



Designation: D4029/D4029M – 23

Standard Specification for Finished Woven Glass Fabrics¹

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1. Scope

1.1 This specification covers finished fabrics woven from “E” electrical glass fiber yarns that are intended as a reinforcing material in laminated plastics for structural use. This specification can also be applied to fabrics made of other glass types as agreed upon between the purchaser and the supplier.

1.2 This specification specifies the terminology, definitions, general requirements, and physical requirements for finished woven glass fabrics. This specification permits the application of sizing materials to the glass fiber yarn during manufacture that helps facilitate weaving. These organic materials are typically removed from the greige fabric and replaced with a finish that is compatible with the resin matrix specified in the contracting document.

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 The values stated in either SI units or inch-pound units are to be regarded separately 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 non-conformance with the standard.

1.4 This specification is one of a series to provide a substitute for Military Specifications: MIL-Y-1140 Yarn, Cord, Sleeving, Cloth, and Tape-Glass; and MIL-C-9084 Cloth, Glass Finished for Resin Laminates.

1.5 Additional ASTM specifications in this series have been drafted and appear in current editions of the Annual Book of ASTM Standards. These include greige glass fabrics, glass tapes, glass sleeveings, glass cords, glass sewing threads, and finished laminates made from finished glass fabrics.

1.6 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.7 *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.*

2. Referenced Documents

2.1 *ASTM Standards:*²

[D123 Terminology Relating to Textiles](#)

[D578/D578M Specification for Glass Fiber Strands](#)

[D1059 Test Method for Yarn Number Based on Short-Length Specimens](#)

[D1423/D1423M Test Method for Twist in Yarns by Direct-Counting](#)

[D1776/D1776M Practice for Conditioning and Testing Textiles](#)

[D1777 Test Method for Thickness of Textile Materials](#)

[D2408 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished With Amino-Silane-Type Finishes, for Plastic Laminates \(Withdrawn 1988\)³](#)

[D2409 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished With Vinyl-Silane-Type Finishes, for Plastic Laminates \(Withdrawn 1988\)³](#)

[D2410 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished With Chrome Complexes, for Plastic Laminates \(Withdrawn 1988\)³](#)

[D2660 Test Method for Finish Content of Woven Glass Fabric, Cleaned and After-Finished with Acrylic-Silane-Type Finishes, for Plastic Laminates \(Withdrawn 1988\)³](#)

[D3098 Test Method for Finish Content of Woven Glass Fabrics, Cleaned and After-Finished with Epoxy-Functions Silane Type Finishes for Plastic Laminates \(Withdrawn 1988\)³](#)

[D3773/D3773M Test Methods for Length of Woven Fabric](#)

¹ 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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ The last approved version of this historical standard is referenced on www.astm.org.



- 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
- D4963/D4963M Test Method for Ignition Loss of Glass Fiber Strands and Fabrics
- D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)
- D7018/D7018M Terminology Relating to Glass Fiber and Its Products (Withdrawn 2021)³

2.2 *ANSI Standard:*

ANSI/ASQC Z1.4 Sampling Procedures for Inspection by Attributes⁴

2.3 *Military Standard and Specifications:*

MIL-Y-1140H Yarn, Cord, Sleeveing, Cloth and Tape-Glass⁵
MIL-C-9084C Cloth, Glass Finished for Resin Laminates⁵

2.4 *Textile Institute Documents:*

Textile Terms and Definitions⁶
Woven Cloth Construction⁶

3. Terminology

3.1 For all terminology relating to D13.18, Glass Fibers and Its Products, refer to Terminology D7018/D7018M.

3.1.1 The following terms are relevant to this specification: atmosphere for testing textiles, continuous filament, crowfoot weave, eight-harness satin, finished, leno weave, mock leno weave, twelve-harness satin.

3.2 For all other terms related to textiles, see Terminology D123.

CLASSIFICATION

4. Classification

4.1 The designation of a fabric shall be by style numbers that are standard throughout the industry. Generally used style numbers are listed in numerical order in Table 1.

REQUIREMENTS

5. Material

5.1 The yarn shall be continuous filament, unless otherwise specified, free of any free alkali metal salts, such as soda or potash, and foreign particles, dirt, and other impurities.

6. Fabric Count

6.1 For fabrics listed in Table 1, the nominal fabric count shall conform to the requirements of Table 1. For fabrics not listed in Table 1, the nominal fabric count shall be agreed upon between the purchaser and the supplier. The average count of

warp ends shall be within two ends of the nominal count and the average count of the filling picks shall be within two picks of the nominal count.

7. Yarn Designations

7.1 For fabrics listed in Table 1, the yarn designations shall conform to the requirements of Table 1. For fabrics not listed in Table 1, the yarn designations may be agreed upon between the purchaser and the supplier. The requirements of the individual elements of the designation are specified in Sections 8 – 12.

7.1.1 In some cases ECE 225 yarn is specified in Table 1. ECD 225 may be substituted with no significant decrease in property performance.

