



# Standard Test Methods for Fully Cured Silicone Rubber-Coated Glass Fabric and Tapes for Electrical Insulation<sup>1</sup>

This standard is issued under the fixed designation D 1458; 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 ( $\epsilon$ ) 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 fully cured silicone rubber-coated glass fabric and tapes to be used for electrical insulation.

1.2 The procedures appear in the following order:

Procedure	ASTM Test Method	
	Sections	References
Breaking Strength	6	D 828
Breaking Strength After Creasing	7	...
Conditioning	4	...
Dielectric Breakdown Voltage	8	D 149, D 295, D 618
Dielectric Proof-Voltage	9	D 1389
Dissipation Factor and Relative Permittivity	10	D 150
Sampling	3	...
Thermal Endurance	14	D 1830
Thickness	5	D 374
Thread Count	13	...
Volume Resistivity	11	D 257
Weight	12	...

1.3 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

1.4 *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. See 8.5.1 for a specific warning statement.*

## 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<sup>2</sup>
- D 150 Test Methods for A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials<sup>2</sup>
- D 202 Test Methods for Sampling and Testing Untreated

<sup>1</sup> 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.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.01.

- Paper Used for Electrical Insulation<sup>2</sup>
- D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials<sup>2</sup>
- D 295 Test Methods for Varnished Cotton Fabrics Used for Electrical Insulation<sup>2</sup>
- D 374 Test Methods for Thickness of Solid Electrical Insulation<sup>2</sup>
- D 618 Practice for Conditioning Plastics and Electrical Insulating Materials for Testing<sup>3</sup>
- D 828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus<sup>4</sup>
- D 1389 Test Method for Proof-Voltage Testing of Thin Solid Electrical Insulating Materials<sup>2</sup>
- D 1830 Test Method for Thermal Endurance of Flexible Sheet Materials Used for Electrical Insulation by the Curved Electrode Method<sup>2</sup>
- D 5032 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Glycerin Solutions<sup>5</sup>
- E 104 Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions<sup>6</sup>

## 3. Sampling

3.1 Sample shipments of material as specified below, and where possible take only one sample from any package.

3.1.1 *Fabric*—Over 3 in. (75 mm) in width.

3.1.1.1 *Rolls*—Select one roll from each ten rolls or fraction thereof in a shipment of full-width fabric. Cut off not less than two turns of fabric from each roll selected from sampling, and select sample material for the preparation of test specimens from the remaining layers of the roll.

3.1.1.2 *Sheets*—Select one sheet from each 50 sheets or fraction thereof in a shipment of sheeted fabric. Remove not less than six sheets from the outer layers of each package of sheets selected from sampling, and then select sample material for the preparation of test specimens from the remaining sheets.

3.1.2 *Tapes and Strips*—3 in. (75 mm) and less in width.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 08.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 10.02.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 11.03.

3.1.2.1 *Tapes*—Cut off not less than six turns of tape from each roll selected for sampling, and then select sample material for the preparation of test specimens from the remaining layers of the roll. Select rolls of tape in accordance with the following schedule:

Number of Rolls in Shipment	Minimum Number of Sample Rolls
Over 10 000	1 per 1000
5001 to 10 000	10
2001 to 5000	5
Less than 2000	2

3.1.2.2 *Strips*—Select three strips from each 100 strips or fraction thereof in a shipment of strips. Remove not less than six strips from the outer layers of each package of strips selected for sampling, and then select sample material for the preparation of test specimens from the remaining strips.

3.2 Prepare the test specimens from samples selected as specified in 3.1, and as provided for in the individual test methods.

#### 4. Conditioning

4.1 *Significance and Use*—The properties of the material described in these test methods are affected by the temperature and moisture content of the material to a greater or lesser extent, depending on the specific property.

4.2 *Conditioning*—Unless otherwise specified in the individual test method, condition test specimens as described in 4.2.1 or 4.2.2, and in matters of dispute, consider 4.2.1 as the referee method.

4.2.1 Condition the test specimens for 48 h in the Standard Laboratory Atmosphere of  $50 \pm 2\%$  relative humidity at a temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ), and conduct the tests under these conditions.

4.2.2 Condition the test specimens for 48 h in the Standard Laboratory Atmosphere of  $50 \pm 2\%$  relative humidity at a temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ), and conduct the tests immediately upon removal of the specimens from the conditioning room or chamber.

#### 5. Thickness

5.1 *Significance and Use*:

5.1.1 The importance of space factor in the design of electrical equipment makes proper determination of thickness essential.

