



Designation: ~~D1710-02~~ Designation: D 1710 - 08

Standard Specification for ~~Extruded and Compression Molded Polytetrafluoroethylene (PTFE) Rod and Heavy Walled Tubing~~ Extruded Polytetrafluoroethylene (PTFE) Rod, Heavy Walled Tubing and Basic Shapes¹

This standard is issued under the fixed designation D 1710; 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.

This standard has been approved for use by agencies of the Department of Defense.

1. Scope*

~~1.1 This specification covers polytetrafluoroethylene (PTFE) rod and heavy-walled tubing manufactured from the PTFE resin of Specification D4894 and reprocessed PTFE resin (as defined in Guide D5033~~

1.1 This specification covers extruded polytetrafluoroethylene (PTFE) rod, heavy-walled tubing, and basic shapes manufactured from the PTFE resin of Specification D 4894 and reprocessed PTFE resin (as defined in Guides D 5033 and D 7209).

1.2 The specification covers rod 200-mm (8-in.) nominal diameter or under and heavy-walled tubing 100-mm outside diameter and with a wall thickness of 1.6 mm ($1/16$ in.) or greater. These materials must be made wholly from PTFE and produced in accordance with good commercial practice.

1.2 The specification covers all sizes of rod, tubing, and basic shapes with a wall thickness of 1.6 mm ($1/16$ in.) or greater. These materials must be made wholly from PTFE and produced in accordance with good commercial ram extrusion practices.

NOTE 1—Although this specification and ISO/DIS 13000-1 (1997) and ISO/DIS 13000-2 (1997) differ in approach or detail, data obtained using either are technically equivalent. 1—This specification and ISO/DIS 13000-1 (1997) and ISO/DIS 13000-2 (1997) differ in approach, however, data obtained using either are technically equivalent.

NOTE 2—For compression molded PTFE materials, see Specification D 3294. Material that can be certified to Specification D 3294 may be substituted for Specification D 1710, however the reverse is not true.

1.3 The values stated in SI units, as detailed in IEEE/ASTM SI 10 are to be regarded as the standard. The inch-pound units given in parentheses are provided for information only.

1.4 The following precautionary caveat pertains to the test methods portion, Section 12, only 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:~~

~~D149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies~~ ASTM Standards: ²

~~D150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation~~²

~~D256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics~~

~~D257 Test Methods for D-C Resistance or Conductance of Insulating Materials~~² 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

D 374 Test Methods for Thickness of Solid Electrical Insulation

D 618 Practice for Conditioning Plastics for Testing

D621 Test Methods for Deformation of Plastics Under Load

D638 Test Method for Tensile Properties of Plastics³

¹ This specification is under the jurisdiction of ASTM Committee D20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials

Current edition approved March 10, 2002. Published May 2002. Originally published as D1710-60T. Last previous edition D1710-99.

Current edition approved April 1, 2008. Published May 2008. Originally approved in 1960. Last previous edition approved in 2002 as D 1710 - 02.

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*, Vol 10.01, 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.

- ~~D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between –30 and 30°C with a Vitreous Silica Dilatometer³~~
- ~~D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials³~~
- ~~638 Test Method for Tensile Properties of Plastics~~
- ~~D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement~~
- ~~D 883 Terminology Relating to Plastics³~~
- ~~D1505 Test Method for Density of Plastics by the Density-Gradient Technique³ Terminology Relating to Plastics~~
- ~~D 1600 Terminology for Abbreviated Terms Relating to Plastics³~~
- ~~D2240 Test Method for Rubber Property-Durometer Hardness~~
- ~~D3295 Specification for PTFE Tubing, Miniature Beading and Spiral Cut Tubing Terminology for Abbreviated Terms Relating to Plastics~~
- ~~D 3892 Practice for Packaging/Packing of Plastics⁶~~
- ~~D4591 Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry Practice for Packaging/Packing of Plastics~~
- ~~D 4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials⁷~~
- ~~D4895 Specification for Polytetrafluoroethylene (PTFE) Resins Produced from Dispersion⁷ Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials~~
- ~~D 5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics~~
- ~~D5740 Guide for Writing Material Standards in the Classification D 4000 Format⁷ 5740 Guide for Writing Material Standards in the Classification D 4000 Format~~
- ~~D 5947 Test Methods for Physical Dimensions of Solid Plastics Specimens~~
- ~~D 7209 Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products~~
- ~~E 94 Guide for Radiographic Examination~~
- ~~F36 Test Method for Compressibility and Recovery of Gasket Materials~~
- ~~IEEE/ASTM SI 10 Standard for the Use of the International System of Units (SI): The Modern Metric System³~~
- ~~2.2 ISO Standards:⁴~~
- ~~ISO 13000-1 (1997)(2005) Plastics—Polytetrafluoroethylene (PTFE) Semi-Finished Products, Part 1: Basis for Specification~~
- ~~ISO 13000-2 (1997)(2005) Plastics—Polytetrafluoroethylene (PTFE) Semi-Finished Products, Part 2: Preparation of Test Specimen and Determination of Properties~~

