Designation: ~~F2160 – 16~~ F2160 – 22

An American National Standard

Standard Specification for Solid Wall High Density Polyethylene (HDPE) Conduit Based on Controlled Outside Diameter (OD)[1]

This standard is issued under the fixed designation F2160; 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 material, dimensional, workmanship and performance requirements for polyethylene conduit, duct and innerduct manufactured for use in a non- pressure applications for the protection of fiber optic and power cables. Applications include telecom, SCADA command and control, highway lighting, ITS (Intelligent Transportation Systems) and Underground Utilities with PE conduit installed using methods such as Horizontal Directional Drilling (HDD), plowing and open trench.

1.2 HDPE conduit meeting the requirements of this standard shall be made as OD or ID controlled solid wall, with or without internal or external ribs in IPS types SDR 9, SDR 11, SDR 13.5, DR 15.5, Schedule 40, Schedule 80 and "True-sized" and SIDR dimensions. The internal or external surface may contain a coextruded layer provided the finished conduit meets the product requirements of this specification.

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 The following precautionary caveat pertains only to the test method 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~~ safety, health, and ~~health~~environmental practices and determine the applicability of regulatory ~~requirements~~limitations prior to use.*

1.5 *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]

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~~

[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.

Current edition approved ~~Nov. 1, 2016~~April 1, 2022. Published ~~December 2016~~May 2022. Originally approved in 2001. Last previous edition approved in ~~2010~~2016 as F2160~~–10.~~–16. DOI: 10.1520/F2160-16.

[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**

D1600 Terminology for Abbreviated Terms Relating to Plastics
D1693 Test Method for Environmental Stress-Cracking of Ethylene Plastics
D2122 Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
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)
~~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
~~D4883 Test Method for Density of Polyethylene by the Ultrasound Technique~~
F412 Terminology Relating to Plastic Piping Systems
~~F1473 Test Method for Notch Tensile Test to Measure the Resistance to Slow Crack Growth of Polyethylene Pipes and Resins~~

3. Terminology

3.1 *Definitions*—General terms used in this Specification are as defined in Terminology F412, and abbreviations are in accordance with Terminology D1600, unless otherwise specified.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *CATV, n*—cable television.

3.2.2 *conduit (duct), n*—a tubular raceway for carrying power, communications, or other wires and cables

3.2.3 *innerduct, n*—a conduit installed inside a conduit.

3.2.4 *kink, n*—a crease across the conduit where it has folded from excessive bending.

3.2.5 *ribs, n*—a series of ridges along the inside or outside surface of a conduit.

3.2.6 *true size, n*—denotes the use of a sizing system that requires a nominal inside diameter to be the equal or greater than the stated nominal size of the conduit (that is, a 1¼ in. conduit has a minimum ID of 1.25 in.).

3.2.7 *SCADA, n*—(Supervisory control and data acquisition) use of fiber optic to, for example, control gates for pipelines.

4. Materials

4.1 PE compound shall meet Specification D3350 requirements and be classified in accordance with Specification D3350 with a minimum cell classification of PE334480C or PE334480E. Higher classification values for the first four cells and the sixth cell shall be acceptable. The classification value for the fifth cell shall be 8 in accordance with 4.2.

4.1.1 *Rework Material*—Clean polyethylene compound from the manufacturers own production may be re-extruded into conduit, either alone or blended with virgin compound. Conduit containing the rework material shall meet all the material and product requirements of this specification. Where rework material is known to contain cadmium, lead, mercury or hexavalent chromium, or a combination thereof, the loading of rework shall be limited such that the final conduit product shall not contain more than 0.01 % by weight cadmium and no more than 0.1 % by weight each of lead, mercury, and hexavalent chromium.

NOTE 1—Conformance with the metal requirements of 4.1.1 can be demonstrated by either a determination of heavy metals in the final product or a calculation of the maximum heavy metals expected to be present based on their presence in the rework material.

4.1.2 *Color Compounds*—Color concentrate compounds used to color the conduit shall have no cadmium, lead, mercury, and hexavalent chromium added as an intentional ingredient and shall contain no more than 0.01 % by weight cadmium and no more than 0.1 % by weight each of lead, mercury, and hexavalent chromium.