5.1.2 Some properties, such as dielectric strength and dielectric breakdown, vary with the thickness of the material, and certain properties, such as thermal conductivity and dielectric constant, cannot be determined without a knowledge of thickness.

5.2 *Test Specimens*—Cut specimens prepared from fabric samples 1 in. (25 mm) wide across the entire width of the fabric, while specimens prepared from tape and strip samples shall be the width of the sample and 36 in. (910 mm) long. Where the specimen is 36 in. or longer (full-width fabric 36 in. or more in width, or where the length of a strip is 36 in. or longer), only one specimen will be required unless otherwise specified. Where the specimen is less than 36 in. (full-width fabric less than 36 in. wide, or strips less than 36 in. long), as many specimens as are needed to obtain the equivalent 36 in.

linear measure will be required.

5.3 *Conditioning*—It is not necessary to condition the specimens for this test. Conduct tests at the Standard Laboratory Temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ).

5.4 *Procedure*—Make ten measurements, equally spaced along 36 in. (910 mm) of the specimen or specimens in accordance with Method C of Test Methods D 374 modified as follows:

5.4.1 Allow the presser foot to remain on the test specimen for 2 s, at the end of which read the dial gage.

5.4.2 Use a presser foot 0.250 in. (6.35 mm) in diameter, and an anvil surface upon which the specimen rests at least 2 in. (51 mm) in diameter. The force exerted on the specimen shall be 3 ozf (85 g).

5.4.3 Method C is not considered interchangeable with Method A.

5.5 *Report*—Report the average, maximum, and minimum thickness to the nearest 0.0001 in. (0.003 mm).

#### 6. Breaking Strength

6.1 *Significance and Use*—The breaking strength of finished fabric or tape is of importance as a measure of the tension it will withstand without failure while being applied in service.

6.2 *Apparatus*—Use a power-driven tensile testing machine meeting the requirements specified for Tensile Properties in Test Methods D 202, except that the means for determining elongation and for recording applied load and elongation are not required. The machine shall be equipped with specimen-gripping devices as described in 6.2.1 or 6.2.2.

6.2.1 Provide two flat-jawed clamps, in which case crocus cloth will be required for holding specimens between the jaws, or

6.2.2 Provide two gripping devices of the drum type as described in Fig. 1, in which case pins as indicated will be required for securing specimens on the cylinders.

6.3 *Test Specimens*—The test specimen shall be of sufficient length to provide positive gripping in the jaws with a separation of approximately 6 in. (150 mm). In the case of the flat-jawed clamps, this will require a minimum specimen length of 8 in. (200 mm) and a desirable length of 10 in. (250 mm). Where drum-type gripping devices are used, a specimen no less than 20 in. (500 mm) long will be required. Prepare the specimens from each sample as follows:

6.3.1 *Fabrics*—Cut five specimens, 1 in. (25.4 mm) wide (Note 1), with sides parallel to the warp threads, and cut five specimens of similar width with sides perpendicular to the warp threads (Note 2).

NOTE 1—Where specimens 1 in. (25.4 mm) in width have ultimate breaking loads exceeding the capacity of the machine, it is permissible to reduce the width of the specimen to not less than 0.5 in. (13 mm).

NOTE 2—Frequently the fill threads of glass fabrics used to manufacture silicone rubber-coated glass fabrics do not run in a straight line and are not perpendicular to the warp threads. Breaking strength from specimens cut perpendicular to the warp threads may, therefore, be highly variable.

6.3.2 *Tapes and Strips*—Cut five specimens, 1 in. (25.4 mm) wide (see Note 2), from each sample. Where tapes or strips are manufactured in widths less than 1 in. (25.4 mm), use the specimen width as manufactured.

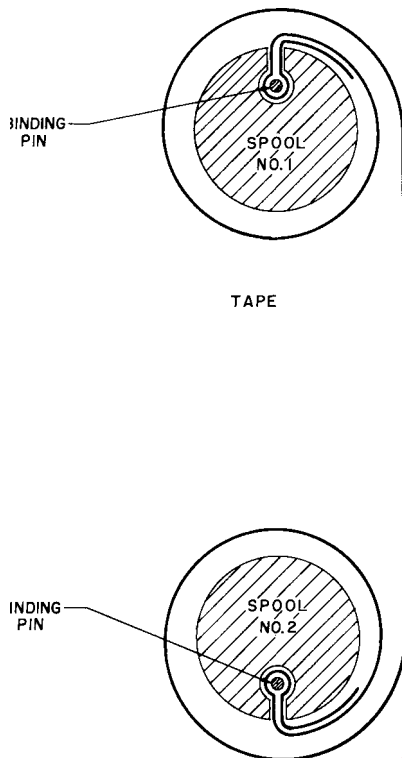


FIG. 1 Drum-Type Gripping Devices

6.4 *Conditioning*—It is not necessary to condition specimens for this test. Conduct tests at the Standard Laboratory Temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ).

