



Designation: D4389/D4389M – 23

# Standard Specification for Finished Glass Fabrics Woven From Rovings<sup>1</sup>

This standard is issued under the fixed designation D4389/D4389M; 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 primarily covers glass fabrics woven from “E” electrical continuous glass fiber rovings that are intended primarily as a reinforcing material in laminated plastics for structural use.

1.2 This specification specifies the terminology, definitions, general requirements, and physical requirements for woven roving glass fiber fabrics. This specification permits the application of sizing materials to the glass fiber roving during manufacture that helps facilitate weaving. When used as permitted in this specification, such materials are compatible with the resin matrix as specified in the contracting instrument.

NOTE 1—Sizing materials on glass fiber yarns, in most cases, are removed by various cleaning procedures as a first stage in preparing a finished fabric. When these yarn sizing materials are removed during a cleaning procedure, they need not be compatible with the subsequent resin matrix.

1.3 *Units*—The values stated in either SI units or inch-pound units are to be regarded as standard. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems will result in nonconformance with the standard.

NOTE 2—This specification is one of a series to provide a substitute for the following Military Specifications:

- MIL-Y-1140H Yarn, Cord, Sleaving, Cloth, and Tape-Glass
- MIL-C-9084C Cloth, Glass Finished for Resin Laminates
- MIL-C-19663C Cloth, Glass, Woven Roving for Plastic Laminates

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee D13 on Textiles and is the direct responsibility of Subcommittee D13.18 on Glass Fiber and its Products.

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## 2. Referenced Documents

### 2.1 *ASTM Standards*:<sup>2</sup>

- D123 Terminology Relating to Textiles
- D578/D578M Specification for Glass Fiber Strands
- D1776/D1776M Practice for Conditioning and Testing Textiles
- D2408 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished With Amino-Silane-Type Finishes, for Plastic Laminates (Withdrawn 1988)<sup>3</sup>
- D2409 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished With Vinyl-Silane Type Finishes, for Plastic Laminates (Withdrawn 1988)<sup>3</sup>
- D2410 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished With Chrome Complexes, for Plastic Laminates (Withdrawn 1988)<sup>3</sup>
- D2660 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished with Acrylic-Silane-Type Finishes, for Plastic Laminates (Withdrawn 1988)<sup>3</sup>
- D3098 Test Method for Finish Content of Woven Glass Fabrics, Cleaned and After-Finished with Epoxy-Functions Silane Type Finishes for Plastic Laminates (Withdrawn 1988)<sup>3</sup>
- D3773/D3773M Test Methods for Length of Woven Fabric
- D3774 Test Method for Width of Textile Fabric
- D3775 Test Method for End (Warp) and Pick (Filling) Count of Woven Fabrics
- D3776/D3776M Test Methods for Mass Per Unit Area (Weight) of Fabric
- D4029/D4029M Specification for Finished Woven Glass Fabrics
- D4963/D4963M Test Method for Ignition Loss of Glass Fiber Strands and Fabrics
- D7018/D7018M Terminology Relating to Glass Fiber and Its Products (Withdrawn 2021)<sup>3</sup>

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

2.2 *ANSI Standard:*

**ANSI/ASQC Z1.4 Sampling Procedures for Inspection by Attributes<sup>4</sup>**

woven roving fabrics not listed in **Table 1**, the average fabric count shall be agreed upon between the purchaser and the supplier.

**7. Yarn Designations**

7.1 For woven roving fabrics, the roving designations shall be as agreed upon between the purchaser and the supplier. The requirements of the individual elements of the designation are specified in Sections **8 – 10**.

**8. Yarn Number**

8.1 For woven roving fabrics listed in **Table 1**, the average size-free yarn numbers of the yarns designated shall conform to the requirements of **Table 1**. For woven roving fabrics not listed in **Table 1**, the average size-free yarn numbers shall be agreed upon between the purchaser and the supplier.

**9. Filament Diameter**

9.1 The range of values for the filament diameters are listed in **Table 2**. The average filament diameter for the rovings in the woven roving fabric shall be within the interval listed in **Table 2**.

**10. Strand Construction**

10.1 The construction of the component strands shall be agreed upon between the purchaser and the supplier.

**11. Weave Type**

11.1 For woven roving fabrics listed in **Table 1**, the weave type shall be plain weave. For woven roving fabrics not listed in **Table 1**, the weave type shall be agreed upon between the purchaser and the supplier.

