the SI units shall be used for metric-sized pipe and inch-pound units for pipe sized per ANSI (ANSI B 36.10).

1.6 *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]

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
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
D2657 Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
D2774 Practice for Underground Installation of Thermoplastic Pressure Piping
D2837 Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
D3350 Specification for Polyethylene Plastics Pipe and Fittings Materials
D3895 Test Method for Oxidative-Induction Time of Polyolefins by Differential Scanning Calorimetry
F412 Terminology Relating to Plastic Piping Systems
F1290 Practice for Electrofusion Joining Polyolefin Pipe and Fittings
F1668 Guide for Construction Procedures for Buried Plastic Pipe

2.2 *ANSI Standard:*

[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.11 on Composite.

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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.

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TABLE 1 Physical Properties of PE-GF Material Tested as Pipe

Property	Test Method(s)	Units	Minimum Value
Density	ASTM D792 or D1505	g/cm^3	1.04
Oxidation Induction Time @ 412°F [200°C]	ASTM D3895	minutes	20
Tensile strength @ yield (longitudinal direction)	ASTM D638	kpsi [MPa]	5.075 [35.0]
Tensile Elastic Modulus	ASTM D638	kpsi [N/mm^2]	333.5 [2300]
Flexural Elastic Modulus	ASTM D790	kpsi [MPa]	372 [2566]
Resistance to Notch Test	ISO 13479	hours	2500
Hydrostatic Design Basis for water at 73°F [23°C]	ASTM D2837	psi [MPa]	2500 [17.22]

TABLE 2 Standard Pressure Ratings

SIDR	11	13.5	15	17	19	21	24	27	31	35	39	44	49	55	63	70
Design Factor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
HDB, psi	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200	3200
P, psi	267	221	201	180	160	143	127	113	101	90	80	71	64	57	51	45
P, kPa	1838	1521	1389	1238	1103	983	876	781	696	621	553	493	439	391	349	311
SIDR	11	13.5	15	17	19	21	24	27	31	35	39	44	49	55	63	70
Design Factor	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
HDB, psi	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
P, psi	208	172	157	140	125	111	99	88	79	70	63	56	50	44	40	35
P, kPa	1436	1188	1085	967	862	768	685	610	544	485	432	385	343	306	272	243

B36.10 Standard Dimensions of Steel Pipe (IPS)[3]

2.3 *ISO Standard:*

ISO 13479 Polyolefin Pipes for the Conveyance of Fluids—Determination of Resistance to Crack Propagation—Test Method for Slow Crack Growth on Notched Pipes (Notch Test)[4]

2.4 *NSF/ANSI Standards:*

Standard No. 4 for Plastic Piping Components and Related Materials[5]

Standard No. 61 for Drinking Water Systems Components —Health Effects[5]

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 polyethylene is PE.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *glass fiber reinforced polyethylene (PE-GF)*—short glass fiber reinforced polyethylene compound.

3.2.2 *relation between standard dimension ratio, hydrostatic design stress, and pressure rating:*

$$P = \frac{2S}{(Di/t) + 1} \quad (1)$$

where:

S = hydrostatic design stress (HDS), psi [or kPa or MPa],
P = pressure rating, psi [or kPa or MPa],
Di = average inside diameter, in. [or mm],
t = minimum wall thickness, in. [or mm], and
Di/t = standard dimension ratio or standard inside diameter dimension ratio (SIDR).

3.2.3 *relationship between hydrostatic design basis (HDB) and hydrostatic design stress (HDS)*—the hydrostatic design stress, S, is determined by multiplying the hydrostatic design basis (HDB) by the design factor, n. The design factor, n, has a value less than 1.0.

3.2.3.1 *Discussion*—The hydrostatic pressure rating of pipes described in this specification is based on the use of a (service) design factor of 0.5.

4. Materials

4.1 *General*—The polyethylene, reinforcements, colorants, and other additives, when combined as a composite structure, shall produce a pipe that shall meet the performance requirements of this specification.

4.2 *Glass Fiber Reinforced Polyethylene (PE-GF) Material*—Pipe shall be made of PE-GF plastic compound meeting the requirements shown in Table 1. The PE-GF pipe, as manufactured, shall have a minimum hydrostatic design basis (HDB) of 2500 psi [17.2 MPa] for water at 73.4°F [23°C] determined using Test Method D2837. Pressure ratings are shown in Table 2. Ambient and elevated temperature sustained pressure testing requirements are shown in Table 5.

4.3 *Polyethylene (PE)*—The polyethylene base compound prior to the incorporation of the glass fibers shall meet the minimum property requirements of either cell class 333444 or 444454 as described in Specification D3350. The inner and external un-reinforced polyethylene layers shall be either black or colored and shall be made of the same polyethylene compound that is used to make the PE-GF compound.

4.4 *Glass Fibers*—Short glass fibers.

4.5 *Color and Ultraviolet (UV) Stabilization*—The pipe shall be black or blue or black with blue stripes. The external and internal colored polyethylene layers shall be made of

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[4] 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.

