



Designation: D 1710 – 02

Standard Specification for Extruded and Compression Molded Polytetrafluoroethylene (PTFE) Rod and Heavy Walled Tubing¹

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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 D 4894 and reprocessed PTFE resin (as defined in Guide D 5033).

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.

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.

1.3 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:

- D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies²
- D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation²
- D 256 Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics³

- D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials²
- D 374 Test Methods for Thickness of Solid Electrical Insulation²
- D 618 Practice for Conditioning Plastics for Testing³
- D 621 Test Methods for Deformation of Plastics Under Load⁴
- D 638 Test Method for Tensile Properties of Plastics³
- D 696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 and 30°C with a Vitreous Silica Dilatometer³
- D 790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials³
- D 792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement³
- D 883 Terminology Relating to Plastics³
- D 1505 Test Method for Density of Plastics by the Density-Gradient Technique³
- D 1600 Terminology for Abbreviated Terms Relating to Plastics³
- D 2240 Test Method for Rubber Property-Durometer Hardness⁵
- D 3295 Specification for PTFE Tubing, Miniature Beading and Spiral Cut Tubing⁶
- D 3892 Practice for Packaging/Packing of Plastics⁶
- D 4591 Test Method for Determining Temperatures and Heats of Transitions of Fluoropolymers by Differential Scanning Calorimetry⁷
- D 4894 Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials⁷
- D 4895 Specification for Polytetrafluoroethylene (PTFE) Resins Produced from Dispersion⁷
- D 5033 Guide for Development of ASTM Standards Relating to Recycling and Use of Recycled Plastics⁷
- D 5740 Guide for Writing Material Standards in the Classification D 4000 Format⁷

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.

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² Annual Book of ASTM Standards, Vol 10.01.

³ Annual Book of ASTM Standards, Vol 08.01.

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

⁵ Annual Book of ASTM Standards, Vol 09.01.

⁶ Annual Book of ASTM Standards, Vol 08.02.

⁷ Annual Book of ASTM Standards, Vol 08.03.

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

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
Tensile strength, min, MPa (psi)	13.8 (2000)	14.5 (2100)	15.2 (2200)	11.7 (1700)	12.4 (1800)	13.1 (1900)	9.7 (1400)	10.3 (1500)	11.0 (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
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.

E 94 Guide for Radiographic Examination⁸

F 36 Test Method for Compressibility and Recovery of Gasket Materials⁹

IEEE/ASTM SI 10 Standard for the Use of the International System of Units (SI): The Modern Metric System¹⁰

2.2 ISO Standards:¹¹

ISO 13000-1 (1997) Plastics—Polytetrafluoroethylene (PTFE) Semi-Finished Products, Part 1: Basis for Specification

ISO 13000-2 (1997) 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. (**D 4895**)

3.2 *Abbreviations*—Abbreviations are in accordance with Terminology **D 1600**. PTFE is the acronym for polytetrafluoroethylene.

4. Classification

4.1 This specification covers three types of PTFE-fluorocarbon rod and heavy-walled tubing. 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.

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:

Standard Number Block	Specification			Class	Special notes
	Type	Grade			

Example: Specification D 1710-02 1 1 A

4.2.1 For this example, the line callout would be Specification D 1710-02, 11 A, and would specify that a rod or heavy-walled tubing 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 or heavy-walled tubing. When special notes are used, they should 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.

4.4.2 *Class B*—Rod or heavy-walled tubing 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 or heavy-walled tubing from Types I, II, and III shall be made from unpigmented PTFE as free of foreign matter as commercially practical.

6. General Requirements General Requirements

6.1 The rod 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**.

⁸ Annual Book of ASTM Standards, Vol 03.03.

⁹ Annual Book of ASTM Standards, Vol 09.02.

¹⁰ Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

¹¹ Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

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 (psi)	13.8 (2000)	10.4 (1500)	12.4 (1800)	9.7 (1400)	11.0 (1600)	9.0 (1300)
Elongation at break, min, %	150	140	130	120	100	80
Dielectric Strength, min 1 mm (0.040 in.) kV/mm Short Time (V/mil)	29.5 (750)	27.5 (700)	25.6 (650)	23.6 (600)	12 (325)	10 (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

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**.

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 and III typically are white but may vary to light gray or light brown. For Types II and III occasional small gray, brown, or black spots shall not be considered cause for rejection.

8.2 *Finish*—The rod or heavy-walled tubing shall be free from surface blisters, cracks, wrinkles, and other surface defects that might impair it for general use.

8.3 *Internal Defects*—Classes C and D shall be free of all macroscopic voids, cracks, and foreign inclusions, or the location of such defects shall be clearly marked or identified. The examination for internal defects shall be made in accordance with Guide **E 94**.

9. Sampling

9.1 Sampling shall be statistically adequate to satisfy the requirements of **13.4**.

10. Number of Tests and Retests

10.1 The tests listed in **Table 1** and **Table 2**, as they apply, are sufficient to establish conformity of the PTFE rod or heavy-walled tubing to this specification. When the number of test specimens is not stated in the test method, single determination may be made. If more than single determinations on

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.

separate portions of the same sample are made, the results shall be averaged. The single or average result shall conform to the requirements prescribed in this specification.