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An American National Standard

Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter[1]

This standard is issued under the fixed designation F714; 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 polyethylene (PE) pipe made in dimensions based on outside diameters of 90 mm (3.500 in.) and larger.

1.2 Three standard outside diameter sizing systems are detailed: one known as the ISO metric system, one known as the IPS system, and the other known as the DIPS system. See 5.2.5 for guidelines for special sizes.

1.3 The piping is intended for new construction and insertion renewal of old piping systems used for the transport of water, municipal sewage, domestic sewage, industrial process liquids, effluents, slurries, etc., in both pressure and nonpressure systems.

NOTE 1—The user should consult the manufacturer to ensure that any damage to the polyethylene pipe caused by the material being transported will not affect the service life beyond limits acceptable to the user.

1.4 All pipes produced under this specification are pressure-rated. See Appendix X5 for information on pressure rating.

NOTE 2—References and material descriptions for PE2406, PE3406, PE3408 and materials having a HDB of 1450 psi have been removed from Specification F714 due to changes in Specification D3350 and PPI TR-3. For removed designations, refer to previous editions of Specification F714, Specification D3350, PPI TR-3 and PPI TR-4. The removal of these materials does not affect pipelines that are in service. See Notes 9 and 9.

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

1.6 Quality-control measures are to be taken by manufacturers. See Appendix X4 for general information on quality control.

1.7 In referee decisions, the SI units shall be used for metric-sized pipe and inch-pound units for pipe sized in the IPS system (ANSI B36.10) and DIPS system. In all cases, the values given in parentheses are provided for information only.

~~1.8 The following safety hazards caveat pertains only to the test methods portion, Section 6, 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.*~~

1.8 The following safety hazards caveat pertains only to the test methods portion, Section 6, 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.*

1.9 *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]

D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer

D1598 Test Method for Time-to-Failure of Plastic Pipe Under Constant Internal Pressure

D1599 Test Method for Resistance to Short-Time Hydraulic Pressure of Plastic Pipe, Tubing, and Fittings

D1600 Terminology for Abbreviated Terms Relating to Plastics

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[1] This specification is under the jurisdiction of ASTM Committee F17 on Plastic Piping Systems and is the direct responsibility of Subcommittee F17.26 on Olefin Based Pipe.

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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.

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

D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
D2290 Test Method for Apparent Hoop Tensile Strength of Plastic or Reinforced Plastic Pipe
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
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
F412 Terminology Relating to Plastic Piping Systems
F585 Guide for Insertion of Flexible Polyethylene Pipe Into Existing Sewers

2.2 *ANSI Standard:*
B36.10 Standard Dimensions of Steel Pipe (IPS)[3]

2.3 *ISO Standards:*
161 Thermoplastic Pipe for the Transport of Fluids - Nominal Outside Diameters and Nominal Pressures[4]
3607 Polyethylene Pipe: Tolerances on Outside Diameters and Wall Thicknesses[4]
4427 Polyethylene Pipes and Fittings for Water Supply Specification[4]

2.4 *Federal Standard:*
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[5]

2.5 *Military Standard:*
MIL-STD-129 Marking for Shipment and Storage[5]

2.6 *Canadian Standard:*
CGSB 41 GP-25M Pipe, Polyethylene for the Transport of Liquids[6]

2.7 *NSF/ANSI Standards:*
Standard No. 14 for Plastic Piping Components and Related Materials[7]
Standard No. 61 for Drinking Water Systems Components—Health Effects[7]

2.8 *Other Documents:*
PPI TR-3 Policies and Procedures for Developing Hydrostatic Design Basis (HDB), Pressure Design Basis (PDB), Strength Design Basis (SDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe[8]
PPI TR-4 HDB/SDB/PDB/MRS Listed Materials, PPI Listing of Hydrostatic Design Basis (HDB), Strength Design Basis (SDB), Pressure Design Basis (PDB), and Minimum Required Strength (MRS) Ratings for Thermoplastic Piping Materials or Pipe[8]
APWA Uniform Color Code[9]