NOTE 2—Conformance with the requirements of 4.1.2 can be demonstrated based on letters of compliance from color compound manufacturers, for example a RoHS[3] compliance letter.

4.2 *Slow Crack Growth*—The minimum specified ESCR cell class 8 requirement is F10 > 96 h per Test Method D1693, condition B, 10 % Igepal. Alternatively, slow crack growth cell classification per Specification D3350 of 4 or higher is acceptable in meeting this requirement

4.3 *Coextruded Layer*—Any material used as a coextruded layer on the inside or outside surface of the PE conduit shall adhere to the surface of the PE and shall not delaminate in normal use. It shall not degrade or lower the performance of the PE conduit.

4.4 *Aerial Applications*—PE material for black conduit in long-term above ground applications, such as aerial suspension, shall be stabilized with a minimum of ~~2–4 %~~2 %–4 % by weight carbon black having an average particle size less than or equal to 20 nanometers.

4.5 *Outdoor Storage Stability:*

NOTE 3—Acceptable cell for Color and UV resistance properties in Table 1 may be achieved by utilizing a precompounded material or by blending a base natural material with a color concentrate.

4.5.1 *Colored Conduit*—PE material for colored (black included) conduit in non-UV exposed applications shall be suitably protected against UV degradation so that conduit may be stored outside and uncovered for a period of not less than one year. Permanent color identification shall be permitted to be as solid color, as stripes, as a co-extruded skin, or a combination of these. If stripes are specified, a minimum of 3 stripes equally spaced around the circumference shall be required, to aid in the identification of the conduit. Colored conduit shall maintain its color for a period of 1 year when stored outside, or as otherwise agreed to by the specifier and producer.

4.5.1.1 Solid yellow or black with yellow stripes shall not be used for identification of conduit due to risk of misidentification with gas pipe.

5. Requirements

5.1 *Workmanship*—Each layer of the conduit shall be homogeneous throughout and essentially uniform in color, opacity, density and other properties. The inside and outside surfaces shall be free of visible cracks, holes, blisters, voids, foreign inclusions, or other deleterious defects.

5.2 *Dimensions and Tolerances:*

5.2.1 *Outside Diameters*—The outside diameters and tolerances shall be as shown in Table 1 for IPS SDR and Schedule 40 and 80 sizes, Table 2 for "true" sizing, and Table 3 for SIDR sized conduit, when measured in accordance with Test Method D2122.

5.2.2 *Wall Thickness*—The wall thicknesses and tolerances shall be as shown in Table 4 for IPS sizes, Schedule 40 and 80 and Table 2 for "True-sized" PE conduit, and Table 3 for SIDR sized Conduit when measured in accordance with Test Method D2122.

5.2.3 *Special Sizes*—When mutually agreeable between the manufacturer and the purchaser, other sizes and wall thicknesses shall be acceptable. The tolerance on outside diameter shall be ± 0.5 percent of the nominal outside diameter. The lowest permissible wall thickness for any conduit outside diameter shall be 0.062 in. (1.57 mm). For wall thicknesses not listed, the tolerances shall be the same percentage of the calculated minimum wall thickness as the closest listed minimum wall thickness.

5.2.4 *Ribbed Conduit*—Conduit shall be permitted to contain either (*a*) spiral or oscillating spiral HDPE ribs inside of the conduit or (*b*) longitudinal ribs on the inside and/or outside of the conduit. The inside diameter of the conduit relative to this specification shall be measured between the ribs. For internally ribbed conduit, the manufacturer shall provide the maximum inside diameter and tolerance that can be circumscribed within the internal rib projections. For externally ribbed conduit, the manufacturer shall provide the minimum outside diameter and tolerance that circumscribes the external rib projections.

