



Standard Specification for Coated Glass Fabrics Used for Electrical Insulation¹

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1. Scope

1.1 This specification covers woven glass fabric coated with fully cured oleoresinous varnish, epoxy resin, polyurethane resin, or polyester resin. Excluded are coated polyester-glass fabric and glass fabric coated with silicone resins and silicone elastomers.

1.2 It is recognized that several properties, notably breaking strength and dielectric strength, are related to the style of base fabric used for any particular thickness. This specification has been developed for materials using fabrics woven from relatively coarse-filament yarns and in some cases from relatively open-weave constructions, and property values are frequently somewhat lower than if finer filament yarns or closer weave constructions were used. The user is therefore alerted that significantly higher levels of performance test values may be obtained through the use of these latter types of alternate base constructions.

1.3 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 ASTM Standards:

- D 902 Test Methods for Flexible Resin-Coated Glass Fabrics and Glass Fabric Tapes Used for Electrical Insulation²
- D 1711 Terminology Relating to Electrical Insulation²
- D 1830 Test Method for Thermal Endurance of Flexible Sheet Materials Used for Electrical Insulation by the Curved Electrode Method²
- D 2518 Specification for Woven Glass Fabrics for Electrical Insulation³
- D 3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials³

3. Terminology

3.1 *Definitions:* For definitions of terms used in this specification refer to Terminology D 1711.

¹ This specification is under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.07 on Flexible and Rigid Insulating Materials.

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

³ *Annual Book of ASTM Standards*, Vol 10.02.

4. Classification

4.1 The materials of this specification are identified according to the type of coating applied, as follows:

- 4.1.1 *Type 1*—Black oleoresinous varnish,
- 4.1.2 *Type 2*—Yellow oleoresinous varnish,
- 4.1.3 *Type 3*—Epoxy resin,
- 4.1.4 *Type 4*—Polyurethane (isocyanate) resin, and
- 4.1.5 *Type 5*—Polyester resin.

5. Ordering Information

5.1 Orders for material covered by this specification shall include the following:

- 5.1.1 Type of coating,
- 5.1.2 Nature of finish, if any (waxy, greasy, dry, oily, mica-dusted, and so forth),
- 5.1.3 Color of coating (oleoresinous only),
- 5.1.4 Nominal coated thickness and base fabric thickness,
- 5.1.5 Put-up,
 - 5.1.5.1 *Full-Width Rolls*—core size, trimmed or untrimmed, length and width,
 - 5.1.5.2 *Sheets*—length and width,
 - 5.1.5.3 *Tapes*—core size, length, width,
- 5.1.6 Number of units per package,
- 5.1.7 Type of packaging (sealed unit packages, carton size, pallet size), and
- 5.1.8 Marking on unit packages and cartons.

6. Materials and Manufacture

6.1 *Materials*—The base fabric for all thicknesses shall be woven from continuous-filament yarns and shall be in conformance with the requirements of Specification D 2518.

6.2 *Splices*—The material shall not be spliced unless agreed upon by the purchaser and seller. If it is necessary to splice rolls, splices shall occur not more than once in each 100 yd (92 m) or less, except that rolls having a length of 10 yd (9 m) or less shall contain no splices. Sheet materials shall contain no splices.

7. Electrical and Mechanical Requirements

7.1 The electrical and mechanical requirements shall be in accordance with the values shown in Tables 1-3.

TABLE 1 Breaking Strength Requirements

Base Fabric Thickness, in. (mm)	Breaking Strength, warp, lbf/in. (kN/m)
0.002 (.051)	70 (12.2)
0.003 (0.08)	100 (17.5)
0.004 (0.10)	130 (22.8)
0.005 (0.13)	150 (26.2)
0.007 (0.18)	220 (38.6)
0.010 (0.25)	300 (52.6)
0.015 (0.38)	350 (61.3)

Types 1 and 2	130
Types 3 and 4	155
Type 5	180

NOTE 2—In the case of materials for special applications, some of the preceding types may have temperature indices below those stated, or may have life values less than 20 000 h. Use of these materials shall be agreed upon between the purchaser and the seller.

11.2 The seller shall, at the request of the purchaser, provide a thermal life graph (Arrhenius plot) showing the nominal temperature indices of the types of materials purchased.

8. Dimensional Requirements

8.1 *Thickness* shall be in accordance with the values shown in Table 4.

8.2 *Width*—Individual measurements on all samples selected shall not vary from the nominal by more than $\pm 1/32$ in. (0.8 mm) for widths up to 1 in. (25 mm) and by more than $\pm 1/16$ in. (1.6 mm) for widths 1 in. and over. Rolls trimmed to 36 in. or 1 m shall not be less than that amount. Sheets shall be within $\pm 1/8$ in. (3.2 mm) of the nominal width and length specified.

8.3 *Length*—The length in yards or metres per roll shall not be less than specified.