3. Terminology

3.1 Unless otherwise specified, definitions are in accordance with Terminology F412 and abbreviations are in accordance with Terminology D1600.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *dimension ratio, hydrostatic design stress, and pressure rating relationship:*

$$P = \frac{2S}{(D_O/t) - 1}$$

where:

S = ~~hydrostatic design stress, HDS, for water at 73°F (23°C), psi (or kPa or MPa),~~
S = hydrostatic design stress, HDS, for water at 73 °F (23 °C), psi (or kPa or MPa),
P = pressure rating, PR, psi (or kPa or MPa),
D_O = outside diameter, in. (or mm), per Tables 3, 4, or 5
t = minimum wall thickness, in. (or mm), per Tables 6, 7, or 8
D_O/t = dimension ratio (DR).

3.2.2 *hydrostatic design basis and hydrostatic design stress*—the hydrostatic design stress, *S*, is determined by multiplying the hydrostatic design basis (HDB) by a design factor, *DF* that has a value less than 1.0.

[3] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, ~~http://www.ansi.org.~~ http://www.ansi.org.
[4] Available from International Organization for Standardization (ISO), 1 rue de Varembé, Case postale 56, CH-1211, Geneva 20, Switzerland, http://www.iso.ch.
[5] Available from ~~Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D,~~ DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA ~~19111-5098, http://www.dodssp.daps.mil.~~ 19111-5094, http://quicksearch.dla.mil.
[6] Available from Canadian Standards Association (CSA), ~~5060 Spectrum Way, Mississauga, ON L4W 5N6, Canada, http://www.csa.ca.~~ 178 Rexdale Blvd., Toronto, ON M9W 1R3, Canada, http://www.csagroup.org.
[7] Available from NSF International, P.O. Box 130140, 789 N. Dixboro Rd., Ann Arbor, MI 48113-0140, http://www.nsf.org.
[8] Available from Plastics Pipe Institute (PPI), 105 Decker Court, Suite 825, Irving, TX 75062, http://www.plasticpipe.org.
[9] American Public Works Association (APWA) ~~2345 Grand Boulevard, Suite 700~~ 1200 Main Street, Suite 1400 Kansas City, MO ~~64108-2625,~~ 64105-2100, http://www.apwa.net

NOTE 3—Hydrostatic design stress (HDS) ratings for PE compounds are in accordance with this specification and are specified in Section 4.

4. Materials

4.1 *Polyethylene Compound*—Polyethylene compounds suitable for use in the manufacture of pipe under this specification shall meet thermoplastic materials designation codes PE2708 or PE3608 or PE4608 or PE4710, and shall meet Table 1 requirements for PE2708 or PE3608 or PE4608 or PE4710, and shall meet thermal stability, brittleness temperature and elongation at break requirements in accordance with Specification D3350.

4.1.1 Polyethylene compounds suitable for use in the manufacturer of DIPS pipe per Table 2 and Table 3 are identified by thermoplastic pipe material designation code, and shall be PE4710 or PE3608 in accordance with 4.1, 4.1.2 and 4.2.

4.1.2 *Color and Ultraviolet (UV) Stabilization*—Per Table 1, polyethylene compounds shall meet Specification D3350code C or E. In addition, Code C polyethylene compounds shall have 2 to 3 percent carbon black, and Code E polyethylene compounds shall have sufficient UV stabilizer to protect pipe from deleterious UV exposure effects during unprotected outdoor shipping and storage for at least eighteen (18) months.

4.2 *Potable Water Requirement*—When required by the regulatory authority having jurisdiction, products intended for contact with potable water shall be evaluated, tested, and certified for conformance with NSF/ANSI Standard No. 61 or the health effects portion of NSF/ANSI Standard No. 14 by an acceptable certifying organization.

4.3 *Rework Material*—Clean polyethylene compound from the manufacturer's own pipe production that met 4.1 through 4.1.2 as new compound is suitable for reextrusion into pipe, when blended with new compound of the same thermoplastic pipe material designation code. Pipe containing rework material shall meet the requirements of this specification.

