Designation: D 1675 – 98

An American National Standard

AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428
Reprinted from the Annual Book of ASTM Standards. Copyright ASTM

Standard Test Methods for Polytetrafluoroethylene Tubing[1]

This standard is issued under the fixed designation D 1675; 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 These test methods cover procedures for testing polytetrafluoroethylene tubing for use as electrical insulation. The procedures appear in the following sections:

Procedure	Sections	ASTM Methods
Conditioning	7	...
Dielectric Breakdown Voltage	28-30	D 149, D 876
Inside Diameter	8-13	D 876
Mandrel Bend Test	46-52	D 149, D 876
Melting Point	41-45	D 3418, D 4895
Penetration Test	26 and 27	D 876
Specific Gravity	36-40	D 792, D 1505
Strain Relief	31-35	...
Volatile Loss	20-25	...
Wall Thickness	14-19	...

1.2 The values stated in inch-pound units are the standard except for temperature, which is stated in degrees Celsius. Values in parentheses are for information only.

1.3 *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.* For specific warning statements, see Section 5.

2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies[2]

D 792 Test Methods for Specific Gravity (Relative Density) and Density of Plastics by Displacement[3]

D 876 Test Methods for Nonrigid Vinyl Chloride Polymer Tubing Used for Electrical Insulation[2]

D 1505 Test Method for Density of Plastics by the Density-Gradient Technique[3]

D 1711 Terminology Relating to Electrical Insulation[2]

D 3418 Test Method for Transition Temperatures of Polymers by Thermal Analysis[4]

D 3487 Specification for Mineral Insulating Oil Used in Electrical Apparatus[5]

D 4895 Specification for Polytetrafluoroethylene (PFTE) Resins Produced from Dispersion[6]

E 176 Terminology of Fire Standards[7]

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions pertaining to electrical insulation, refer to Terminology D 1711.

3.1.2 For definitions pertaining to fire standards, refer to Terminology E 176.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *apparent melting point, n*—the temperature at which the appearance of the plastic changes from opaque to transparent.

3.2.2 *strain relief, n*—a dimensional change brought about by subjecting the tubing to an elevated temperature.

3.2.3 *volatile loss, n*—the reduction in weight by vaporization under controlled conditions.

4. Significance and Use

4.1 The test methods in this standard are considered important to characterize polytetrafluoroethylene tubing. They are intended primarily for, but not limited to polytetrafluoroethylene tubing.

4.2 Variations in these methods or alternate contemporary methods of measurement may be used to determine the values for the properties in this standard provided such methods ensure quality levels and measurement accuracy equal to or better than those prescribed herein. It is the responsibility of the organizations using alternate test methods to be able to demonstrate this condition. In cases of dispute, the methods specified herein shall be used.

NOTE 1—Provision for alternate methods is necessary because of (1) the desire to simplify procedures for specific applications, and (2) the desire to eliminate redundant testing and use data generated during manufacturing process control, including that generated under Statistical Process Control (SPC) conditions, using equipment and methods other

[1] These test methods are under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and are the direct responsibility of Subcommittee D09.07 on Flexible and Rigid Insulating Materials.

Current edition approved May 10, 1998. Published January 1999. Originally published as D 1675 – 59 T. Last previous edition D 1675 – 95.

[2] *Annual Book of ASTM Standards*, Vol 10.01.

[3] *Annual Book of ASTM Standards*, Vol 08.01.

[4] *Annual Book of ASTM Standards*, Vol 08.02.

[5] *Annual Book of ASTM Standards*, Vol 10.03.

[6] *Annual Book of ASTM Standards*, Vol 08.03.

[7] *Annual Book of ASTM Standards*, Vol 04.07.

than those specified herein. An example would be the use of laser micrometers or optical comparators to measure dimensions.

5. Hazards

5.1 *Lethal voltages may be present during this test. It is essential that the test apparatus, and all associated equipment that may be electrically connected to it, be properly designed and installed for safe operation. Solidly ground all electrically conductive parts that any person might come in contact with during the test. Provide means for use at the completion of any test to ground any parts which: were at high voltage during the test; may have acquired an induced charge during the test; may retain a charge even after disconnection of the voltage source. Thoroughly instruct all operators in the proper way to conduct tests safely. When making high voltage tests, particularly in compressed gas or in oil, the energy released at breakdown may be sufficient to result in fire, explosion, or rupture of the test chamber. Design test equipment, test chambers, and test specimens so as to minimize the possibility of such occurrences and to eliminate the possibility of personal injury*. See Section 28.

5.2 *Toxic Chemicals from Thermal Decomposition*:

5.2.1 Polytetrafluoroethylene at temperatures above 200°C may produce sufficient toxic vapors to be hazardous in a confined area. Sufficient ventilation must be provided in all tests where the material is subjected to testing above 200°C. (See Sections 7, 23, 26, 33, and 43.)

6. Selection of Test Specimens

6.1 In the case of material on spools or in coils, remove and discard at least two turns of the product before selecting material for samples from which to prepare test specimens.

