



# Standard Specification for Polytetrafluoroethylene–(PTFE) Coated Glass Fabric<sup>1</sup>

This standard is issued under the fixed designation D 4969; 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 approval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

## 1. Scope \*

1.1 This specification covers glass fabric impregnated, coated, and sintered on both sides with PTFE to a nominal thickness of 0.318 mm (0.015 in.) or less.

1.2 The PTFE-coated glass fabric is for electrical, chemical, and mechanical uses.

1.3 The PTFE-coated glass fabric of this specification does not pertain to structural fabric, single-sided PTFE coatings, or materials used for laminates.

1.4 The values stated in SI units as detailed in IEEE/ASTM SI-10.

NOTE 1—There is no ISO standard that covers information included in this specification. A few of these test methods are mentioned in ISO 12086-2: 1995.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 123 Terminology Relating to Textile Materials<sup>2</sup>
- D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies<sup>3</sup>
- D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials<sup>3</sup>
- D 374 Test Methods for Thickness of Solid Electrical Insulation<sup>3</sup>
- D 578 Specification for Glass Fiber Yarns<sup>2</sup>
- D 579 Specification for Greige Woven Glass Fabrics<sup>2</sup>
- D 618 Method for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>4</sup>
- D 737 Test Method for Air Permeability of Textile Fabrics<sup>2</sup>
- D 751 Test Methods for Coated Fabrics<sup>5</sup>
- D 827 Method of Test for Edge Tearing Strength of Paper<sup>6</sup>
- D 883 Definitions of Terms Relating to Plastics<sup>4</sup>

D 902 Methods of Testing Flexible Resin-Coated Glass Fabric and Glass Fabric Tapes Used for Electrical Insulation<sup>3</sup>

D 1424 Test Method for Tearing Strength of Fabrics by Falling-Pendulum Type (Elmendorf) Apparatus<sup>2</sup>

D 3892 Practice for Packaging/Packing of Plastics<sup>7</sup>

D 4441 Specification for Aqueous Dispersions of Polytetrafluoroethylene<sup>8</sup>

IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System<sup>9</sup>

2.2 ISO Standard:<sup>10</sup>

ISO 12086-2: 1995 Plastics—Fluoropolymer Dispersions and Moulding and Extrusion Materials—Part 2: Preparation of Test Specimens and Determination of Properties

## 3. Terminology

3.1 *Definitions*—Definitions of terms relating to plastics used in this specification shall be in accordance with Definitions D 883. Definitions of terms relating to textiles used in this specification shall be in accordance with Terminology D 123.

3.1.1 *structural fabric*—PTFE-coated fabric to a thickness of greater than 0.381 mm (0.015 in.).

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

## 4. Classification

4.1 There shall be six types of PTFE-coated glass fabrics as described in Table 1.

4.2 Use a one-line system to specify materials covered by this specification. The system uses redefined cells to refer to specific aspects of this specification, as illustrated below as follows.

Standard Number Block	Specification			
	Type	Grade	Class	Special Notes
Example: ASTM D4969-XX	IV	–	–	.

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<sup>2</sup> Annual Book of ASTM Standards, Vol 07.01.

<sup>3</sup> Annual Book of ASTM Standards, Vol 10.01.

<sup>4</sup> Annual Book of ASTM Standards, Vol 08.01.

<sup>5</sup> Annual Book of ASTM Standards, Vol 09.02.

<sup>6</sup> Discontinued, See 1981 Annual Book of ASTM Standards, Part 20.

<sup>7</sup> Annual Book of ASTM Standards, Vol 08.02.

<sup>8</sup> Annual Book of ASTM Standards, Vol 08.03.

