

AEROSPACE MATERIAL SPECIFICATION

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Superseding AMS 3827A

An American National Standard

CLOTH, TYPE "E" GLASS, "B" STAGE POLYESTER-RESIN-IMPREGNATED
7781 Style Fabric, Flame Resistant

1. SCOPE:

- 1.1 Form: This specification covers a style 7781 glass cloth impregnated with a heat-curable polyester resin system, the resin being processed to a "B" stage condition, and furnished in the form of continuous rolls.
- 1.2 Application: Primarily for vacuum-bag molded, flame resistant laminates used up to 80°C (176°F).
- 1.3 Safety - Hazardous Materials: While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

- 2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS 2825 - Material Safety Data Sheets
AMS 3824 - Cloth, Type "E" Glass, Finished for Resin Laminates

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2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 638 - Tensile Properties of Plastics

ASTM D 638M - Tensile Properties of Plastics (Metric)

ASTM D 695 - Compressive Properties of Rigid Plastics

ASTM D 695M - Compressive Properties of Rigid Plastics (Metric)

ASTM D 790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials

ASTM D 790M - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials (Metric)

ASTM D 2344 - Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method

ASTM F 501 - Aerospace Materials Response to Flame, with Vertical Test Specimen (for Aerospace Vehicles Standard Conditions)

2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Military Standards:

MIL-STD-2073-1 - DOD Materials, Procedures for Development and Application of Packaging Requirements

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 Reinforcement: Shall conform to AMS 3824, Style 181, 1581, or 7781.

3.1.2 Resin: Shall be a low-pressure-laminating polyester resin modified as necessary to meet the requirements of 3.2, 3.3, and 3.4.

3.2 Shelf Life: The impregnated cloth shall have a shelf life of not less than \emptyset three months from date of receipt by purchaser when stored below 7°C (45°F) or six months when stored at 18°C (0°F) or below in moisture-proof, sealed containers.

3.3 Working Life: The impregnated cloth shall meet the requirements of 3.4 when tested after continuous exposure up to 20 days within the relative humidity and temperature limits shown in Figure 1.

3.4 Properties: Impregnated cloth shall conform to the following requirements:

3.4.1 Uncured Impregnated Cloth: Shall conform to the following requirements; tests shall be performed on the cloth after warming to above the dew point in its sealed moisture-proof container prior to sampling and in accordance with specified test methods:

Volatiles, % by weight	To be reported in preproduction report	4.5.2
Resin Solids Content (Volatile Free), % by weight	40 ± 4	4.5.2
Gel Time, minutes	Preproduction Value ±20%	4.5.3
Resin Flow	Preproduction Value ±20%	4.5.4

3.4.2 Cured Laminate: Shall conform to the following requirements; tests shall be performed at 25°C ± 3 (77°F ± 5) in accordance with specified test methods on specimens cut from test laminates prepared as in 4.5.1. Reported average values shall be based on four determinations for each requirement.

3.4.2.1 Tensile Strength: ASTM D 638 or
ASTM D 638M

Minimum Average	38.2 ksi (263 MPa)
Individual Minimum	32.2 ksi (222 MPa)

3.4.2.2 Compressive Strength (Edgewise): 4.5.5

Minimum Average	25.0 ksi (172 MPa)
Individual Minimum	22.5 ksi (155 MPa)

3.4.2.3 Flexural Strength: ASTM D 790 or
ASTM D 790M

Minimum Average	46.0 ksi (317 MPa)
Individual Minimum	41.4 ksi (285 MPa)

3.4.2.4 Flexural Modulus: ASTM D 790 or
ASTM D 790M

Minimum Average	2,100.0 ksi (145 GPa)
Individual Minimum	2,000.0 ksi (140 GPa)

3.4.2.5 Flame Resistance: (See 8.3)

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3.4.2.5.1 Vertical Test, 60 Second Ignition: ASTM F 501

3.4.2.5.1.1 Time to Extinguish after Flame
Removal, maximum

Maximum Average	5.0 seconds
Individual maximum	6.0 seconds

3.4.2.5.1.2 Burn Length

Maximum	6.0 inches (152 mm)
Individual maximum	7.2 inches (183 mm)

3.4.2.5.1.3 Drip Flaming Time

Maximum average	3.0 seconds
Individual maximum	3.6 seconds

3.4.2.5.2 Penetration Flame Test:

4.5.6

3.4.2.5.2.1 Time to Extinguish after Flame Removal

Maximum average	15 seconds
Individual average	18 seconds

3.4.2.5.2.2 Time of Afterglow

Maximum average	10 seconds
Individual Average	12 seconds

3.4.2.5.2.3 Penetration (Complete of Laminate) None

3.4.2.6 Interlaminar Shear Strength:

ASTM D 2344

Minimum Average	Preproduction Value -20%
Individual minimum	Preproduction Value -20%