[3] DIRECTIVE 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

TABLE 1 Outside Diameter and Tolerance for PE Conduit, IPS SDR 9, SDR 11, SDR 13.5, DR 15.5, Schedule 40 and Schedule 80

Nominal Size, in.	Outside Diameter		Tolerance	
	in.	(mm)	in.	(mm)
½	0.840	(21.34)	± 0.004	(± 0.11)
¾	1.050	(26.67)	± 0.005	(± 0.13)
1	1.315	(33.40)	± 0.007	(± 0.17)
1¼	1.660	(42.16)	± 0.008	(± 0.21)
1½	1.900	(48.26)	± 0.010	(± 0.24)
2	2.375	(60.33)	± 0.012	(± 0.30)
2½	2.875	(73.03)	± 0.014	(± 0.37)
3	3.500	(88.90)	± 0.018	(± 0.44)
4	4.500	(114.30)	± 0.023	(± 0.57)
5	5.563	(141.30)	± 0.028	(± 0.71)
6	6.625	(168.28)	± 0.033	(± 0.84)
8	8.625	(219.08)	± 0.043	(± 1.10)
10	10.750	(273.05)	± 0.054	(± 1.37)
12	12.750	(323.85)	± 0.064	(± 1.62)

TABLE 2 Minimum Inside Diameter and Tolerance and Minimum Wall Thickness and Tolerance for "True Sized" SDR 11 and SDR 9 PE Conduit

Nominal Size	Minimum ID		Wall Thickness SDR 11		Wall Thickness SDR 9	
	Min	Tol	Min	Tol	Min	Tol
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
½	0.512 (13.00)	+0.020 +(0.51)	0.047 (1.19)	+0.006 +(0.15)	0.057 (1.45)	+0.007 +(0.18)
¾	0.750 (19.05)	+0.020 +(0.51)	0.068 (1.72)	+0.008 +(0.20)	0.083 (3.18)	+0.010 +(0.25)
1	1.000 (25.40)	+0.020 +(0.51)	0.091 (2.31)	+0.011 +(0.28)	0.111 (2.82)	+0.013 +(0.33)
1⅛	1.125 (28.58)	+0.020 +(0.51)	0.102 (2.59)	+0.012 +(0.30)	0.125 (3.18)	+0.015 +(0.38)
1¼	1.250 (31.75)	+0.020 +(0.51)	0.114 (2.90)	+0.014 +(0.36)	0.139 (3.53)	+0.017 +(0.43)
1⅜	1.375 (34.93)	+0.020 +(0.51)	0.125 (3.18)	+0.015 +(0.41)	0.153 (3.89)	+0.018 +(0.46)
1½	1.500 (38.10)	+0.020 +(0.51)	0.136 (3.45)	+0.016 +(0.41)	0.167 (4.24)	+0.020 +(0.51)
2	2.000 (50.80)	+0.027 +(0.51)	0.182 (4.62)	+0.022 +(0.55)	0.222 (5.64)	+0.027 +(0.68)

5.2.5 *Friction Reduction*—Internal lubrication or a coextruded layer on the inner wall of conduit for reducing frictional resistance shall be permitted. Lubrication materials shall be compatible with the conduit and any cable jacketing.

5.2.6 *Toe-In*—When measured in accordance with 5.2.1, the outside diameter at the cut end of the conduit shall not be more than 1.5 % smaller than the outside diameter per 5.2.1. Outside diameter measurement 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 conduit.

5.2.7 *Ovality*—The ovality (cross section) of 2 in. IPS and smaller conduit shall not exceed 7 % when measured in accordance with 6.4. Coiled conduit larger than 2 in. IPS through 3 in. IPS shall not exceed 10 % when measured in accordance with 6.4. Kinks in a coil shall not be acceptable.

NOTE 4— Deformations due to packaging requirements, when within five (5) ft. of the ends of coiled products, should not be considered. Conduit with deformation as noted above should not be utilized.

NOTE 5—Ovality is a packaging condition that occurs when roundable conduit is wound into a coil. Conduit flattens out as it is coiled. Larger diameter conduit may have significant ovality, for example, the inner coil layers of 6 in. IPS coiled conduit may have 20 % or more ovality. Ovality is corrected when joining equipment is applied to roundable conduit, or by field processing roundable conduit through re-rounding and straightening equipment during installation.

5.2.7.1 Ovality measurements of coiled conduit shall be made on a sample cut from the end of the coil or reel, and in case of disagreement, conditioned per 6.1.