6.5 *Procedure:*

6.5.1 Clamp the ends of the specimen in the jaws between two pieces of crocus cloth, the abrasive side of the cloth facing the metal jaws. Carefully align the specimen so that the breaking force is parallel to the length of the specimen between the jaws. Adjust the clearance between jaws to 6 in. (150 mm).

6.5.2 Alternatively, loop the specimen around a binding pin of suitable diameter so that the specimen fits neither too tightly nor too loosely in the hole provided. Insert the looped specimen and pin in the hole provided in the drum-type gripping device. Carefully align the specimen so that the breaking force will be parallel to the length of the specimen. Adjust the clearance between jaws to 6 in. (150 mm).

6.5.3 Adjust the speed of the machine in accordance with the requirements for Tensile Properties in Test Methods D 202.

6.5.4 Disregard values for breaks in or at the jaws. In these cases, continue tests so that there are five reportable breaking strength values per sample.

6.6 *Report:*

6.6.1 Report the average, maximum, and minimum breaking strength in pounds per inch of width (or kilograms per millimetre of width), together with the width and nominal thickness.

6.6.2 In the case of fabrics, report the breaking strength in the warp and fill directions separately.

6.7 *Precision and Bias*—The precision (repeatability within a single laboratory) of this test method has been demonstrated to be approximately 17%, expressed as a coefficient of variation of a series of replicate measurements on different

specimens of the same sample. Since there is no accepted reference material suitable for determining the bias for this test method, no statement on bias is being made.

7. **Breaking Strength After Creasing**

7.1 *Significance and Use*—Creasing of silicone rubber-coated glass fabric is accompanied by breaking of some of the glass fibers at the crease and a consequent reduction in breaking strength. The extent of this damage is related to the thickness and weave of the glass fabric and the nature and thickness of the silicone rubber coating. The creasing simulates to a degree the pinching action resulting from several successive layers of tape moving relative to one another while in confined position, such as in cables.

7.2 *Apparatus:*

7.2.1 Use a metal weight adjustable between 2.25 and 4.50 lbf (10 and 20 N). Mount it suitably through guides over a metal horizontal plane so that the weight may be lowered at a uniform speed perpendicular to the horizontal plane. The bottom of the weight shall be parallel to the top surface of the horizontal plane at all times. The creasing surface of the weight is a rectangle of such dimensions that the side which is perpendicular to the crease made on the specimen is 1.5 in. (40 mm). Suitable apparatus is shown in Fig. 2.

7.2.2 Provide suitable means for lowering the weight at a uniform rate of 12 in. (300 mm)/min and of raising the weight at the end of a 2-s dwell. This may be accomplished by utilizing the breaking strength machine, described in 6.2, in combination with a system of pulleys. It may also be achieved by using a motor fitted with reducing gears and a cam, or by other devices that accomplish the purpose.

7.3 *Test Specimens*—Prepare ten specimens as described in 6.3 except that specimens shall be taken from samples of tape or rolls of fabric only. In the case of fabric, cut the specimens in the warp direction only.

7.4 *Conditioning:*

7.4.1 It is usually not necessary to condition specimens for this test. When specimens are not especially conditioned, test them at the Standard Laboratory Temperature of  $23 \pm 1^\circ\text{C}$  ( $73.4 \pm 1.8^\circ\text{F}$ ).

7.4.2 Where it is desired to obtain the greatest degree of reproducibility, condition specimens in accordance with 4.2.

7.5 *Procedure:*

7.5.1 Adjust the weight so that the specimens are creased by a load of 4.5 lbf (20 N)/in. of width.

7.5.2 Fold the specimen without creasing, and insert the looped end under the weight so that the crease will be formed under the center of the weight. Lower the weight at a uniform rate of 12 in. (300 mm)/min to crease the specimen.

7.5.3 Allow the creased specimen to support the weight for a period of 2 s, at the end of which period lift the weight from the specimen.

7.5.4 Determine the breaking strength of the creased specimen in accordance with 6.5.

7.6 *Report*—Report the following information:

7.6.1 Average, maximum, and minimum breaking strengths after creasing, in kilograms per millimetre of width (or pounds-force per inch of width), unless otherwise specified,

7.6.2 Width and nominal thickness of the specimens, and