3.5 Quality: The cloth, as received by purchaser, shall be uniform in quality and condition, and free from foreign materials and from imperfections detrimental to usage of the cloth.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of cloth shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the cloth conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for uncured properties of impregnated cloth (3.4.1) and for tensile strength (3.4.2.1), flexural strength (3.4.2.3), flame resistance (3.4.2.5.1 and 3.4.2.5.2), and interlaminar shear strength (3.4.2.6) of cured laminates are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of cloth to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing: Shall be as follows:

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4.3.1 For Acceptance Tests:

4.3.1.1 Frequency of Sampling: The vendor shall sample the cloth at random according to the following schedule:

Volatiles	Each roll
Resin Solids	Each roll
Gel Time	Each roll
Resin Flow	Each roll
Tensile Strength	Lot basis
Flexural Strength	Lot basis
Flame Resistance	Lot basis
Interlaminar Shear Strength	Lot basis

4.3.1.2 Each roll of cloth offered for acceptance shall not exceed 250 yards (229 m) in length.

4.3.1.3 A lot shall be all cloth treated at one time without changes in treater settings using a single batch of resin and reinforcement and presented for vendor's inspection at one time. An inspection lot shall not exceed 2000 yards (1829 m). A lot may be packaged in smaller quantities and delivered under the basis lot approval provided lot identification is maintained.

4.3.1.4 From the test laminates prepared as in 4.5.1, four specimens shall be taken, with the length of each specimen parallel to the warp, for each requirement for properties of the cured product.

4.3.1.5 When a statistical sampling plan has been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1 and the report of 4.6 shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

4.4 Approval:

4.4.1 Sample cloth shall be approved by purchaser before cloth for production use is supplied, unless such approval be waived by purchaser. Results of tests on production cloth shall be essentially equivalent to those on the approved sample.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production cloth which are essentially the same as those used on the approved sample cloth. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in ingredients and/or processing and, when requested, sample cloth. Production cloth made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Preparation of Test Laminates: All test laminates shall be layed up with the warp parallel and unnested so that the satin shafts of the warp always face the top of the layup and shall be cured in accordance with resin manufacturer's recommendation. Laminates from which tensile specimens are cut shall be composed of eight plies and shall be not less than 14 inches (356 mm) in the warp direction. Laminates from which test specimens for compressive strength, flexural strength, flexural modulus, and shear strength are cut shall be composed of twelve plies and shall be not less than 12 inches (305 mm) square. Laminates from which test specimens for flame resistance are cut shall be composed of two plies and shall be not less than 12 inches (305 mm) square.

4.5.2 Volatile Content and Resin Solids Test: Volatile and resin content shall be determined by accurately weighing (W_1) 4.0-inch (102-mm) square samples (or equivalent area) cut from the cloth. Using porcelain crucibles previously brought to constant weight by igniting at $845^{\circ}\text{C} \pm 25$ ($1553^{\circ}\text{F} \pm 45$), dry samples in a circulating air oven at $120^{\circ}\text{C} \pm 5$ ($248^{\circ}\text{F} \pm 9$) for 15 minutes, cool in a desiccator, and reweigh (W_2).

Burn out resin in muffle furnace for 3 hours at $565^{\circ}\text{C} \pm 25$ ($1050^{\circ}\text{F} \pm 45$) or until fabric is white. Cool in a desiccator and reweigh. Repeat the 565°C (1050°F) burn out as necessary to obtain constant weight (W_3).

$$\text{Volatiles Content, \%} = \frac{(W_1 - W_2) \times 100}{W_1}$$

$$\text{Resin Solids Content, Volatile Free, \%} = \frac{(W_2 - W_3) \times 100}{W_2}$$

4.5.3 Gel Time: Cut sufficient 2-inch (51-mm) square pieces across the roll width to make a sample approximately 0.020 inch (0.51 mm) thick. Place the sample between sheets of suitable film and insert between the platens of a press which has been stabilized at $120^{\circ}\text{C} \pm 5$ ($248^{\circ}\text{F} \pm 9$). Apply sufficient pressure to form a bead of resin around the sample. Timing shall begin as soon as pressure is applied. The resin bead shall be probed at intervals with a wire. Gelling will be preceded by the appearance, during probing, of long strands of resin. Probing shall be continued until these long strands of resin no longer occur; the elapsed time shall be recorded as gel time.

- 4.5.4 Resin Flow: Cut four 4.0-inch (102-mm) square pieces on the bias of cloth and weigh to the nearest 0.01 gram (W_1). Stack pieces between separator sheets, approximately 6 x 8 inches (152 x 203 mm) of aluminum foil, or equivalent, and reweigh pieces and foil to nearest 0.01 gram (W_2).
- 4.5.4.1 If the sample tends to stick to the separator sheets after curing, it is permissible to use a nonvolatile mold release agent. Such agents may be used only under conditions such that they do not undergo a weight loss greater than 0.005 gram during curing.
- 4.5.4.2 Place samples and separator sheets between press platens preheated to $120^\circ\text{C} \pm 3$ ($248^\circ\text{F} \pm 5$), taking care that the edges of all pieces remain properly aligned. Apply pressure of $15 \text{ psi} \pm 1.25$ ($103 \text{ kPa} \pm 10$) and hold for 10 minutes while maintaining press platens at $120^\circ\text{C} \pm 3$ ($248^\circ\text{F} \pm 5$). Remove sample and cool in desiccator. Weigh sample with separators to nearest 0.1 gram (W_3). Remove separator and resin flash, trimming sample to original 4 x 4 inch (102 x 102 mm) size, taking care not to remove any reinforcing fibers. Weigh sample to nearest 0.01 gram (W_4).