9. Workmanship and Appearance

9.1 *Visual Nonconformities*—The material shall be free from the following nonconformities to the extent specified in 12.4:

- 9.1.1 Weave distortion in base fabric,
- 9.1.2 Wrinkles, creases, tears,
- 9.1.3 Dirt in coating,
- 9.1.4 Nonuniform application of coating (runs, drains, wrinkles, uncoated spots),
- 9.1.5 Poor adhesion of coating to fabric,
- 9.1.6 Roughness caused by broken glass filaments, gels in coating,
- 9.1.7 Unevenly wound rolls,
- 9.1.8 Ragged cut edges of rolls,
- 9.1.9 Collapsed cores, and
- 9.1.10 Unmarked splices, open splices.

10. Oil Resistance

10.1 The coated film shall show no evidence of blistering, disintegration in the oil, or removal by the blotter used in the test. The oil shall not become turbid. Thickness measurements are not required, since there are no specifications for this property.

NOTE 1—Slight swelling of the coated film in that portion of the material located between the yarns sometimes occurs, particularly with freshly coated Type 1 material. This is evidenced by a regularity in the spacing of the effect and can be differentiated from true blistering, which occurs randomly over the surface of the test specimens.

11. Temperature Classification

11.1 The materials covered by this specification shall not have a temperature index less than that specified as follows when tested in accordance with Test Method D 1830 using a life criterion of 20 000 h:

12. Sampling

12.1 *Lot Definition*—Refer to Terminology Section of Practice D 3636.

12.2 *Unit of Sample*—The unit of sample shall be the unit of product (rolls or sheets).

12.3 *Sampling the Lot*—Randomly select, to the nearest integral package, a number of packages equal to \sqrt{N} from each lot, where N is the total number of packages in the shipment. These shall constitute the source of the unit sampling in 12.4 and 12.5.

12.4 *Sampling for Visual and Dimensional Examination*—Select a random sample of rolls or sheets from material of 12.3 in accordance with Inspection Level I of Practice D 3636. Acceptance shall be determined in accordance with 11.1 and Table 4 on the basis of AQL = 2.5. Take as the test sample 5 yd (4.5 m) from each sampled roll or sheet.

12.5 *Sampling for Performance Tests*—Select a random sample of rolls or sheets from the material of 12.3 in accordance with Inspection Level S-2 of Practice D 3636. Take an amount corresponding to about 0.5 yd² (0.3 m²) from each sampled roll or sheet.

13. Tests and Retests

13.1 If the results of any test to determine conformance with 7.1 and 10.1 do not conform to the requirements prescribed in this specification, make two additional tests on different specimens of the same sample. If either of these additional tests fail, or if the average of all tests computed including the retests fail, the lot of material shall be subject to rejection. Notice of failure of the material based on tests made shall be reported to the supplier within 3 weeks after receipt of the material by the purchaser.

14. Test Methods

14.1 Use the methods described in Test Methods D 902 to determine compliance with this specification, unless otherwise agreed upon between the purchaser and the seller.

15. Preparation for Delivery

15.1 Unless otherwise agreed upon between the purchaser and the seller, the following shall be considered standard procedure for finishing, packaging, and marking:

15.1.1 *Packaging of Rolls*—Roll full-width material on 3-in. (75-mm) diameter cores, or other diameters as agreed upon between the purchaser and the seller. Wrap rolls individually in minimum 25-lb (24 × 36/500) basis-weight kraft paper and securely tape with gummed kraft paper tape. Completely

TABLE 2 Dielectric Strength Requirements

Nominal Thickness, in. (mm)		Condition 48/23/50, average min. V/mil ^A					Condition 96/23/96, average min. V/mil ^A				
Total	Fabric	Type 1	Type 2	Type 3	Type 4	Type 5	Type 1	Type 2	Type 3	Type 4	Type 5
0.003 (0.08)	0.002 (0.05)	1950	1900	1300	1750	1900	1050	1000	800	750	1200
0.005 (0.13)	0.002 (0.05)	1900	1850	1350	1700	1800	950	900	750	700	1200
0.005 (0.13)	0.003 (0.13)	1850	1750	1400	1500	1600	950	900	800	700	900
0.007 (0.18)	0.003 (0.08)	1800	1650	1300	1350	1500	900	850	800	750	900
0.007 (0.18)	0.004 (0.10)	1650	1450	1250	1250	1400	850	800	650	600	700
0.010 (0.25)	0.004 (0.10)	1600	1350	1250	1200	1400	800	700	650	600	700
0.010 (0.25)	0.005 (0.13)	1100	1000	1200	1150	1300	600	550	600	550	600
0.010 (0.25)	0.007 (0.18)	1000	800	1100	1150	1150	550	450	600	500	550
0.012 (0.30)	0.007 (0.18)	950	750	1000	1150	1150	500	400	450	400	550
0.015 (0.38)	0.007 (0.18)	900	700	1000	1000	1150	500	400	400	350	550
0.015 (0.38)	0.010 (0.25)	850	750	900	750	1050	450	300	350	300	500
0.020 (0.51)	0.010 (0.25)	800	700	...	...	...	450	300	...	...	...
0.020 (0.51)	0.015 (0.38)	750	600	...	...	...	400	300	...	...	...
0.025 (0.64)	0.015 (0.38)	750	600	...	...	...	400	300	...	...	...
0.030 (0.76)	0.015 (0.38)	700	550	...	...	...	350	300	...	...	...