TABLE 3 Inside Diameter and Tolerance and Minimum Wall Thickness and Tolerance for SIDR PE Conduit

Nominal Size	Inside Diameter		Wall Thickness SIDR 15		Wall Thickness SIDR 11.5		Wall Thickness SIDR 9	
	Min	Tol	Min	Tol	Min	Tol	Min	Tol
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
1	1.049 (26.64)	+0.010 -0.020 (+0.25) (-0.51)	0.070 (1.78)	+0.020 +(0.51)	0.091 (2.31)	+0.020 +(0.51)	0.117 (2.97)	+0.020 +(0.51)
1¼	1.380 (35.05)	+0.010 -0.020 (+0.25) (-0.51)	0.092 (2.34)	+0.020 +(0.51)	0.120 (3.05)	+0.020 +(0.51)	0.153 (3.89)	+0.020 +(0.51)
1½	1.610 (40.89)	+0.015 -0.020 (+0.38) (-0.51)	0.107 (2.72)	+0.020 +(0.51)	0.140 (3.56)	+0.020 +(0.51)	0.179 (4.55)	+0.020 +(0.51)
2	2.067 (52.50)	+0.015 -0.020 (+0.38) (-0.51)	0.138 (3.51)	+0.020 +(0.51)	0.180 (4.57)	+0.022 +(0.56)	0.230 (5.84)	+0.028 +(0.71)
2½	2.469 (62.71)	+0.015 -0.020 (+0.38) (-0.51)	0.165 (4.19)	+0.020 +(0.51)	0.215 (5.46)	+0.026 +(0.66)	... ...	... ...
3	3.068 (77.93)	+0.015 -0.030 (+0.38) (-0.76)	... ...	... ...	0.267 (6.78)	+0.032 +(0.81)	... ...	... ...
4	4.026 (102.26)	+0.020 -0.020 (+0.51) (-0.051)	... ...	... ...	0.350 (8.89)	+0.042 +(1.07)	... ...	... ...
5	5.046 (128.17)	+0.025 -0.025 (+0.64)	... ...	... ...	0.429 (10.90)	+0.053 +(1.35)	... ...	... ...

TABLE 4 Minimum Wall Thickness and Tolerance for IPS SDR 9, SDR 11, SDR 13.5, DR 15.5, Schedule 40 and Schedule 80 PE Conduit