$$\text{Resin flow, \%} = 100 \times \frac{W_1 - (W_2 - W_3) - W_4}{W_1 - (W_2 - W_3)}$$

- 4.5.5 Compressive Strength: Shall be determined in accordance with ASTM D 695 or ASTM D 695M except that the specimen supporting jig shall be modified to incorporate specimen end clamps. An example of a suitable supporting jig with end clamps is shown in Figure 2. In addition, the specimen configuration shall be modified to conform to Figure 3.
- 4.5.6 Penetration Flame Test: Specimens shall be supported at 45 degrees to horizontal by clamping in a metal frame such that an 8-inch (203-mm) square is exposed. A 3/8-inch (9.5-mm) diameter Bunsen or Tirrill burner shall rest upon a horizontal surface. The burner shall be adjusted for no air intake, giving a yellow-tipped, 1-1/2 inch (38 mm) high flame which shall be applied to the center of the specimen for 30 seconds with one-third of the flame in contact with the specimen. Report the time to extinguish and the time to stop glowing after removal of the flame for each specimen.
- 4.6 Reports: The vendor of cloth shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the cloth conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 3827B, vendor's material designation, values to be reported, and quantity.
- 4.6.1 A material safety data sheet conforming to AMS 2825, or equivalent, shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results, or, if preproduction testing be waived by purchaser, concurrent with the first shipment of cloth for production use. Each request for modification of cloth formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the cloth may be based on the results of testing three additional specimens, cut from the same panel or newly-prepared test panel, for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the cloth represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

5.1.1 Each roll of cloth shall be legibly identified by attached removable tags using characters which will not be obliterated by normal handling.

5.1.2 Each tag shall be legibly marked with not less than the following information:

CLOTH, TYPE "E" GLASS, "B" STAGE POLYESTER RESIN IMPREGNATED, 7781 STYLE

AMS 3827B

PURCHASE ORDER NUMBER _____

MANUFACTURER'S IDENTIFICATION _____

DATE OF IMPREGNATION _____

LOT NUMBER _____

ROLL NUMBER, SEQUENTIAL _____

5.2 Packaging:

5.2.1 Cloth shall be shipped on reels or spools with 3-inch (76-mm) inside diameter. Width shall be as specified by purchaser \pm 1/2 inch (\pm 12.7 mm).

5.2.2 Cloth shall be interleaved with a colored separator in a manner to provide an outer wrapping with not less than a 2-inch (51-mm) overlap.

5.2.3 Cloth shall be shipped in sealed polyethylene bags and packaged in outer cartons so that the cloth, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any other normal hazard. The outer carton shall either contain dry ice or be shipped in an environment refrigerated below 7°C (45°F).

5.2.4 Each container of cloth shall be legibly marked with not less than the following information:

CLOTH, TYPE "E" GLASS, "B" STAGE POLYESTER RESIN IMPREGNATED, 7781 STYLE
AMS 3827B

DATE OF IMPREGNATION _____

PURCHASE ORDER NUMBER _____

DATE OF SHIPMENT _____

LOT NUMBER _____

QUANTITY _____

MANUFACTURER'S IDENTIFICATION _____

PERISHABLE - STORE BELOW 7°C (45°F)

- 5.2.5 Containers of cloth shall be prepared for shipment in accordance with
Ø commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the cloth to ensure carrier acceptance and safe delivery.
- 5.2.6 For direct U.S. Military procurement, packaging shall be in accordance with
Ø MIL-STD-2073-1, Commercial Level, unless Level A is specified in the request for procurement.
6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
7. REJECTIONS: Cloth not conforming to this specification, or to modifications authorized by purchaser, will be subject to rejection.
8. NOTES:
- 8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.
- 8.2 For definition of terms, refer to ASTM D 123.
- 8.3 The flame resistance requirements of this specification meet the requirements of FAA FAR 25.853(a) and Appendix F. The flame resistance test is intended only for comparative evaluation of materials and is not to be construed as an indication of characteristics of the product under actual fire conditions.
- 8.4 Dimensions and properties in inch/pound units and the Celsius temperatures are primary; dimensions and properties in SI units and the Fahrenheit temperatures are shown as the approximate equivalents of the primary units and are presented only for information.
- 8.5 For direct U.S. Military procurement, purchase documents should specify not less than the following:
- Title, number, and date of this specification
Width of cloth desired
Quantity of cloth desired
Level A packaging, if required (See 5.2.6).
- 8.6 Cloth meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 8305.

This specification is under the jurisdiction of AMS Committee "CC".