^A Divide V/mil by 25.4 to obtain kV/mm.

TABLE 3 Effect of Elevated Temperature

Nominal Thickness, in. (mm)		Dielectric strength at Room Temperature After Bending 180° average min. V/mil ^A					Percentage Retention of Breakdown Voltage After Aging 168 h at Temperature ^B and Bent 180° min, %
Total	Fabric	Type 1	Type 2	Type 3	Type 4	Type 5	All Types
0.003 (0.08)	0.002 (0.05)	1650	1550	1300	1550	1550	75
0.005 (0.13)	0.002 (0.05)	1650	1500	1250	1300	1400	75
0.005 (0.13)	0.003 (0.08)	1600	1500	1250	1250	1300	75
0.007 (0.18)	0.003 (0.08)	1600	1500	1200	1200	1300	75
0.007 (0.18)	0.004 (0.10)	1100	1050	1050	1150	1300	65
0.010 (0.25)	0.004 (0.10)	1400	1300	1050	1100	1600	70
0.010 (0.25)	0.005 (0.13)	500	450	1000	1050	1100	70
0.010 (0.25)	0.007 (0.18)	600	500	1000	900	950	70
0.012 (0.30)	0.007 (0.18)	500	450	1000	800	800	70
0.015 (0.38)	0.007 (0.18)	500	450	700	750	800	65
0.015 (0.38)	0.010 (0.25)	500	450	700	550	750	65
0.020 (0.51)	0.010 (0.25)	500	400	...	...	...	60
0.020 (0.51)	0.015 (0.38)	400	300	...	...	...	55
0.025 (0.64)	0.015 (0.38)	400	300	...	...	...	55
0.030 (0.76)	0.015 (0.38)	350	300	...	...	...	50

^A Divide V/mil by 25.4 to obtain kV/mm.

^B Temperature of aging: Types 1 and 2 = 130°C.
Types 3 and 4 = 180°C
Type 5 = 200°C

TABLE 4 Thickness Requirements

Nominal Thickness, in. (mm)	Tolerances, in. (mm)	
	Average	Individual
0.003 (0.08)	-0.0001 (0.003) +0.0004 (0.010)	-0.0002 (0.005) + 0.0006 (0.015)
0.005 (0.13)	±0.0005 (0.013)	±0.0008 (0.020)
0.007 (0.18)	±0.0007 (0.018)	±0.001 (0.030)
0.010 (0.25)	±0.0010 (0.03)	±0.002 (0.05)
0.012 (0.30)	±0.0010 (0.03)	±0.002 (0.05)
0.015 (0.38)	±0.0015 (0.038)	±0.0025 (0.064)
0.020 (0.51)	±0.0020 (0.051)	±0.0030 (0.076)
0.025 (0.64)	±0.0025 (0.064)	±0.0038 (0.097)
0.030 (0.76)	±0.0030 (0.076)	±0.0045 (0.114)

encircle each roll with kraft tape at a minimum of three places equidistant along its length, with the tape overlapping itself at least 2 in. (50 mm).

15.1.2 *Packaging of Tape Rolls*—Roll material on 1½-in. (38-mm) diameter cores, or other diameters as agreed upon between the purchaser and the seller. Form rolls of tape into

stacks and overwrap with 25-lb (24 × 36/500) basis-weight kraft paper and securely tape with gummed kraft paper tape.

15.1.3 *Packaging of Sheets*—Cut sheets with square corners in sizes as specified. Stack sheets neatly in layers and overwrap in 25-lb (24 × 36/500) basis-weight kraft paper and securely tape with gummed kraft paper tape.

15.1.4 *Packing*—Pack rolls, sheets, and tapes, packaged as specified in 15.1.1-15.1.3, in containers of the type, size, and kind commonly used in ordinary handling. Securely tape the containers to avoid spillage of contents in ordinary handling.

15.1.5 *Marking*—Make markings as specified on the order using any appropriate method that ensures legibility and permanency. Do not make the markings over applied tape seals.

15.2 Sample for conformity with the requirements of 15.1.1-15.1.5 in accordance with Inspection Level II of Practice D 3636, the unit of sample being one carton, one sheet, or one roll, as applicable. Determine acceptance on the basis of AQL = 4.0.

16. Keywords

glass fabric

16.1 coated glass fabric; electrical insulation; epoxy resin coated glass fabric; polyester resin coated glass fabric; polyurethane resin coated glass fabric; oleoresinous varnish; coated

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