Nominal Size	DR 15.5		SDR 13.5		SDR 11		SDR 9		Schedule 40		Schedule 80	
	Min.	Tol.	Min.	Tol.	Min.	Tol.	Min.	Tol.	Min.	Tol.	Min.	Tol.
	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)	in. (mm)
½	0.062 (13.00)	+0.020 +(0.51)	0.062 (1.57)	+0.020 +(0.51)	0.076 (1.93)	+0.020 +(0.51)	0.093 (2.36)	+0.020 +(0.51)	0.109 (2.77)	+0.020 +(0.51)	0.147 (3.73)	+0.020 +(0.51)
¾	0.068 (1.73)	+0.020 +(0.51)	0.078 (1.98)	+0.020 +(0.51)	0.095 (2.41)	+0.020 +(0.51)	0.117 (2.97)	+0.020 +(0.51)	0.113 (2.87)	+0.020 +(0.51)	0.154 (3.91)	+0.020 +(0.51)
1	0.084 (2.13)	+0.020 +(0.51)	0.097 (2.46)	+0.020 +(0.51)	0.120 (3.05)	+0.020 +(0.51)	0.146 (3.71)	+0.020 +(0.51)	0.133 (3.38)	+0.020 +(0.51)	0.179 (4.55)	+0.021 +(0.53)
1¼	0.107 (2.72)	+0.020 +(0.51)	0.123 (3.12)	+0.020 +(0.51)	0.151 (3.84)	+0.020 +(0.51)	0.184 (4.67)	+0.022 +(0.56)	0.140 (3.56)	+0.020 +(0.51)	0.191 (4.85)	+0.023 +(0.58)
1½	0.123 (3.12)	+0.020 +(0.51)	0.141 (3.58)	+0.020 +(0.51)	0.173 (4.39)	+0.021 +(0.53)	0.211 (5.36)	+0.025 +(0.64)	0.145 (3.68)	+0.020 +(0.51)	0.200 (5.08)	+0.024 +(0.61)
2	0.153 (3.89)	+0.020 +(0.51)	0.176 (4.47)	+0.020 +(0.51)	0.216 (5.49)	+0.026 +(0.66)	0.264 (6.71)	+0.032 +(0.81)	0.154 (3.91)	+0.020 +(0.51)	0.218 (5.54)	+0.026 +(0.66)
2½	0.185 (4.70)	+0.022 +(0.56)	0.213 (5.41)	+0.020 +(0.51)	0.261 (6.64)	+0.031 +(0.80)	0.319 (8.11)	+0.038 +(0.97)	0.203 (5.16)	+0.024 +(0.61)	0.276 (7.01)	+0.033 +(0.84)
3	0.226 (5.74)	+0.027 +(0.69)	0.259 (6.58)	+0.031 +(0.79)	0.318 (8.08)	+0.038 +(0.97)	0.389 (9.88)	+0.047 +(1.19)	0.216 (5.49)	+0.026 +(0.66)	0.300 (7.62)	+0.036 +(0.91)
4	**0.290**[A] **(7.37)**	**+0.035 +(0.89)**	0.333 (8.46)	+0.040 +(1.02)	0.409 (10.39)	+0.049 +(1.24)	0.500 (12.70)	+0.060 +(1.52)	**0.237 (6.02)**	**+0.028 +(0.71)**	0.337 (8.56)	+0.040 +(1.02)
5	**0.359 (9.12)**	**+0.043 +(1.09)**	0.412 (10.47)	+0.049 +(1.26)	0.506 (12.86)	+0.061 +(1.54)	0.618 (15.70)	+0.074 +(1.88)	**0.258 (6.55)**	**+0.031 +(0.79)**	0.375 (9.53)	+0.045 +(1.14)
6	**0.427 (10.85)**	**+0.051 +(1.30)**	0.491 (12.47)	+0.059 +(1.50)	0.602 (15.29)	+0.072 +(1.83)	0.736 (18.69)	+0.088 +(2.24)	**0.280 (7.11)**	**+0.034 +(0.86)**	0.432 (10.97)	+0.05 (+1.32)
8	... ...	... ...	**0.639 (16.23)**	**+0.077 +(1.96)**	**0.784 (19.91)**	**+0.094 +(2.39)**	**0.958 (24.3)**	**+0.115 +(2.92)**	... ...	... ...	... ...	... ...
10	... ...	... ...	**0.796 (20.23)**	**+0.096 +(2.43)**	**0.977 (24.82)**	**+0.117 +(2.98)**	**1.194 (30.34)**	**+0.143 +(3.64)**	... ...	... ...	... ...	... ...
12	... ...	... ...	**0.944 (23.99)**	**+0.113 +(2.88)**	**1.159 (29.44)**	**+0.139 +(3.53)**	**1.417 (35.98)**	**+0.170 +(4.32)**	... ...	... ...	... ...	... ...

[A]Reference Bolding: Nominal diameters size 4 and larger in wall thickness DR 15.5 and Schedule 40 and diameters size 6 and larger in Schedule 80 should be produced only as stick pipe due to the potential for buckling if produced on a reel or as a coil. Nominal diameters size 8 and larger are available only in stick pipe because they cannot be coiled.

5.2.7.2 If ovality greater than 10 % for coiled conduit larger than 3 in. IPS is unsuitable for a particular application, the coiled conduit shall be processed by the installer through re-rounding equipment that corrects ovality to 10 % or less.

5.3 *Test Performance*—All specimens shall be measured before testing in accordance with Test Method D2122 and shall meet all the required dimensions and tolerances for the conduit type being manufactured. Except for 5.3.2, all measurements and tests shall be conducted at ~~73°~~73°F ± 3.6°F (23° ± 2°C).

5.3.1 *Elongation at Break*—When tested in accordance with 6.2, the minimum elongation at break shall be 400 %.

5.3.2 *Impact*—The conduit shall not fail when three specimen are tested at the low-temperature condition of ~~-4°F (-20°C),~~-4 °F (-20 °C), in accordance with 6.3 – 6.3.2 or if one out of three specimen fails, then a retest of three additional specimen shall result in no failures.

5.4 *Outdoor Storage Stability*—Colored conduit intended for non-UV exposed application and stored outside and uncovered for more than one year from date of manufacture shall meet the requirements of this specification.