5. Requirements

5.1 *Workmanship*—The pipe shall be homogeneous throughout and essentially uniform in color, opacity, density, and other properties. The inside and outside surfaces shall be semimatte or glossy in appearance (depending on the PE compound) and free of chalking, sticky, or tacky material. The surfaces shall be free of excessive bloom, that is, slight bloom is acceptable. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects that are visible to the naked eye and that may affect the wall integrity. Holes deliberately placed in perforated pipe are acceptable. Bloom or chalking may develop in pipe exposed to direct rays of the sun (ultraviolet radiant energy) for extended periods and, consequently, these requirements do not apply to pipe after extended exposure to direct rays of the sun.

5.2 *Dimensions and Tolerances:*

5.2.1 *Outside Diameters*—These shall be in accordance with Table 2 (inch-pound units), Table 4 (SI units), Table 5 (inch-pound units) or when measured in accordance with Test Method D2122 at any point not closer than 300 mm (11.8 in.) to the cut end of a length of pipe. Conditioning to standard temperature without regard to relative humidity is required.

TABLE 1 Polyethylene Compound Requirements

Requirement	Material Designation			
	PE2708	PE3608	PE4608	PE4710
	Required Value			
Minimum HDB at 140ºF (60ºC), psi (MPa), per D2837and PPI TR-3	800 (5.5)[A]	800 (5.5)[A]	800 (5.5)[A]	800 (5.5)[A]
~~HDS for water at 73°F (23°C) psi (MPa), per D2837 and PPI TR-3[A]~~	~~800 (5.5)~~	~~800 (5.5)~~	~~800 (5.5)~~	~~1000 (6.9)~~
HDS for water at 73 °F (23 °C) psi (MPa), per D2837 and PPI TR-3[A]	800 (5.5)	800 (5.5)	800 (5.5)	1000 (6.9)
Melt flow rate per D1238	≤0.40 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6	≤0.15 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6	≤0.15 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6	≤0.15 g/10 min Cond. 190/2.16 or ≤20 g/10 min Cond. 190/21.6
Specification D3350 Cell Classification Property	Required Value			
Density (natural base resin)	2	3	4	4
SCG Resistance	7	6	6	7
Color and UV Stabilizer Code[B]	C or E	C or E	C or E	C or E

[A]Contact manufacturer or see PPI TR-4 for listed value.
[B]See 4.1.1.

TABLE 2 Outside Diameters and Tolerances-DIPS Sizing System

Nominal Size	Outside Diameter, in (mm)	Minimum Outside Diameter, in. (mm)	Maximum Outside Diameter, in. (mm)
3	3.960 (100.58)	3.942 (100.13)	3.976 (100.99)
4	4.800 (121.92)	4.778 (121.37)	4.822 (122.48)
6	6.900 (175.26)	6.869 (174.47)	6.931 (176.05)
8	9.050 (229.87)	9.009 (228.84)	9.091 (230.91)
10	11.100 (281.94)	11.050 (280.67)	11.150 (283.21)
12	13.200 (335.28)	13.141 (333.77)	13.259 (336.78)
14	15.300 (388.62)	15.231 (386.87)	15.369 (390.37)
16	17.400 (441.96)	17.322 (439.97)	17.478 (443.94)
18	19.500 (495.30)	19.412 (493.07)	19.588 (497.54)
20	21.600 (548.64)	21.503 (546.17)	21.697 (551.10)
24	25.800 (655.32)	25.684 (652.37)	25.916 (658.27)
30	32.000 (815.80)	31.856 (809.14)	32.144 (816.46)
36	38.300 (972.82)	38.128 (968.44)	38.472 (977.19)
42	44.500 (1130.30)	44.300 (1125.21)	44.700 (1135.38)
48	50.800 (1290.32)	50.571 (1284.51)	51.029 (1296.14)

5.2.2 *Wall Thicknesses*—The minimum thicknesses shall be in accordance with Table 3, Table 6, or Table 7 when measured in accordance with Test Method D2122. Conditioning to standard temperature without regard to relative humidity is required.

5.2.3 *Eccentricity*—The wall thickness variability as measured and calculated in accordance with Test Method D2122 in any diametrical cross section of the pipe shall not exceed 12 %.