<sup>9</sup> Available from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428

<sup>10</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

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

**TABLE 1 PTFE-Coated Glass Fabric Types**

Type	Name	General Description and Common Application
I	Premium	Smooth, defect-free, primarily used as a dielectric application, release sheet, and Military Specification material.
II	Standard	Regular-grade material primarily used for mechanical applications where temperature and easy-release characteristics are required.
III	Mechanical	Regular-grade material primarily used for mechanical applications where smoothness is not a critical requirement.
IV	Porous	Permeable material, with a range of porosity primarily used as a release sheet in molding.
V	Tear resistant	Smooth, flexible, and tear-resistant material for mechanical applications requiring flexible materials.
VI	Conductive	Regular-grade material primarily used for static discharge.

For this example, the line call out would be: ASTM D 4969 – XX, IV – – , Porosity 15–30 CFM, and would specify a Type IV porous product which is referenced in Table 1 with no grade or class since these subcategories do not appear in this specification. A comma is used as the separator between the standard number and the type. Separators are not needed between the type, grade, and class because they are, in turn, Roman numerals, Arabic digits, and uppercase letters, as provided in Section B8 of *Form and Style for ASTM Standards*. Provision for “Special Notes” is included so that other information can be provided when required. An example would be in this specification where porosity would be defined as 15–30 CFM. When special notes are used, they should be preceded by a comma.

## 5. Materials and Manufacture

5.1 *Glass Fabric*—The base material used in the manufacture of the products of this specification shall be a woven glass fabric produced in accordance with Specification D 579. A guideline for generally acceptable substrate fabrics for the common thickness of PTFE/glass fabric products is given in Table 2.

5.2 *Coating*—The glass fabric is impregnated or coated with polytetrafluoroethylene in accordance with Specification D 4441. When necessary, use additives to aid the dispersion to achieve the required properties and performance of the final product.

## 6. Physical Requirements

6.1 The coating shall penetrate and adhere to the fabric and shall be substantially free of wrinkles, creases, blisters, and other imperfections.

6.2 *Color*:

6.2.1 The material will have a natural color that varies from off-white to dark brown when viewed by the unaided eye. The usual color is tan.

6.2.2 If color is required by the customer, specify it.

6.2.3 Color will be uniform from roll to roll within a lot.

6.2.4 Other colors for products that contain pigments, fillers, and additives will be agreed upon between the suppliers and the customers.

6.3 *Thickness*—The thickness of the glass fabric is dependent on glass style and percent PTFE coating. Tolerances are typically  $\pm 10\%$  of the finished thickness. Thickness shall be tested in accordance with Test Methods D 374.

NOTE 2—Typically, glass and coated glass products are manufactured to a weight per unit area.

6.4 *Breaking Strength*—When tested in accordance with Methods D 902, the breaking strength shall be at least 80 % of the specified value stated in Table 6 of Specification D 579.

NOTE 3—Reduction of tensile strength is due to added heat required for coating.

6.5 *Edge Tear Strength*—(Elmendorf) Tears shall be tested in accordance with Test Method D 1424. Tear values are dependent upon glass style and additives added to the PTFE. Typical Tear Resistant (Type 5) products exhibit two times the values of their counterparts. Conductive (Type 6) products exhibit one half the values of their counterparts. Test values and tolerances shall be determined by the supplier and the customer.

6.6 *Mass*—A sample shall be prepared in accordance with Method D 751. The amount of PTFE added shall be agreed upon between the customer and the supplier and shall have a tolerance of  $\pm 5\%$  of the total coated product weight.

6.7 *Widths*—The coated glass fabric shall be furnished in the widths and tolerances indicated in Table 3, when tested in accordance with Method D 751.