5.5 *Pipe Stiffness, Compression and Recovery*—Specimens shall achieve the minimum loads given in Table 5, Table 6, and Table 7 at ~~5%~~5 % deflection when tested in accordance with 6.5. In addition, during compression and recovery testing specimens shall not split or crack, when tested in accordance with 6.6.

NOTE 6—The minimum values for Pipe Stiffness (PS) are calculated using the minimum allowable flexural modulus specified of 80,000 psi. The calculated values are derived as outlined in Appendix X2 of Test Method D2412. The minimum values shown for (LbsF) force are calculated based on the test requirements of 5% deflection of the average ID at a deflection rate of 0.5 in/minute on a sample six inches long from the minimum PS values.

6. Test Methods

6.1 *Conditioning*—Condition the test specimens at test temperature for not less than 40 h prior to test in accordance with procedure A of Practice D618, for those tests where conditioning is required. Requirements for humidity are excluded.

TABLE 5 Minimum Load for Pipe Stiffness Test IPS DR and Schedule Conduit Minimum Pipe Stiffness and Test Values (4)

IPS Size, in. (mm)	DR 15.5		SDR 13.5		SDR 11		SDR 9		Schedule 40		Schedule 80	
	PS	Test Values	PS	Test Values	PS	Test Values	PS	Test Values	PS	Test Values	PS	Test Values
	lbs/in./in. (kPa)	lbsF (N)	lbs/in./in. (kPa)	lbsF (N)	lbs/in./in. (kPa)	lbsF (N)	lbs/in./in. (kPa)	lbsF (N)	lbs/in./in. (kPa)	lbsF (N)	lbs/in./in. (kPa)	lbsF (N)
½	160	35	180	39	360	74	695	130	1190	222	3420	560
(13)	(1120)	(156)	(1208)	(167)	(2416)	(321)	(4800)	(580)	(7985)	(961)	(22948)	(2425)
¾	120	33	180	48	360	93	695	170	630	156	1820	405
(19)	(810)	(143)	(1208)	(209)	(2416)	(402)	(4800)	(750)	(4227)	(674)	(12212)	(1754)
1	120	41	180	60	360	116	695	210	510	160	1400	402
(25)	(810)	(180)	(1208)	(262)	(2416)	(503)	(4800)	(930)	(3422)	(695)	(9394)	(1740)
1¼	120	52	180	76	360	147	695	260	280	116	790	303
(32)	(810)	(227)	(1208)	(331)	(2416)	(635)	(4800)	(1175)	(1879)	(502)	(5301)	(1311)
1½	120	60	180	87	360	168	695	300	200	97	580	26
(38)	(810)	(259)	(1208)	(378)	(2416)	(727)	(4800)	(1350)	(1342)	(418)	(3892)	(1130)
2	120	74	180	109	360	210	695	380	120	74	370	215
(51)	(810)	(324)	(1208)	(473)	(2416)	(909)	(4800)	(1700)	(805)	(322)	(2483)	(932)
2½	120	90	180	132	360	254	695	460	160	119	430	300
(64)	(810)	(393)	(1208)	(573)	(2416)	(1100)	(4800)	(2040)	(1074)	(513)	(2885)	(1297)
3	120	110	180	161	360	309	695	560	100	92	300	261
(76)	(810)	(478)	(1208)	(697)	(2416)	(1339)	(4800)	(2500)	(671)	(398)	(2013)	(1129)
4	120	141	180	207	360	398	695	721	60	72	190	218
(102)	(810)	(614)	(1208)	(896)	(2416)	(1721)	(4800)	(3210)	(403)	(314)	(1275)	(944)
5	120	174	180	256	360	492	695	892	40	61	140	202
(127)	(810)	(760)	(1208)	(1108)	(2416)	(2128)	(4800)	(3970)	(268)	(262)	(939)	(875)
6	120	208	180	305	360	585	695	1050	31	56	120	205
(152)	(810)	(905)	(1208)	(1319)	(2416)	(2534)	(4800)	(4700)	(201)	(236)	(805)	(898)
8	...	...	180	397	360	762	695	1390	...	...	...	...
(203)	...	...	(1208)	(1718)	(2416)	(3299)	(4800)	(6180)	...	...	...	...
10	...	...	180	500	360	935	695	1730	...	...	...	...
(250)	...	...	(1208)	(2200)	(2416)	(4100)	(4800)	(7700)	...	...	...	...
12	...	...	180	590	360	1110	695	2060	...	...	...	...
(305)	...	...	(1208)	(2600)	(2416)	(4900)	(4800)	(9150)	...	...	...	...