5.2.4 *Toe-In*—When measured in accordance with 5.2.1, the outside diameter at the cut end of the pipe shall not be more than 1.5 % smaller than the undistorted outside diameter. Measurement of the undistorted outside diameter shall be made no closer than 1.5 pipe diameters or 11.8 in. (300 mm), whichever distance is less, from the cut end of the pipe. Undistorted outside diameter shall meet specifications in Table 2, Table 4, or Table 5.

5.2.5 *Special Sizes*—Where existing system conditions or special local requirements make other diameters or dimension ratios necessary, other sizes or dimension ratios, or both, shall be acceptable for engineered applications when mutually agreed upon by the customer and the manufacturer, if the pipe is manufactured from plastic compounds meeting the material requirements of this specification, and the strength and design requirements are calculated on the same basis as those used in this specification. For diameters not shown in Table 2, Table 4, or Table 5, the tolerance shall be the same percentage as that used in the corresponding table for the next smaller listed size. Minimum wall thicknesses for DRs not shown in Table 3, Table 6, or Table 7 or shall be determined by dividing the average outside diameter by the DR and rounding to three decimal places for inch sized pipes or two decimal places for metric sized pipes, and the tolerance shall comply with 5.2.3.

5.3 *Pressure Test Performance*—All pipe shall meet the requirements of 5.3.2 and either 5.3.1 or 5.4.

NOTE 4—The requirements of 5.3.1 and 5.3.2 are for laboratory proof-testing only and should not be interpreted as applicable to in situ testing for acceptance of installed systems. See appropriate installation and leak testing standards or manufacturer's recommendations for field testing procedure.

5.3.1 *Short-Term Pressurization*—Quick burst or non-failure testing shall be conducted per 5.3.1.1 or 5.3.1.2. Test pressure shall be determined per 3.2.1 except that *S* shall be the prescribed hoop stress value, and *P* shall be test pressure.

5.3.1.1 *Quick Burst*—For pipe nominal ~~12-in.~~ 12 in. (315 mm) and smaller diameter, rupture shall be ductile when tested in accordance with 6.1. The minimum hoop stress shall be 2520 psi (17.4 MPa) for Table 1 density cell 2 materials and 2900 psi (20.0 MPa) for Table 1 density cell 3 and 4 materials.

5.3.1.2 *Non-Failure*—When raised to test pressure and held at test pressure for five (5) seconds, pipe shall not rupture, leak, nor exhibit localized deformation when tested in accordance with 6.1 at a test pressure determined using 2500 psi hoop stress for Table 1 density cell 2 materials, and 3200 psi hoop stress for Table 1 density cell 3 and 4 materials.

5.3.2 *Elevated Temperature Sustained Pressure*—Elevated-temperature sustained-pressure test for each Table 1 polyethylene pipe material (material designation) used in production at the facility shall be conducted twice annually per 6.2.

NOTE 5—Elevated temperature sustained pressure tests are intended to verify extrusion processing and are conducted in accordance with the manufacture's quality program.

5.3.2.1 Passing results are *(1)* non-failure for all three specimens at a time equal to or greater than the Table 8 "minimum average time before failure", or *(2)* not more than one ductile specimen failure and the average time before failure for all three specimens shall be greater than the specified "minimum average time before failure" for the selected Table 8 Condition. If more than one ductile failure occurs before the Table 8 "minimum average time before failure", it is permissible to conduct one retest at a Table 8 Condition of lower stress and longer minimum average time before failure for the material designation except that for Table 8 Condition 6 no retest is permissible. Brittle failure of any specimen in the test sample when tested at Table 8 Condition 1 through 6 constitutes failure to meet this requirement and no retest is allowed.

TABLE 3 Minimum Wall Thickness DIPS Sizing System, in.