6.2 In the case of material offered in cut lengths, do not prepare specimens from samples of material closer than 1 in. (25 mm) from each end.

6.3 Do not use specimens with obvious defects unless the purpose of the test is to determine the effects of these defects.

7. Conditioning

7.1 **Warning**—See 5.2.

7.2 Unless otherwise specified, condition and test specimens at least 3 h at 23 ± 2°C (73.4 ± 4°F) and 50 ± 5 % relative humidity.

INSIDE DIAMETER

8. Significance and Use

8.1 The inside diameter is of importance in determining the proper physical fit of the tubing.

9. Apparatus

9.1 *Gage Rods*—Use standard gage steel rods with smooth surfaces and hemispherical ends having diameters within ±0.0002 in. (±0.005 mm) of the values listed as maxima and minima in Table 1. A set of two gages (“go” and “no go”) is required for each size of tubing.

NOTE 2—Tapered steel gages as described in Test Methods D 876 may be used as an alternate. These gages are not practical, however, for tubing smaller than Size No. 20.

TABLE 1 Sizes of Polytetrafluoroethylene Tubing

Size	Inside Diameter, in. (mm)		
	Maximum	Minimum	Nominal
1 in.	1.060 (26.98)	1.000 (25.40)	...
⅞ in.	0.927 (23.55)	0.875 (22.23)	...
¾ in.	0.795 (20.19)	0.750 (19.05)	...
⅝ in.	0.662 (16.81)	0.625 (15.88)	...
½ in.	0.530 (13.46)	0.500 (12.70)	...
7/16 in.	0.464 (11.79)	0.438 (11.38)	...
⅜ in.	0.399 (10.13)	0.375 (9.53)	...
No. 0	0.347 (8.81)	0.325 (8.25)	0.330 (8.38)
No. 1	0.311 (7.90)	0.289 (7.34)	0.294 (7.47)
No. 2	0.278 (7.06)	0.258 (6.55)	0.263 (6.68)
No. 3	0.249 (6.32)	0.229 (5.82)	0.234 (5.94)
No. 4	0.224 (5.69)	0.204 (5.18)	0.208 (5.28)
No. 5	0.198 (5.03)	0.182 (4.62)	0.186 (4.72)
No. 6	0.178 (4.52)	0.162 (4.11)	0.166 (4.22)
No. 7	0.158 (4.01)	0.144 (3.66)	0.148 (3.76)
No. 8	0.141 (3.58)	0.129 (3.28)	0.133 (3.38)
No. 9	0.124 (3.15)	0.114 (2.90)	0.118 (3.00)
No. 10	0.112 (2.84)	0.102 (2.78)	0.106 (2.69)
No. 11	0.101 (2.57)	0.091 (2.31)	0.095 (2.41)
No. 12	0.091 (2.31)	0.081 (2.06)	0.085 (2.16)
No. 13	0.082 (2.08)	0.072 (1.83)	0.075 (1.91)
No. 14	0.074 (1.88)	0.064 (1.63)	0.066 (1.68)
No. 15	0.067 (1.70)	0.057 (1.45)	0.059 (1.50)
No. 16	0.061 (1.55)	0.051 (1.30)	0.053 (1.35)
No. 17	0.054 (1.37)	0.045 (1.14)	0.047 (1.19)
No. 18	0.049 (1.24)	0.040 (1.02)	0.042 (1.07)
No. 19	0.044 (1.12)	0.036 (0.91)	0.038 (0.97)
No. 20	0.040 (1.02)	0.032 (0.81)	0.034 (0.86)
No. 22	0.032 (0.81)	0.026 (0.66)	0.028 (0.71)
No. 24	0.027 (0.69)	0.020 (0.51)	0.022 (0.56)
No. 26	0.022 (0.56)	0.016 (0.41)	0.018 (0.46)
No. 28	0.019 (0.48)	0.013 (0.33)	0.015 (0.38)
No. 30	0.015 (0.38)	0.010 (0.25)	0.012 (0.30)

10. Test Specimens

10.1 Cut five specimens of any convenient length, but not less than 3 in. (75 mm) long, from the sample. Do not test kinked specimens.

11. Procedure

11.1 Insert the minimum gage rod for the size tubing under test into the specimen for a distance of at least 1 in. (25 mm) if possible, noting whether the rod is easily inserted and withdrawn without appreciable force. If the rod cannot be readily inserted and removed, consider the specimen as having an inside diameter less than the minimum.

11.2 Select a gage rod having the maximum size for the tubing under test. Attempt to insert the gage rod into the tubing. If the rod can be easily inserted to a distance of 1 in., the tubing has an inside diameter that exceeds the specified maximum. If the rod cannot be readily inserted, the tubing has an inside diameter less than the maximum specified.

12. Report

12.1 Report the following information:

12.1.1 Nominal size or size number of the tubing, and

12.1.2 Size or size number as determined.

13. Precision and Bias

13.1 The precision of this test method has not been determined. Since there is no standard reference material, no statement on bias is being made.