TABLE 6 Minimum Load for Pipe Stiffness Test for "True Sized" PE Conduit Minimum Pipe Stiffness and Test Values (4)

True Sized in. (mm)	SDR 9		SDR 11	
	PS lbsF Lbs/in/in	Test Value (N) (kPa)	PS lbsF Lbs/in/in	Test Value (N) (kPa)
½	310	47	165	25
(13)	(2100)	(205)	(1150)	(110)
¾	310	70	165	35
(19)	(2100)	(310)	(1150)	(160)
1	310	95	165	50
(25)	(2100)	(430)	(1150)	(225)
1⅛	310	110	165	55
(28)	(2100)	(490)	(1150)	(250)
1¼	310	120	165	65
(32)	(2100)	(545)	(1150)	(285)
1⅜	310	135	165	70
(34)	(2100)	(600)	(1150)	(310)
1½	310	145	165	75
(38)	(2100)	(660)	(1150)	(335)
2	310	195	165	100
(51)	(2100)	(870)	(1150)	(455)

TABLE 7 Minimum Load for Pipe Stiffness Test for SIDR PE Conduit Minimum Pipe Stiffness and Test Values (4)

SIDR Size in (mm)	SIDR 15		SIDR 11.5		SIDR 9	
	PS Lbs/in/in kPa	Test Values lbsF N	PS Lbs/in/in kPa	Test Values lbsF N	PS Lbs/in/in kPa	Test Values lbsF N
1	85	26	175	55	345	105
(25)	(575)	(115)	(1200)	(240)	(575)	(480)
1¼	85	35	175	70	345	140
(32)	(575)	(150)	(1200)	(325)	(575)	(630)
1½	85	40	175	85	345	165
(38)	(575)	(175)	(1200)	(380)	(575)	(745)
2	85	50	175	110	345	215
(51)	(575)	(235)	(1200)	(490)	(575)	(955)
2½	85	65	175	130	...	...
(64)	(575)	(280)	(1200)	(590)	...	...
3	...	...	175	160	...	...
(76)	...	...	(1200)	(730)	...	...
4	...	...	175	215	...	...
(102)	...	...	(1200)	(955)	...	...
5	...	...	175	270	...	...
(127)	...	...	(1200)	(1200)	...	...

NOTE 7—These conditioning requirements are only for product qualification or certification testing—not for manufacturing quality assurance purposes.

6.2 *Elongation at Break*—Specimens shall be die cut or machined from the wall of the conduit parallel to the extrusion direction. Testing shall be performed in accordance with Specification D3350 for tensile properties (that is in accordance with Test Method D638 at a strain rate or cross-head separation rate of 2 in./min). If sample thickness of the specimen must be reduced by milling in order to meet test specimen dimensional requirements, the inside surface of the conduit shall be left unaltered.

6.3 *Impact*—Test specimens at a temperature of ~~-4°F (-20°C).~~-4 °F (-20 °C).

6.3.1 *Low-Temperature Test*—Test three specimens of each Nominal Size conduit listed in Table 8. The specimens shall be equal in length to the nominal outside diameter but not less than 6 in. (152 mm) in length. Condition the specimens at a temperature of ~~-4~~-4 °F ± ~~3.6°F (-20~~3.6 °F (-20 °C ± ~~2°C)~~2 °C) for 5 h. Conduct the test in a room maintained at a temperature of ~~73.4~~73.4 °F ± ~~3.6°F (23~~3.6 °F (23 °C ± ~~2°C),~~2 °C), within 3 min. after removal from the cold chamber or, if the test is made in an atmosphere or at a temperature other than that at which the specimens are conditioned, conduct the tests as soon as possible after removal from the cold chamber and test within 3 min. In a case of disagreement, conduct the tests in a room maintained at ~~73.4~~73.4 °F ± ~~3.6°F (23±2°C)~~3.6 °F (23 °C±2 °C) within 3 min. The test apparatus and method are described in 6.3.2.