		PE4710[A]						PE3608[A]					
		PR350[B]	PR300[B]	PR250[B]	PR200[B]	PR150[B]	PR100[B]	PR350[B]	PR300[B]	PR250[B]	PR200[B]	PR150[B]	PR100[B]
Nominal Size	Outside Diameter in. (mm)[C]	350 psi (2415 kPa)[D]	300 psi (2070 kPa)[D]	250 psi (1725 kPa)[D]	200 psi (1380 kPa)[D]	150 psi (1035 kPa)[D]	100 psi (690 kPa)[D]	350 psi (2415 kPa)[D]	300 psi (2070 kPa)[D]	250 psi (1725 kPa)[D]	200 psi (1380 kPa)[D]	150 psi (1035 kPa)[D]	100 psi (690 kPa)[D]
		DR 6.7	DR 7.7	DR 9	DR 11	DR 14.3	DR 21	DR 5.6	DR 6.3	DR 7.4	DR 9	DR 11.7	DR 17
3	3.960	0.591	0.514	0.440	0.360	0.277	0.189	0.707	0.629	0.535	0.440	0.338	0.233
	(100.58)	(15.01)	(13.06)	(11.18)	(9.14)	(7.04)	(4.80)	(17.96)	(15.97)	(13.59)	(11.18)	(8.59)	(5.92)
4	4.800	0.761	0.623	0.533	0.436	0.336	0.229	0.857	0.762	0.649	0.533	0.410	0.282
	(121.92)	(18.20)	(15.83)	(13.54)	(11.07)	(8.53)	(5.82)	(21.77)	(19.35)	(16.48)	(13.54)	(10.41)	(7.16)
6	6.900	1.030	0.896	0.767	0.627	0.483	0.329	1.232	1.095	0.932	0.767	0.590	0.406
	(175.26)	(26.16)	(22.76)	(19.48)	(15.93)	(12.27)	(8.36)	(31.30)	(27.82)	(23.67)	(19.48)	(14.99)	(10.31)
8	9.050	1.351	1.175	1.006	0.823	0.633	0.431	1.616	1.437	1.223	1.006	0.774	0.532
	(229.87)	(34.31)	(29.85)	(25.55)	(20.90)	(16.08)	(10.95)	(41.05)	(36.49)	(31.06)	(25.55)	(19.66)	(13.51)
10	11.100	1.657	1.441	1.233	1.009	0.776	0.529	1.982	1.762	1.500	1.233	0.949	0.653
	(281.94)	(42.08)	(36.62)	(31.32)	(25.63)	(19.71)	(13.44)	(50.35)	(44.75)	(38.10)	(31.32)	(24.10)	(16.59)
12	13.200	1.970	1.714	1.467	1.200	0.923	0.629	2.357	2.095	1.784	1.467	1.128	0.776
	(335.28)	(50.04)	(43.54)	(37.26)	(30.48)	(23.44)	(15.98)	(59.87)	(53.22)	(45.31)	(37.26)	(28.65)	(19.71)
14	15.300	2.284	1.987	1.700	1.391	1.070	0.729	2.732	2.429	2.068	1.700	1.308	0.900
	(388.62)	(58.00)	(50.47)	(43.18)	(35.33)	(27.18)	(18.52)	(69.40)	(61.69)	(52.53)	(43.18)	(33.22)	(22.86)
16	17.400	2.597	2.260	1.933	1.582	1.217	0.829	3.107	2.762	2.351	1.933	1.487	1.024
	(441.96)	(65.96)	(57.40)	(49.10)	(39.67)	(30.91)	(21.06)	(78.92)	(70.15)	(59.72)	(49.10)	(37.77)	(26.01)
18	19.500	2.910	2.532	2.167	1.773	1.364	0.929	3.482	3.095	2.635	2.167	1.667	1.147
	(495.30)	(73.93)	(64.32)	(55.04)	(45.03)	(34.65)	(23.60)	(88.45)	(78.62)	(66.93)	(55.04)	(42.34)	(29.13)
20	21.600	3.224	2.805	2.400	1.964	1.510	1.029	...	3.429	2.919	2.400	1.846	1.271
	(548.64)	(81.89)	(71.25)	(60.96)	(49.89)	(38.35)	(26.14)		(87.09)	(74.14)	(60.96)	(46.89)	(32.28)
24	25.800	...	3.351	2.867	2.345	1.804	1.229	...	...	3.486	2.867	2.205	1.518
	(655.32)		(85.11)	(72.82)	(59.56)	(45.82)	(31.22)			(88.54)	(72.82)	(56.01)	(38.56)
30	32.000	...	...	3.556	2.909	2.238	1.524	...	...	...	3.556	2.735	1.882
	(815.80)			(90.32)	(73.89)	(56.85)	(38.71)				(90.32)	(69.47)	(47.80)
36	38.300	...	...	...	3.482	2.678	1.824	...	...	...	...	3.274	2.253
	(972.82)				(88.44)	(68.02)	(46.33)					(83.16)	(57.23)
42	44.500	...	...	...	...	3.112	2.119	...	...	...	...	...	2.618
	(1130.30)					(79.04)	(53.82)						(66.50)
48	50.800	...	...	...	...	3.552	2.419	...	...	...	...	...	2.988
	(1290.32)					(90.22)	(61.44)						(75.90)