**12. Mass per Unit Area**

12.1 For woven roving fabrics listed in **Table 1**, the average mass per unit area shall conform to the requirements of **Table 1**. For woven roving fabrics not listed in **Table 1**, the average mass per unit area shall be agreed upon between the purchaser and the supplier. The average mass per unit area for the lot shall

**3. Terminology**

3.1 For definitions of glass fiber and product terms used in this specification refer to Terminology **D7018/D7018M**.

3.1.1 The following terms are relevant to this standard: *continuous filament yarn, roving*.

3.2 For definitions of other textile terms used in this specification, refer to Terminology **D123**.

**CLASSIFICATION**

**4. Classification**

4.1 *Designation of Woven Roving Fabric*— The basic designations for glass woven roving fabric is by mass per unit area and is given in grams per square metre (ounces per square yard). Historically, an ASTM type number has been used by the industry. These numbers have been sequentially assigned as new woven roving constructions as they were added to this specification. Numbers 1 through 10 are shown in **Table 1** with the relationship to mass per unit area and fabric count.

**REQUIREMENTS**

**5. Material**

5.1 The roving shall be continuous filament fiber, free of any free alkali, such as sodium or potassium metal salts and foreign particles, dirt, and other impurities. It shall be an E type glass as defined in Specification **D578/D578M**.

5.1.1 The fabric shall be uniformly woven, have uniform color, overall cleanness, and no objectionable odor.

**6. Fabric Count**

6.1 For woven roving fabrics listed in **Table 1**, the average fabric count shall conform to the requirements of **Table 1**. For

<sup>4</sup> Available from American National Standards Institute 11 W. 42nd St., 13th Floor, New York, NY 10036.

**TABLE 1 Physical Properties of Generally Available “E” Glass Finished Woven Roving Fabrics**

ASTM Type	Weave	Nominal Mass Per Unit Area		Roving Count 25.4 mm [1 in.] min		Construction <sup>A</sup> Nominal Roving Length Per Unit Mass				Standard Roll Length	
						Tex		yd/lb			
		g/m <sup>2</sup>	oz/yd <sup>2</sup>	Warp	Fill	Warp	Fill	Warp	Fill	m	yd
1	Plain	441	13.0	10	4	840 to 755	1065 to 925	590 to 655	465 to 535	91.5	100
2	Plain	542	16.0	10	4	840 to 755	1680 to 1505	590 to 655	295 to 330	91.5	100
3	Plain	831	24.5	5	4	2360 to 2065	2680 to 2255	210 to 240	185 to 220	68.5	75
4	Plain	831	24.5	5	3	2360 to 2065	3545 to 3105	210 to 240	140 to 160	68.5	75
5	Plain	915	27.0	5	2.5	2360 to 2065	4960 to 4725	210 to 240	100 to 105	59.5	65
6	Plain	610	18.0	7	6	1210 to 1835	1340 to 1155	410 to 270	370 to 430	68.5	75
7	Plain	745	22.0	5	4	2360 to 2065	2155 to 1910	210 to 240	230 to 260	68.5	75
8	Plain	610	18.0	4	4	2360 to 2065	1655 to 1505	210 to 240	300 to 330	68.5	75
9	Plain	559	16.5	5	4	1710 to 1525	1710 to 1525	290 to 325	290 to 325	91.5	100
10	Plain	711	21.0	4	4	2420 to 2155	2420 to 2155	205 to 230	205 to 230	82.5	90

<sup>A</sup> In some cases, the fill yarn may be woven as 2 picks per shed and as 1 fill yarn. The basic roving length per unit area used to produce the above fill yarns should be doubled.

**TABLE 2 Letter Designation for Average Fiber Diameter Range of Glass Roving Used in Woven Roving Fabrics**

Letter Designation	SI Units Diameter in Micrometres		US Customary Units Diameter in Inches	
	At Least	Below	At Least	Below
G	8.9	10.2	0.00035	0.00040
H	10.2	11.4	0.00040	0.00045
J	11.4	12.7	0.00045	0.00050
K	12.7	14.0	0.00050	0.00055
L	14.0	15.2	0.00055	0.00060
M	15.2	16.5	0.00060	0.00065
N	16.5	17.8	0.00065	0.00070
P	17.8	19.0	0.00070	0.00075
T	22.8	24.2	0.00090	0.00095

be within the interval: specified mass per unit area  $\pm 10\%$  of the specified mass per unit area.

