



Designation: D1710 – 15

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

This standard is issued under the fixed designation D1710; 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 U.S. Department of Defense.

1. Scope*

1.1 This specification covers extruded polytetrafluoroethylene (PTFE) rod, heavy-walled tubing, and basic shapes manufactured from the PTFE resin of Specification [D4894](#) and reprocessed PTFE resin (as defined in Guide [D7209](#)).

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—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 [D3294](#). Material that can be certified to Specification [D3294](#) may be substituted for Specification [D1710](#), 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:²

[D149](#) Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials

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 Sept. 1, 2015. Published September 2015. Originally approved in 1960. Last previous edition approved in 2008 as [D1710-08](#). DOI: 10.1520/D1710-15.

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.

- [D374](#) Test Methods for Thickness of Solid Electrical Insulation (Withdrawn 2013)³
- [D618](#) Practice for Conditioning Plastics for Testing
- [D792](#) Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
- [D883](#) Terminology Relating to Plastics
- [D1600](#) Terminology for Abbreviated Terms Relating to Plastics
- [D3892](#) Practice for Packaging/Packing of Plastics
- [D4894](#) Specification for Polytetrafluoroethylene (PTFE) Granular Molding and Ram Extrusion Materials
- [D5740](#) Guide for Writing Material Standards in the Classification Format
- [D5947](#) Test Methods for Physical Dimensions of Solid Plastics Specimens
- [D7209](#) Guide for Waste Reduction, Resource Recovery, and Use of Recycled Polymeric Materials and Products (Withdrawn 2015)³
- [E94](#) Guide for Radiographic Examination
- IEEE/ASTM SI 10 Standard for the Use of the International System of Units (SI): The Modern Metric System⁴
- 2.2 ISO Standards:⁵
- ISO 13000-1 (2005) Plastics—Polytetrafluoroethylene (PTFE) Semi-Finished Products, Part 1: Basis for Specification
- ISO 13000-2 (2005) Plastics—Polytetrafluoroethylene (PTFE) Semi-Finished Products, Part 2: Preparation of Test Specimen and Determination of Properties

3. Terminology

3.1 Definitions:

3.1.1 Definitions are in accordance with Terminology [D883](#) unless otherwise specified.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

*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	2.14	2.15	2.15	2.12	2.13	2.14
Tensile strength, min, MPa (psi)	13.8 (2000)	14.5 (2100)	15.2 (2200)	13.8 (2000)	14.5 (2100)	15.2 (2200)	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	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.

^BThis 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 manufacture and buyer or manufacture stating material was stress relieved after manufacture of extruded rod.

3.1.2 *lot, n*—one production run or a uniform blend of two or more production runs.

3.2 *Abbreviations*—Abbreviations are in accordance with Terminology **D1600**. PTFE is the acronym for polytetrafluoroethylene.

4. Classification

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, 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, 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.

NOTE 3—Type I and Type II are Grade 1 (Virgin Resin) and Type III and Type IV are Grade 2 (Reprocessed Resin).

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:

Standard Number Block	Specification			Special notes
	Type	Grade	Class	

Example: Specification D1710-08 1 1 A

4.2.1 For this example, the line callout would be Specification D1710-08, 11 A, and would specify that a rod, heavy-walled tubing, or 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 basic shape. When special notes are used, they 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, heavy-walled tubing, or basic shape having normal dimensional stability.

4.4.2 *Class B*—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 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

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** 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** when tested by the methods given in Section 12.

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 **D374** or Test Method **D5947**.

7.2 For rod and heavy-walled tubing, it is 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.

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.

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)	13.8 (2000)	10.4 (1500)	11.0 (1600)	9.0 (1300)
Elongation at break, min, %	150	140	150	140	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

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)

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

^BThe tolerance is plus for outside diameters and minus for inside diameters.

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 III and IV typically are white but may vary to light gray or light brown. For Types II, III, and IV 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 E94.

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 shall be made. If more than single determinations on 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.

11. Test Conditions

11.1 *Conditioning of Specimens*—The test specimens shall be conditioned in accordance with Procedure A of Practice D618 for a period of at least 4 h prior to test.

11.2 *Standard Temperature*—The tests shall be conducted at the standard laboratory temperature of 23 ± 2°C. Since the rod or heavy-walled tubing does not absorb water, the maintenance of constant humidity during testing is not important.

12. Test Methods

12.1 *Visual Inspection*—Visually inspect each of the samples of PTFE rod or heavy-walled tubing selected in accordance with Section 9 to verify its compliance with the requirements of this specification. Occasional superficial flaws in PTFE rod or heavy-walled tubing shall be interpreted as not affecting the physical and electrical properties; however, if there is an appearance of a transverse discontinuity or “poker chip,” testing for tensile strength and elongation is imperative.

12.2 *Specific Gravity*—Determine the specific gravity of the rod or heavy-walled tubing in accordance with Method A of Test Methods D792. Two drops of wetting agent shall be added to the water in order to reduce the surface tension and ensure complete wetting of the specimens. Test two specimens representative of the cross section of the rod or heavy-walled tubing and average the results.

12.3 *Tensile Strength and Elongation:*