8. Yarn Number

8.1 For fabrics listed in Table 1, the nominal size-free yarn numbers of the yarns designated shall conform to Specification D578/D578M. For fabrics not listed in Table 1, the nominal size-free yarn number may be agreed upon between the purchaser and the supplier.

9. Filament Diameter

9.1 The nominal filament diameter for the yarns in the fabric shall conform to the nominal range for filament diameter average values specified in Table 1 of Specification D578/D578M.

10. Strand Construction

10.1 The basis for specifying strand construction is given in Specification D578/D578M. For fabrics listed in Table 1 of this specification, the construction of the component strands shall conform to the requirements of Table 1 in Specification D578/D578M. For fabrics not listed in Table 1, the construction of the component strands may be agreed upon between the purchaser and the supplier.

11. Direction of Twist

11.1 The primary twist in the singles strands shall be “Z” twist and the final twist in the plied yarns shall be “S” twist unless otherwise agreed upon between the purchaser and the supplier.

12. Twist Level

12.1 The nominal twist in the component strands and the finished yarns shall conform to the requirements of Table 1 in Specification D578/D578M unless otherwise agreed upon between the purchaser and the supplier. The tolerances for the primary twist and the final twist shall conform to Table 2 of this specification.

13. Fabric Weave Type

13.1 For fabrics listed in Table 1, the fabric weave type shall conform to the requirements of Table 1. For fabrics not listed in Table 1, the fabric weave type shall be agreed upon between the purchaser and the supplier.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, <http://quicksearch.dla.mil>.

⁶ Available from the Textile Institute, 10 Blackfriars St., Manchester, M3 5DR England.