3. Terminology

- 3.1 *Definitions*—Definitions are in accordance with Terminology D 883 unless otherwise specified.
- 3.1.1 *lot, n*—one production run or a uniform blend of two or more production runs. (D4895)
- 3.2 *Abbreviations*— Abbreviations are in accordance with Terminology D 1600. PTFE is the acronym for polytetrafluoroethylene. <https://standards.iteh.ai/catalog/standards/sist/ddaf6c5e-12f4-40a4-8b76-6d02761c27c8/astm-d1710-08>

4. Classification

- ~~4.1 This specification covers three types of PTFE fluorocarbon rod and heavy-walled tubing. They are as follows:~~
- ~~4.1 This specification covers three types of PTFE rod, heavy-walled tubing, and basic shapes. They are as follows:~~
- ~~4.1.1 Type I, Premium—A type of rod or heavy-walled tubing having maximum physical and electrical properties to meet rigid requirements:~~
- ~~4.1.2 Type II, General Purpose—A type of rod or heavy-walled tubing having properties required of general electrical, mechanical, and chemical applications.— A type of rod, heavy-walled tubing, or basic shape requiring both maximum physical and electrical properties to meet rigid requirements.~~
- ~~4.1.2 Type II, Non-electrical Premium —A type of rod, heavy-walled tubing, or basic shape requiring physical properties, but no electrical requirements.~~
- ~~4.1.3 Type III—A type of rod or heavy-walled tubing for noncritical chemical, electrical, and mechanical applications.~~
- ~~4.2 A one-line system may be used to specify materials covered by this specification. The system uses predefined cells to refer to specific aspects of this specification, illustrated as follows: —A type of rod, heavy-walled tubing, or basic shape for non-critical chemical, electrical, and mechanical applications.~~
- ~~4.1.4 Type IV—A type of rod, heavy-walled tubing, or basic shape for chemical, electrical, and mechanical applications, not requiring physical property testing as described for Types I, II, and III, in Tables 1 and 2.~~
- ~~4.2 A one-line system is used to specify materials covered by this specification. The system uses predefined cells to refer to specific aspects of this specification, illustrated as follows:~~

³ Annual Book of ASTM Standards, Vol 08.01.

³ Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

⁴ Discontinued; see 1994 Annual Book of ASTM Standards, Vol 08.01.

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

Standard Number Block	Specification Type	Grade	Class	Special notes
Example: Specification D 1710-02	4	4	A	
Example: Specification D 1710-08	1	1	A	

4.2.1 For this example, the line callout would be Specification D 1710-028, 11 A, and would specify that a rod, heavy-walled tubing, or heavy-walled tubing basic shape has all of the properties listed for that type, grade, and class. A comma is used as the separator between the standard number and the type. Separators are not needed between the type, grade, and class. A provision for special notes is included so that other information can be provided when required. An example would be to specify the dimension tolerances for each size of rod, heavy-walled tubing, or heavy-walled tubing basic shape. When special notes are used, they should shall be preceded by a comma.

4.3 The types are further subdivided into two grades:

4.3.1 *Grade 1*—Made only from virgin resin.

4.3.2 *Grade 2*—Made using reprocessed resin.

4.4 The grades are further subdivided into four classes:

4.4.1 *Class A*—Rod or heavy-walled tubing having normal dimensional stability.—Rod, heavy-walled tubing, or basic shape having normal dimensional stability.

4.4.2 *Class B*—Rod or heavy-walled tubing meeting the dimensional stability requirements of—Rod, heavy-walled tubing, or basic shape meeting the dimensional stability requirements of Table 1.

4.4.3 *Class C*—Same as Class A, but, in addition, completely examined for internal defects.

4.4.4 *Class D*—Same as Class B, but, in addition, completely examined for internal defects.

5. Materials and Manufacture

5.1 The rod, heavy-walled tubing, or heavy-walled tubing basic shapes from Types I, II, III, and IV shall be made from non-pigmented PTFE as free of foreign matter as commercially practical.

6. General Requirements General Requirements

6.1 The rod, heavy-walled tubing, or basic shapes covered by this specification shall meet the mechanical and electrical requirements specified in Table 1 and 6.1.1 when tested by the methods given in Section 12. The heavy-walled tubing covered by this specification shall meet the mechanical and electrical requirements in Table 2 and 6.1.1 when tested by the methods given in Section 12.

6.1.1 *Melting Point*—The melting point of all types of rod and heavy-walled tubing shall be $327 \pm 10^\circ\text{C}$ when tested in accordance with 12.7.

7. Dimensions, Mass, and Permissible Variations

7.1 The dimensions and tolerances of heavy-walled tubing shall be in accordance with Table 3. Measurements shall be made in accordance with Method A of Test Methods D 374.