### 13. Width

13.1 Fabric width shall be agreed upon between the purchaser and the supplier. The fabric width, including both selvages but excluding any feathered edges, shall not be less than the specified width and no more than 13 mm [0.5 in.] wider than the specified width.

NOTE 3—During the processing of glass fabrics, the selvages may be slit to minimize tension influences. This slit distance is excluded when measuring the fabric width unless otherwise agreed upon between the purchaser and the supplier.

### 14. Length

14.1 For woven roving fabrics listed in Table 1, the fabric length on each roll shall not be less than 2 m [2 yd] below the requirements listed in Table 1 unless otherwise agreed upon between the purchaser and the supplier. For woven roving fabrics not listed in Table 1, the fabric length on each roll shall be agreed upon between the purchaser and the supplier.

14.2 No piece of woven roving fabric shall be less than 14 m [15 yd] long and there shall be no more than two pieces in a roll, unless otherwise agreed upon between the purchaser and the supplier.

14.3 None of the sample rolls shall contain more than the allowable pieces, and the combined length of all of the sample rolls shall not be less than the combined lengths given on the identification labels of the sample rolls.

### 15. Ignition Loss

15.1 The organic content of woven roving fabric shall be no less than 0.075 wt % and no more than 0.25 wt % unless otherwise agreed upon between the purchaser and the supplier.

15.2 The type of, level of, and tolerances for roving finish shall be agreed upon between the purchaser and the supplier. The roving finish should be compatible with and produce the required performance characteristics for the resin system specified in the applicable laminate specification or other procurement document. If the purchaser and the supplier agree that laminate testing (wet and dry) is to be used to determine acceptability of the finish content, this fact and the test method shall be specified in the contracting document.

## 16. Fabric Appearance

16.1 The woven roving fabric shall be generally uniform in quality and condition, clean, smooth, and free of foreign particles and defects detrimental to fabrication, appearance, or performance.

16.2 The fabric in the laboratory sample for the fabric appearance shall be examined for the defects listed in Table 3 and the acceptable quality levels (AQLs) shall be 6.5 total defects per hundred units of fabric unless otherwise agreed upon between the purchaser and the supplier.

16.3 When specified, the warp direction of the fabric shall be marked by blue direction-indicator yarns running warpwise in the cloth and spaced approximately 150 mm [6 in.] apart.

## 17. Put-Up

17.1 Woven roving fabric shall be furnished in rolls and shall be wound on spiral tubes measuring 76.2-mm [3-in.] minimum inside diameter and 25 mm [1 in.] longer than the overall width of the fabric, unless otherwise specified. The maximum number of pieces contained in any roll shall be as specified in 18.1.

17.2 Unless otherwise agreed upon, as when specified in an applicable material specification, each roll shall be packed in a sealed, vapor-tight bag of polyethylene not less than 0.05 mm [0.002 in.] thick in such a manner as to ensure that the fabric, during shipment and storage, will be protected against damage from exposure to moisture, weather, or any other normal hazard.

NOTE 4—Once opened by the user, if the roll is not totally consumed, it is good practice to rebag the roll, add desiccant, and seal the bag.

## 18. Packaging

18.1 Each roll of woven roving fabric, put up as specified, shall be packaged to afford adequate protection against physical damage during shipment from the supply source to the receiving activity. The supplier's standard practice may be used when it meets this requirement.

## 19. Marking

19.1 Each package shall be marked to show the following information unless specified otherwise between the purchaser and the supplier. Characters shall be of such size as to be clearly legible and shall not be obliterated by normal handling:

100 % Fiber Glass Woven Roving Cloth  
Glass Type E

**TABLE 3 Woven Roving Fabric Defects**

Crease or wrinkle, embedded; cannot be removed by hand rubbing
Any knots
Any brittle or fused area
Any smash
Any broken or missing end or pick
Any hole, cut, or tear
Any spot, stain, or streak clearly visible
Any pulled together or torn filament
Any torn, broken, or otherwise damaged selvage
Any thick or thin place, clearly visible
Foreign matter adhering to surface, clearly visible
Any jerked-in filling or slough-off