



# Standard Specification for Varnished Glass-Polyester Cloth Used for Electrical Insulation<sup>1</sup>

This standard is issued under the fixed designation D 2400; 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.

## 1. Scope

1.1 This specification applies to black and yellow varnished woven cloth and tape for electrical insulation, having as a base fabric poly(ethylene terephthalate) yarns in the warp direction and glass yarns in the filler direction.

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

## 2. Referenced Documents

### 2.1 ASTM Standards:

D 295 Test Methods for Varnished Cotton Fabrics Used for Electrical Insulation<sup>2</sup>

D 902 Test Methods for Flexible Resin-Coated Glass Fabrics and Glass Fabric Tapes Used for Electrical Insulation<sup>2</sup>

D 1711 Terminology Relating to Electrical Insulation<sup>2</sup>

D 3487 Specification for Mineral Insulating Oil Used in Electrical Apparatus<sup>3</sup>

D 3636 Practice for Sampling and Judging Quality of Solid Electrical Insulating Materials<sup>4</sup>

## 3. Terminology

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

## 4. Ordering Information

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

4.1.1 Color: black or yellow,

4.1.2 Nominal thickness, width and length,

4.1.3 Type of surface: greasy or dry,

4.1.4 Core size and type,

4.1.5 Type of packing: dry or in oil,

4.1.6 Number of rolls per package, and

4.1.7 Marking on package.

<sup>1</sup> 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.

Current edition approved Oct. 10, 1999. Published November 1999. Originally published as D 2400 – 67 T. Last previous edition D 2400 – 99.

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

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 10.03.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 10.02.

## 5. Materials and Manufacture

5.1 *Materials*—The base fabric for all thickness and color styles shall have a nominal thickness of 0.004 in. (0.10 mm) and a warp by filler thread count per inch (or centimetre) of 32(12.6) by 28(11.0) respectively. The varnish shall be of the oleoresinous type. The warp threads shall consist of 140 denier continuous filament yarns having a twist of 5 turns per inch, and the filler threads shall consist of ECG-150-1/0 yarns.

5.2 *Splices*—The material shall not be spliced unless agreed upon by the purchaser and the manufacturer. If it is necessary to splice, splices shall not occur more than once in each roll of 100 yd (92 m) or less, except that rolls having a length of 6 yd (5.5 m) or less shall contain no splices. All splices shall be flagged in a manner suitable to the purchaser.

5.3 *Nonconformities*—The varnished fabric and tape shall be free from wrinkles, blisters, or any imperfections which will detract from its value as electrical insulation.

## 6. Electrical and Mechanical Requirements

6.1 The electrical and mechanical requirements shall be in accordance with the values shown in Table 1.

## 7. Oil Resistance

7.1 The varnish film shall show no evidence of blistering, or disintegration in the oil or on the blotter used in the test. The oil used in the test shall not become turbid.

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

## 8. Dimensional Requirements

8.1 Thickness requirements shall be in accordance with the values shown in Table 2.

8.2 The nominal width shall be specified in the purchase order. Individual measurements on all samples selected shall not vary from the nominal width by more than  $\pm 1/32$  in. (0.8 mm) for tapes 1 in. (25 mm) or less in width nor more than  $\pm 1/16$  in. (1.6 mm) for tapes over 1 in. in width.

**TABLE 1 Electrical and Mechanical Requirements<sup>A</sup>**

Color Style	Black			Yellow	
Nominal Thickness, in. (mm)	0.008 (0.20)	0.010 (0.25)	0.012 (0.31)	0.008 (0.20)	0.010 (0.25)
Breaking strength, lbf/in. (N/m):	(7.0)	(7.0)	(7.0)	(7.0)	(7.0)
Warp	40	40	40	40	40
Filler	100 (17.5)	100 (17.5)	100 (17.5)	100 (17.5)	100 (17.5)
Tear resistance, g, warp yarns	500	500	500	500	500
Elongation (warp), %, 25 lb 3 min	7.0	7.0	7.0	7.0	7.0
Dielectric breakdown voltage kV:					
Unstressed	10.5	12.5	15.0	9.5	11.0
Under 6 % elongation	8.5	10.0	12.5	8.0	9.5
After hot oil	10.5	12.5	15.0	9.5	11.0
Temperature index at 20 000 h	130	130	130	130	130

<sup>A</sup> All values shown are minimum averages unless otherwise noted.

