



Designation: D 4969 – 97

Standard Specification for Polytetrafluoroethylene-(PTFE) Coated Glass Fabric¹

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 reapproval. 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 Practice E 380 and the practices of Practice E 380 incorporated herein, are regarded as standard.

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 Materials²
- D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies³
- D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials³
- D 374 Test Methods for Thickness of Solid Electrical Insulation³
- D 578 Specification for Glass Fiber Yarns²
- D 579 Specification for Griage Woven Glass Fabrics²
- D 618 Method for Conditioning Plastics and Electrical Insulating Materials for Testing⁴
- D 737 Test Method for Air Permeability of Textile Fabrics²
- D 751 Test Methods for Coated Fabrics⁵
- D 827 Method of Test for Edge Tearing Strength of Paper⁶
- D 883 Definitions of Terms Relating to Plastics⁴
- D 902 Methods of Testing Flexible Resin-Coated Glass

Fabric and Glass Fabric Tapes Used for Electrical Insulation³

D 1424 Test Method for Tearing Strength of Fabrics by Falling-Pendulum Type (Elmendorf) Apparatus²

D 1898 Practice for Sampling of Plastics⁴

D 3892 Practice for Packaging/Packing of Plastics⁷

D 4441 Specification for Aqueous Dispersions of Polytetrafluoroethylene⁸

E 380 Practice for Use of the International System of Units (SI)⁹

2.2 ISO Standard:¹⁰

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.).

4. Classification

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

4.2 A one-line system may be used 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 | | | Special Notes |
|--------------------------|---------------|-------|-------|------------------|
| | Type | Grade | Class | |
| Example: ASTM D4969-97 | IV | – | – | , |

For this example, the line call out would be: ASTM D 4969 – 97, 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

¹ This specification is under the jurisdiction of Committee D-20 on Plastics and is the direct responsibility of Subcommittee D20.15 on Thermoplastic Materials. Current edition approved Nov. 10, 1997. Published April 1998. Originally published as D 4969 – 89. Last previous edition D 4969 – 91a¹.

² Annual Book of ASTM Standards, Vol 07.01.

³ Annual Book of ASTM Standards, Vol 10.01.

⁴ Annual Book of ASTM Standards, Vol 08.01.

⁵ Annual Book of ASTM Standards, Vol 09.02.

⁶ Discontinued, See 1981 Annual Book of ASTM Standards, Part 20.

⁷ Annual Book of ASTM Standards, Vol 08.02.

⁸ Annual Book of ASTM Standards, Vol 08.03.

⁹ Annual Book of ASTM Standards, Vol 14.02.

¹⁰ Available from American National Standards Institute, 11 W. 42nd St., 13th 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. |

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. Additives may be added to 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 Color should be specified only if it is a critical parameter to the customer.

6.2.3 Color should 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 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.

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 | ($1/8$ to $<1/2$) | 0.397 | ($\pm 1/64$) |
| 12.7 to <38.1 | ($1/2$ to $<1/2$) | 0.794 | ($\pm 1/32$) |
| 38.1 to <76.2 | ($1\ 1/2$ to <3) | 1.587 | ($\pm 1/16$) |
| 76.2 to <305 | (3 to <12) | 1.411 | ($\pm 1/8$) |
| 305 or greater | (12 or greater) | 6.35 | ($\pm 1/4$) |



D 4969

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.

TABLE 4 Electrical Properties of PTFE-Coated Glass Fabric^A

| 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 |

^A Only Type 1 is applicable.

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 microinch.

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 micro-inches. 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 The materials shall be sampled in accordance with the sampling procedure in Practice D 1898.

7.2 A lot shall consist of all of one type of material of the same thickness manufactured at the same time.

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

7.4 *Visual Inspection*—At least ten yards of the roll selected in accordance with 7.3 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 ± 3°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



D 4969

SUMMARY OF CHANGES

Committee D-20 has identified the location of selected changes to this edition of this standard since the last issue, that may impact the use of this standard.

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 Elmen-dorf 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.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).