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

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TABLE 3 PE-GF Pipe Dimensions and Out-of-Roundness Allowance

Nominal Pipe Size, in. [mm]	Inside Diameter, minimum in. [mm]	Inside Diameter, maximum in. [mm]	Maximum Out-of-Roundness in. [mm]
12 [300]	11.81 [300]	12.13 [308]	0.39 [10]
16 [400]	15.75 [400]	16.06 [408]	0.55 [14]
20 [500]	19.69 [500]	20.00 [508]	0.67 [17]
24 [600]	23.62 [600]	23.98 [609]	0.83 [21]
28 [700]	27.56 [700]	27.95 [710]	0.94 [24]
32 [800]	31.50 [800]	31.97 [812]	1.10 [28]
36 [900]	35.43 [900]	35.94 [913]	1.22 [31]
40 [1000]	39.37 [1000]	39.96 [1015]	1.38 [35]
44 [1100]	43.31 [1100]	43.90 [1115]	1.50 [38]
48 [1200]	47.24 [1200]	47.95 [1218]	1.65 [42]
52 [1300]	51.18 [1300]	51.89 [1318]	1.77 [45]
56[1400]	55.12 [1400]	55.94 [1421]	1.93 [49]
64 [1600]	62.99 [1600]	63.94 [1624]	2.20 [56]
72 [1800]	70.87 [1800]	71.93 [1827]	2.48 [63]
80 [2000]	78.74 [2000]	79.92 [2030]	2.76 [70]
88 [2200]	86.61 [2200]	87.91 [2233]	3.03 [77]
96 [2400]	94.49 [2400]	95.91 [2436]	3.31 [84]
104 [2600]	102.36 [2600]	103.90 [2639]	3.58 [91]
112 [2800]	110.24 [2800]	111.89 [2842]	3.86 [98]
120 [3000]	118.11 [3000]	119.49 [3035]	4.13 [105]
128 [3200]	125.98 [3200]	127.87 [3248]	4.41 [112]
136 [3400]	133.86 [3400]	135.87 [3451]	4.69 [119]
144 [3600]	141.73 [3600]	143.86 [3654]	4.96 [126]
152 [3800]	149.61 [3800]	151.85 [3857]	5.24 [133]
160 [4000]	157.48 [4000]	159.84 [4060]	5.51 [140]

un-reinforced polyethylene compounds meeting the requirements of Specification D3350 Code C or Code E. Code C polyethylene compounds shall have between 2.0 and 3.0 percent carbon black. Code E polyethylene compounds shall be colored and protected from Ultraviolet (UV) degradation with UV stabilizers.

4.6 *Rework Material*—Clean rework material generated from the manufacturer's own pipe production shall be allowed up to a maximum of 10 % by weight in the PE-GF compound. The PE-GF pipe produced shall meet all the requirements of this specification.

5. Classification and Uses

5.1 *Uses*—The requirements of this specification are intended to provide pipe suitable for underground or above ground pressure applications as well as gravity and low pressure drainage of sewer and surface water.

5.2 *Classifications*—This specification covers PE-GF pressure pipe products made in standard inside diameter ratios (SIDR) from 11 to 70. Standard pressure ratings for the various SIDR pipes are shown in Table 2.

6. Joining Systems

6.1 *Electrofusion Joint*:

6.1.1 The joint shall consist of an integral electrofusion device built into the inside of the bell and a plain spigot, which come together to form an electrofusion joint with the proper application of electrical current for an appropriate time period. The seal is made by electrofusion joining through an integral electrofusion device built into the belled end of the pipe. The spigot is inserted into the socket (or bell) and current applied to the contacts.

6.2 *Electrofusion Coupling*—The seal is made by electrofusion joining through a separate electrofusion coupling or fitting. The electrofusion fitting may be an enlarged OD coupler, a reduced ID coupler, or an equal OD/ID internal coupler.

6.2.1 The assembly of the electrofusion joint shall follow the general requirements of Practice F1290 and with the manufacturer's recommendations.

7. Requirements

7.1 *Workmanship*—The inside and outside surfaces shall be semi-matte or semi-glossy in appearance and be free of chalking, sticky, or tacky material. The pipe walls shall be free of cracks, blisters, foreign inclusions, or other defects that are visible to the naked eye and that may affect the wall integrity.

7.2 *Pipe Dimensions*:

7.2.1 *Diameter*—The average inside diameter of the pipe, including the diameter in integral socket or bell sections where present, shall meet the requirements given in Table 3, when measured in accordance with 8.4.1.

7.2.2 *Pipe Wall Thickness*—The minimum wall thickness of the pipe (see Fig. 1) shall meet the requirements given in Table 5, when measured in accordance with 8.4.2.

7.2.3 *Laying Length*—Standard pipe laying length, measured from the bottom of the bell to the tip of the spigot (see Fig. 1), shall be 19.7 ft [6.0 m) when measured in accordance with Test Method D2122. For pipe with an integral bell, the pipe laying length is measured from the bottom of the bell to the tip of the spigot.

7.3 *Ambient and Elevated Temperature Sustained Pressure Test*—Test representative PE-GF pipe in accordance with 8.5 at one ambient temperature and stress condition and one elevated temperature and stress condition for the specified minimum time to failure as shown in Table 5.

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