**TABLE 2 Thickness Requirements**

Nominal Thickness, in (mm)	0.008 (0.20)	0.010 (0.25)	0.012 (0.31)
Average thickness, in. (mm):			
max	0.0090 (0.23)	0.0110 (0.28)	0.0130 (0.33)
min	0.0075 (0.19)	0.0090 (0.23)	0.0110 (0.28)
Individual thickness, in. (mm):			
max	0.0095 (0.24)	0.0115 (0.29)	0.0135 (0.34)
min	0.0073 (0.18)	0.0085 (0.22)	0.0105 (0.27)

8.3 The nominal length in yards or metres per roll shall be specified in the purchase order. The measured lengths of any individual rolls sampled shall not be less than that specified.

## 9. Surface Finish

9.1 Sheets, rolls, and tapes of black varnished cloth shall have two different types of surface finish: greasy and dry. Yellow varnished cloth shall be furnished only with dry finish. Under normal room conditions (20 to 30°C) greasy tapes shall have the property of sliding freely between layers when moved by the fingers, and shall show a decidedly oily surface. Dry finish tapes shall show some resistance to movement when so handled, but shall not bind or stick together and shall not have an oily surface. A slight amount of waxiness shall be permitted in dry cloth if dullness of surface is not apparent or if noticeable amounts of wax cannot be removed mechanically from the surface.

## 10. Sampling

10.1 Refer to Practice D 3636 for the definition of a lot.

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

10.3 *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 10.4 and 10.5.

10.4 *Sampling for Defects and Dimensions*—A random sample of rolls, tapes, or sheets shall be selected from material specified in 10.3 in accordance with Inspection Level I of Practice D 3636. Acceptance shall be determined in accordance with 5.3 and Table 2 on the basis of AQL = 2.5. The test sample shall be 5 yd (4.5 m) from each sampled roll or sheet.

10.5 *Sampling for Performance Tests*—A random sample of rolls or sheets shall be selected from the material specified in

10.3 in accordance with Inspection Level S-2 of Practice D 3636. An amount corresponding to about 0.5 yd<sup>2</sup> (0.3 m<sup>2</sup>) shall be taken from each of the sampled rolls or sheets.

## 11. Number of Tests and Retests

11.1 If the results of any test to determine conformance with 6.1 or Table 1 do not meet the requirements prescribed in this specification, two additional tests shall be made on different specimens of the same sample. If either of these additional tests fail, or if the average of all tests performed do not meet the requirements, 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.

## 12. Test Methods

12.1 Varnished cloth and tape shall be sampled, conditioned, and tested in accordance with Test Methods D 902, with the following additions and exceptions:

12.1.1 *Elongation*—Elongation shall be measured in the warp direction in accordance with the sections on elongation in Test Methods D 295, using a load of 25 lb/in. width (4.5 kg/cm width) applied for a period of 3 min.

12.1.2 *Dielectric Breakdown Under Elongation*—Tests shall be conducted in accordance with the sections on dielectric breakdown under elongation in Test Methods D 295 while tapes are under 6 % elongation in the warp direction.

12.1.3 *Tear Resistance*—Tests shall be conducted in accordance with sections on tear resistance in Test Methods D 295 in such a manner that the warp (polyester) yarns are torn.

## 13. Packaging and Package Marking

13.1 *Dry Packaging*—The packaging instructions shall include:

13.1.1 Number of rolls of tape per package, and

13.1.2 Wax coating of rolls or package, or both, or neither.

13.2 *Oil Packing*—Tape shall be supplied in suitable oil-tight cans secured with easily removable lids. The purchaser shall specify the number, width, and length of rolls in each can. The type of oil used for packing shall meet the requirements of Specification D 3487, unless agreed upon between the supplier and the purchaser.

## 14. Keywords

14.1 electrical insulation; varnished glass-polyester cloth



*The American Society for Testing and Materials 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 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, 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](mailto:service@astm.org) (e-mail); or through the ASTM website ([www.astm.org](http://www.astm.org)).*