7.2 For rod and heavy-walled tubing, it may be necessary to center-less-grind the outside diameter for rod and heavy-walled tubing to meet the tolerances given in Table 3—. Tolerances for sizes of rod 50.8 mm (2.0 in.) and above shall be agreed upon by manufacturer and buyer.

TABLE 1 Detail Requirements of Extruded Rod

Properties	Type I			Type II			Type III		
	Rod Diameter, in. ^A			Rod Diameter, in. ^A			Rod Diameter, in. ^A		
	under ½	½ to 1½	over 1½	under ½	½ to 1½	over 1½	under ½	½ to 1½	over 1½
Specific gravity, min	2.14	2.15	2.15	2.12	2.13	2.14	2.12	2.13	2.14
Specific gravity, min	2.14	2.15	2.15	2.14	2.15	2.15	2.12	2.13	2.14
Tensile strength, min, MPa	13.8	14.5	15.2	11.7	12.4	13.1	9.7	10.3	11.0
Tensile strength, min, MPa	13.8	14.5	15.2	13.8	14.5	15.2	9.7	10.3	11.0
—(psi)	(2000)	(2100)	(2200)	(1700)	(1800)	(1900)	(1400)	(1500)	(1600)
—(psi)	(2000)	(2100)	(2200)	(2000)	(2100)	(2200)	(1400)	(1500)	(1600)
Elongation at Break, min, %	150	175	200	100	125	150	50	75	75
Dielectric strength, min, V/mil	700	750	800	600	650	700	250	250	250
Dielectric strength, min, V/mil	700	750	750
Dimensional stability, ^B max, %									
Length	1.5	1.5	...	1.5	1.5	...	3.0	3.0	...
Diameter	0.5	0.5	...	0.5	0.5	...	1.0	1.0	...

^A 1 in. = 25.4 mm.

^B This requirement applies only to rod of Classes B and D that is under 25.4 mm (1 in.) in diameter. Values for larger sizes shall be as agreed upon by manufacturer and buyer or manufacturer stating material was stress relieved after manufacture of extruded rod.

TABLE 2 Properties of PTFE Heavy-Walled Tubing

Grade	Type I		Type II		Type III	
	Grade 1	Grade 2	Grade 1	Grade 2	Grade 1	Grade 2
Specific Gravity, min	2.15	2.14	2.15	2.14	2.14	2.13
Tensile Strength, min, MPA	13.8	10.4	12.4	9.7	11.0	9.0
Tensile Strength, min, MPA (psi)	13.8 (2000)	10.4 (1500)	13.8 (1800)	10.4 (1400)	11.0 (1600)	9.0 (1300)
Tensile Strength, min, MPA (psi)	(2000)	(1500)	(2000)	(1500)	(1600)	(1300)
Elongation at break, min, %	150	140	130	120	100	80
Elongation at break, min, %	150	140	150	140	100	80
Dielectric Strength, min 1 mm (0.040 in.) kV/mm	29.5	27.5	25.6	23.6	12	10
Short Time (V/mil)	(750)	(700)	(650)	(600)	(325)	(250)
Dimensional Stability max, Classes B and D, %						
Length	1.5	1.5	2.0	2.0	2.5	2.5
Diameter	0.5	0.5	0.75	0.75	1.0	1.0

TABLE 3 Diameter and Tolerances for PTFE Rod and Heavy-Walled Tubing

Nominal Inside or Outside Diameter, ^A mm (in.)	Tolerance, ^B mm (in.)
1.6 (1/16)	0.13 (0.005)
3.2 (1/8)	0.18 (0.007)
4.8 (3/16)	0.23 (0.009)
6.3 (1/4)	0.30 (0.012)
9.5 (3/8)	0.30 (0.012)
12.7 (1/2)	0.36 (0.014)
15.8 (5/8)	0.41 (0.016)
19.1 (3/4)	0.43 (0.017)
25.4 (1)	0.51 (0.020)
31.8 (1 1/4)	0.64 (0.025)
38.1 (1 1/2)	0.76 (0.030)
44.4 (1 3/4)	0.89 (0.035)
50.8 (2)	0.89 (0.035)
57.2 (2 1/4)	1.02 (0.040)
63.5 (2 1/2)	1.14 (0.045)
76.2 (3)	1.14 (0.045)
101.6 (4)	1.14 (0.045)
203.2 (8)	1.14 (0.045)

^A Intermediate diameters shall conform to the tolerances of the next larger diameter in the table.

^B The tolerance is plus for outside diameters and minus for inside diameters.

7.2.1 *Eccentricity*— The eccentricity of the heavy-walled tubing, when measured as one half of the difference between the maximum and minimum wall thickness at either end of the tube, shall not exceed 10 % of the nominal wall thickness. Nominal wall thickness is one half the difference between the nominal outside diameter and the nominal inside diameter.

8. Workmanship, Finish and Appearance

8.1 *Color*—Type I shall be white to translucent but may have occasional spots. Types II, III, and IIIV typically are white but