6.8 *Conductivity*—For Type 6 material, conductivity shall be tested in accordance with Test Methods D 257, using the

**TABLE 2 Acceptable Substrate Fabrics for Common Thickness of PTFE Glass Fabric Products**

PTFE/Glass Fabrics Thickness.		Generally Acceptable Woven Glass Fabrics Style Number
mm	(in.)	
0.051	(0.002)	104, 106
0.076	(0.003)	108, 1080
0.102	(0.004)	112, 113, 2113
0.127	(0.005)	116, 1165, 2116, 2165
0.152	(0.006)	116, 1165, 2116
0.203	(0.008)	125, 1528, 7628
0.254	(0.010)	128, 1528, 7628
0.356	(0.014)	141, 1142

**TABLE 3 Widths of PTFE-Coated Glass Fabric**

Nominal Widths		Tolerances	
mm	(in.)	mm	(in.)
3.17 to <12.7	( $\frac{1}{8}$ to < $\frac{1}{2}$ )	0.397	( $\pm \frac{1}{64}$ )
12.7 to <38.1	( $\frac{1}{2}$ to < $\frac{1}{2}$ )	0.794	( $\pm \frac{1}{32}$ )
38.1 to <76.2	( $1\frac{1}{2}$ to <3)	1.587	( $\pm \frac{1}{16}$ )
76.2 to <305	(3 to <12)	1.411	( $\pm \frac{1}{8}$ )
305 or greater	(12 or greater)	6.35	( $\pm \frac{1}{4}$ )

Flat Metal Plate Method, and a comparison bridge. Material shall be deemed conductive when the resistivity is below  $10^6 \Omega/\text{square}$ .

6.9 *Dielectric Breakdown*—Type I only.

6.9.1 *Dielectric Breakdown Voltage*—When tested in accordance with Test Methods D 149 and Methods D 902, with a ¼-in. electrode, the dielectric breakdown voltage for the various thickness shall be as specified in Table 4.

6.9.2 *Dielectric Breakdown After Heating*—After exposure to a temperature of 150°C (302°F) for 12 h, the average value of five samples shall be not less than 80 % of the value determined before exposure.

6.10 *Length*—The length of the products of this specification shall be furnished in rolls or in sheets. Typical roll lengths are 40 to 80 m (36 to 72 yd).

6.11 *Percent PTFE*—When required in the purchase order or contract, the supplier shall provide the ratio by weight of the fluoropolymer coating to the total weight of the finished product using the following formula:

$$\frac{\text{total weight—bare glass weight}}{\text{total weight}} \times 100 \quad (1)$$

where:

total weight = as calculated in 6.6 of this specification.

bare glass weight = as specified in Table 6 of Specification D 579.

6.12 *Smoothness*, Type I Material—Smoothness shall be tested using a profilometer, or equivalent, capable of measuring the average roughness to the nearest micromin.

6.12.1 Three samples shall be measured across the width at a 45° angle to the weave. The length of measurement shall be greater than ½ in.

6.12.2 Record the reading from each measurement. Average the recorded results and report the average value in microminches. Smoothness values and tolerances shall be determined between the customer and the supplier.

6.13 *Porosity*, Type IV Material—Porosity shall be measured in accordance with Test Method D 737.

6.13.1 Porosity values and tolerances shall be determined between the customer and the supplier.

**7. Sampling**

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

7.2 A random sample of roll or sheet shall be selected from each lot for visual, dimensional, and weight inspection.

7.3 *Visual Inspection*—At least ten yards of the roll selected in accordance with 7.2 shall be unwound and inspected for compliance with 6.1.

**8. Conditioning and Test Conditions**

8.1 *Conditioning*—Because of the nature of these materials, conditioning has little merit; however, if conditioning is desired, use Procedure A of Method D 618 for a period of 4 h prior to test.

8.2 *Test Conditions*—Unless otherwise specified, conduct tests at the standard laboratory temperature of  $23 \pm 3^\circ\text{C}$  (68 to 79°F) and relative humidity of 50 to 70 %.

**9. Conformance**

9.1 Due to the various suppliers and customer requirements, color, thickness, breaking strength, edge tear, conductivity, percent PTFE, smoothness, and porosity can not be realistically specified in a table. However, when measuring these properties, these test methods must be used to ensure consistency in measurements and comparisons between and among suppliers and users.

9.2 Upon request, a manufacturer’s certification that the material was manufactured and tested in accordance with this specification together with a report of the test results shall be furnished.