TABLE 1 Physical Properties of Typical “E” Glass Finished Woven Glass Fabrics

Commercial Style Designation	Fabric Count, Warp × Fill Yarns 25 mm yarns/in.	Yarn Designation tex ^A inch-pound units		Fabric Weave Type ^B	Mass per Unit Area, g/m ² [oz/yd. ²]	Nominal Thickness, ^C mm [in.]	Breaking Force, min, ^C Warp × Fill N/5 cm [lbf/in.]
		Warp	Filling				
101	74 × 74	EC5 2.75 1 × 0	EC5 2.75 1 × 0	plain	16.9	0.020	162 × 162
	75 × 75	ECD 1800 1/0	ECD 1800 1/0		0.50	0.0008	19 × 19
104	59 × 51	EC5 5.5 1 × 0	EC5 2.75 1 × 0	plain	19	0.028	131 × 26
	60 × 52	ECD 900 1/0	ECD 1800 1/0		0.56	0.0011	15 × 3
105	59 × 51	EC5 5.5 1 × 0	EC5 5.5 1 × 0	plain	24.4	0.0330	114 × 96
	60 × 52	ECD 900 1/0	ECD 900 1/0		0.72	0.0013	13 × 11
106	55 × 55	EC5 5.5 1 × 0	EC5 5.5 1 × 0	plain	25	0.036	105 × 105
	56 × 56	ECD 900 1/0	ECD 900 1/0		0.73	0.0014	12 × 12
107	59 × 34	EC5 5.5 1 × 2	EC5 5.5 1 × 00	plain	34	0.046	210 × 44
	60 × 35	ECD 900 1/2	ECD 900 1/		1.01	0.0018	24 × 5
108	59 × 46	EC5 5.5 1 × 2	EC5 5.5 1 × 2	plain	47.5	0.061	578 × 456
	60 × 47	D900 1/2	D900 1/2		1.40	0.0024	66 × 52
112	39 × 38	EC5 11 1 × 2	EC5 11 1 × 2	plain	71	0.089	350 × 306
	40 × 39	ECD 450 1/2	ECD 450 1/2		2.10	0.0035	40 × 35
113	59 × 63	EC5 11 1 × 2	EC5 5.5 1 × 2	plain	83	0.086	438 × 219
	60 × 64	ECD 450 1/2	ECD 900 1/2		2.45	0.0034	50 × 25
116	59 × 57	EC5 11 1 × 2	EC5 11 1 × 2	plain	105	0.102	525 × 486
	60 × 58	ECD 450 1/2	ECD 450 1/2		3.10	0.0040	60 × 55
118	89 × 59	EC5 11 1 × 2	EC5 11 1 × 2	crowfoot	132	0.132	657 × 525
	90 × 60	ECD 450 1/2	ECD 450 1/2		3.90	0.0052	75 × 60
119	53 × 49	EC5 11 1 × 2	EC5 11 1 × 2	plain	92	0.099	525 × 438
	54 × 50	ECD 450 1/2	ECD 450 1/2		2.71	0.0039	60 × 50
120	59 × 57	EC5 11 1 × 2	EC5 11 1 × 2	crowfoot	106	0.107	525 × 482
	60 × 58	ECD 450 1/2	ECD 450 1/2		3.14	0.0042	60 × 55
125	35 × 33	EC5 11 2 × 2	EC5 11 2 × 2	plain	125	0.145	525 × 482
	36 × 34	ECD 450 2/2	ECD 450 2/2		3.70	0.0057	60 × 55
126	33 × 31	EC5 11 3 × 2	EC5 11 3 × 2	plain	180	0.193	701 × 482
	34 × 32	ECD 450 3/2	ECD 450 3/2		5.30	0.0076	80 × 55
127	41 × 31	EC5 11 3 × 2	EC5 11 3 × 2	plain	197	0.198	701 × 482
	42 × 32	ECD 450 3/2	ECD 450 3/2		5.80	0.0078	80 × 55
128	41 × 31	EC7 22 1 × 3	EC7 22 1 × 3	plain	197	0.183	701 × 482
	42 × 32	ECE 225 1/3	ECE 225 1/3		5.80	0.0072	80 × 55
141	31 × 21	EC7 22 3 × 2	EC7 22 3 × 2	plain	288	0.292	1095 × 788
	32 × 21	ECE 225 3/2	ECE 225 3/2		8.50	0.0115	125 × 90
143	48 × 30	EC7 22 3 × 2	EC5 11 1 × 2	crowfoot	281	0.241	2189 × 175
	49 × 30	ECE 225 3/2	ECD 450 1/2		8.30	0.0095	250 × 20
162	28 × 16	EC7 22 2 × 5	EC7 22 2 × 5	plain	397	0.419	1664 × 1995
	28 × 16	ECE 225 2/5	ECE 225 2/5		11.7	0.0165	190 × 125
164	20 × 18	EC7 22 4 × 3	EC7 22 4 × 3	plain	420	0.406	1664 × 1401
	20 × 18	ECE 225 4/3	ECE 225 4/3		12.4	0.016	190 × 160
166	59 × 57	EC5 11 1 × 2	EC5 22 1 × 0	plain	105	0.102	420 × 488
	60 × 58	ECD 450 1/2	ECD 225 1/0		3.10	0.0040	48 × 57
182	59 × 55	EC7 22 2 × 2	EC7 22 2 × 2	8-H satin	414	0.343	1576 × 1401
	60 × 56	ECE 225 2/2	ECE 225 2/2		12.2	0.0135	180 × 160
183	53 × 47	EC7 22 3 × 2	EC7 22 3 × 2	8-H satin	542	0.470	2189 × 1970
	54 × 48	ECE 225 3/2	ECE 225 3/2		16.0	0.0185	250 × 225
184	41 × 35	EC7 22 4 × 3	EC7 22 4 × 3	8-H satin	848	0.762	2627 × 2189
	42 × 36	ECE 225 4/3	ECE 225 4/3		25.0	0.0300	300 × 250
325	89 × 43	EC5 5.5 1 × 0	EC5 2.75 1 × 0	plain	24	0.033	149 × 44
	90 × 44	ECD 900 1/0	ECD 1800 1/0		0.70	0.0013	17 × 5
341	30 × 48	EC5 11 1 × 2	EC7 22 3 × 2	crowfoot	294	0.241	263 × 2189
	30 × 49	ECD 450 1/2	ECE 225 3/2		8.68	0.0095	30 × 250
1000	84 × 84	BC 4 1.65 1 × 0	BC 4 1.65 1 × 0	plain	11.1	0.012	
	85 × 85	BC 3000 1/0	BC 3000 1/0		0.33	0.00047	
1012	69 × 69	BC4 2.2 1 × 0	BC4 2.2 1 × 0	plain	12.3	0.018	
	70 × 70	BC 2250 1/0	BC 2250 1/0		0.36	0.00071	
1015	94 × 94	BC4 2.20 1 × 0	BC4 2.20 1 × 0	plain	16.9	0.015	
	96 × 96	BC 2259 1/0	BC 2259 1/0		0.50	0.00059	
1017	94 × 94	BC 4 1.65 1 × 0	BC 4 1.65 1 × 0	plain	12.3	0.013	
	95 × 95	BC 3000 1/0	BC 3000 1/0		0.36	0.00053	
1020	54 × 54	EC4.5 2.76 1 × 0	EC4.5 2.76 1 × 0	plain	12.2	0.025	
	55 × 55	ECC 1800 1/0	ECC 1800 1/0		0.36	0.00098	
1024	90 × 90	BC4 3.31 1 × 0	BC4 3.31 1 × 0	plain	23.8	0.020	
	91 × 91	BC 1500 1/0	BC 1500 1/0		0.70	0.00079	
1027	74 × 74	BC4 3.31 1 × 0	BC4 3.31 1 × 0	plain	19.9	0.019	
	75 × 75	BC 1500 1/0	BC 1500 1/0		0.59	0.00075	
1030	90 × 90	EC4.5 4.1 1 × 0	EC4.5 4.1 1 × 0	plain	29.7	0.026	
	91 × 91	EC 1200 1/0	EC 1200 1/0		0.88	0.00102	