[A] Thermoplastic material designation code per 4.1.1.
[B] See 9.1.7.
[C] Per Table 2
[D] Per 3.2.1. Values rounded to the nearest 5 kPa.

TABLE 4 Outside Diameters and Tolerances

ISO Sizing System (ISO 161/1)			
NominalPipe Size	Equivalent	Outside Diameter, D_o, mm	
mm	in.	min	max[A]
90	3.543	90	90.8
110	4.331	110	111.0
160	6.299	160	161.4
200	7.874	200	201.8
250	9.843	250	252.3
280	11.024	280	282.5
315	12.402	315	317.8
355	13.976	355	358.2
400	15.748	400	403.6
450	17.717	450	454.1
500	19.685	500	504.5
560	22.047	560	565.0
630	24.803	630	635.7
710	27.953	710	716.4
800	31.496	800	807.2
900	35.433	900	908.1
1000	39.370	1000	1009.0
1200	47.244	1200	1210.8
1400	55.118	1400	1412.6
1600	62.992	1600	1614.4

[A] As specified in ISO 3607.

TABLE 5 Outside Diameters and Tolerances IPS Sizing System (ANSI B36.10)

Nominal Pipe Size, in.	Equivalent, mm	Actual Outside Diameters, in.	
		Average	Tolerance ± in.
3	88.9	3.500	0.016
4	114.3	4.500	0.020
5[A]	136.5	5.375	0.025
5	141.3	5.563	0.025
6	168.3	6.625	0.030
7[A]	181.0	7.125	0.034
8	219.1	8.625	0.039
10	273.1	10.750	0.048
12	323.8	12.750	0.057
13[A]	339.7	13.375	0.060
14	355.6	14.000	0.063
16	406.4	16.000	0.072
18	457.2	18.000	0.081
20	508.0	20.000	0.090
21.5[A]	546.1	21.500	0.097
22	558.8	22.000	0.099
24	609.6	24.000	0.108
26	660.4	26.000	0.117
28	711.2	28.000	0.126
30	762.0	30.000	0.135
32	812.8	32.000	0.144
34	863.6	34.000	0.153
36	914.4	36.000	0.162
42	1066.8	42.000	0.189
48	1219.2	48.000	0.216
54	1371.6	54.000	0.243

[A] Irregular size.

5.3.2.2 *Provision for retest (if needed)*—The retest sample shall be three specimens of the same pipe or tubing size and material designation from the same time frame as the test sample per 6.2. For the retest, any specimen failure before the "minimum average time before failure" at the retest condition of lower stress and longer minimum average time before failure constitutes failure to meet this requirement.

5.4 *Apparent Tensile Strength at Yield*—For pipe nominal 3-in. (90-mm) diameter and larger, Short-Term Pressurization requirement, 5.3.1, may be replaced by the apparent tensile strength at yield requirement, 5.4. The minimum apparent tensile strength at yield when determined in accordance with 6.3 shall be 2520 psi (17.4 MPa) for Table 1 density cell 2 materials and 2900 (20.0 MPa) for Table 1 density cell 3 and 4 materials.