**10. Packaging and Package Marking**

10.1 *Packaging*—The materials shall be packaged in standard commercial containers constructed so as to ensure acceptance by common carrier, unless otherwise specified in the contract or order.

10.2 *Package Marking*—Shipping containers shall be marked with the name of the material, type, thickness, and quantity contained therein. Each roll or package of sheets shall be marked to designate type and lot number.

10.3 All packaging and marking provisions of Practice D 3892 shall apply to this specification.

**11. Keywords**

11.1 dispersion; fluorocarbon; fluoropolymers; polymer coating; polytetrafluoroethylene; PTFE; PTFE coated glass fabric

**TABLE 4 Electrical Properties of PTFE-Coated Glass Fabric<sup>A</sup>**

Type	Thickness		Dielectric Breakdown Volts, min
	mm	(in.)	
Type 1	0.051	(0.002)	1000
	0.076	(0.003)	2500
	0.102	(0.004)	3300
	0.127	(0.005)	3900
	0.152	(0.006)	4300
	0.203	(0.008)	4700
	0.054	(0.010)	5200
	0.356	(0.014)	7500

<sup>A</sup> Only Type 1 is applicable.

**SUMMARY OF CHANGES**

This section identifies the location of selected changes to this specification. For the convenience of the user, Committee D20 has highlighted those changes that may impact the use of this specification. This section may also include descriptions of the changes or reasons for the changes, or both.

*D 4969 – 02:*

- (1) Deleted Practice E 380 and added IEEE/ASTM SI-10.
- (2) Deleted D 1898 throughout the standard and added a new sampling statement in 7.1.
- (3) Corrected the spelling of Geige.
- (4) Added the definition of “lot.”
- (5) Deleted 97 and added XX to represent the proper year of the standard in 4.2.

*D 4969 – 97:*

- (1) Title—Spelled out polytetrafluoroethylene; put PTFE in parentheses.
- (2) Section 1.1—Reworded the scope statement; added a maximum thickness requirement of 0.318 mm (0.015 in.).
- (3) Section 1.3—Added single-sided PTFE coatings to materials not covered by this specification.
- (4) Section 1—Added ISO equivalency statement.
- (5) Section 2.2—Deleted Government standards; added ISO standard.
- (6) Section 3—Added 3.1.1, *structural fabric*.
- (7) Table 1—Deleted and replaced table; updated types.
- (8) Section 4—Redefined the illustration and example to coincide with this specification.
- (9) Section 5.1—Editorial change.
- (10) Section 5.2—Editorial change; deleted and replaced section.
- (11) Table 2—Deleted thickness 0.381 and higher; added glass styles.
- (12) Section 6.1—Editorial changes.

- (13) Section 6.2—Editorial changes; added 6.2.4.
- (14) Section 6.3—Deleted and replaced; added note.
- (15) Table 3—Deleted. The data reference in this table was taken out of Specification D 579. This document is referenced in the appropriate sections of this specification.
- (16) Table 4—Renumbered to Table 3.
- (17) Section 6.4—Editorial change; added reference to Specification D 579; added note.
- (18) Section 6.5—Deleted and replaced. Major change in specification changing the edge tear requirements to an Elmendorf method.
- (19) Section 6.6—Editorial change.
- (20) Section 6.7—Editorial change.
- (21) Section 6.8—Deleted and replaced *surface resistivity* with *conductivity*.
- (22) Section 6.9—Editorial change.
- (23) Section 6.10—Changed roll lengths from 30 to 100 mm to 40 to 80 mm.
- (24) Section 6.11—Changed mass ratio to percent PTFE and added a formula to calculate the percent PTFE.
- (25) Section 6.12—Added smoothness section for Type I material.
- (26) Section 6.13—Added porosity section for Type IV material.
- (27) Table 5—Changed to Table 4; deleted surface resistivity section of table.
- (28) Section 9—Deleted; replaced with Conformance section.

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