

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 3831A

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Reaffirmed OCT 1997

Superseding AMS 3831

Cloth, Type "E" Glass, "B" Stage Epoxy-Resin-Impregnated 7781 Style Fabric, Flame Resistant, Improved Strength

1. SCOPE:

1.1 Form:

This specification covers a glass cloth impregnated with a heat-curable epoxy resin system, the resin being processed to a "B" stage condition, and furnished in the form of continuous rolls.

1.2 Application:

This cloth has been used typically for vacuum-bag molded, flame-resistant laminates for service up to 82 °C (180 °F), but usage is not limited to such applications.

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.

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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

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 D 3529	Resin Solids Content of Carbon Fiber-Epoxy Prepreg
ASTM D 3530	Volatiles Content of Carbon Fiber-Epoxy Prepreg
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 DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

3. TECHNICAL REQUIREMENTS:

3.1 Material:

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

3.1.2 Resin: Shall be a low-pressure-laminating epoxy 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 six months from date of receipt by purchaser 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 up to 20 days continuous exposure within the relative humidity and temperature limits shown in Figure 1.

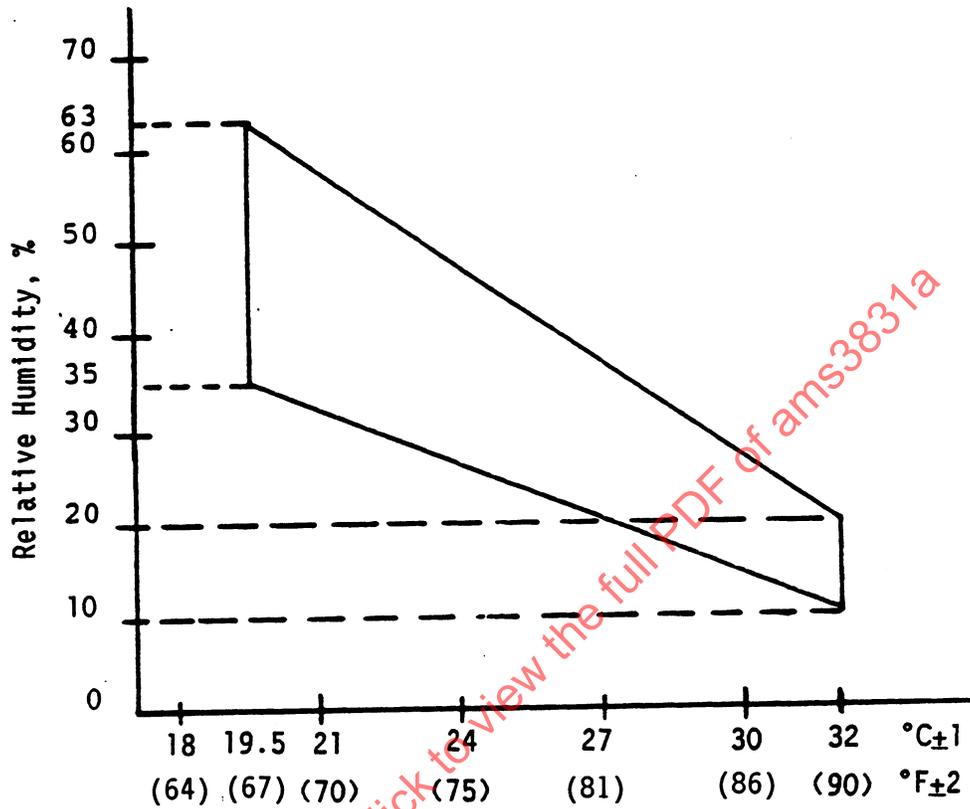


FIGURE 1 - Working Life Exposure Conditions

3.4 Properties:

Impregnated cloth shall conform to the following requirements:

- 3.4.1 Uncured Impregnated Cloth: Shall conform to the requirements shown in Table 1; 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.

TABLE 1 - Uncured Properties

Paragraph	Property	Requirement	Test Method
3.4.1.1	Volatiles, % by weight, maximum	2%	4.5.2
3.4.1.2	Resin Solids Content, Volatile Free, % by weight	40 ± 4	ASTM D 3529
3.4.1.3	Gel Time, minutes	Preproduction value ± 20%	4.5.3
3.4.1.4	Resin Flow	Preproduction value ± 20%	4.5.4

3.4.2 Cured Laminate: Shall conform to the requirements shown in Table 2; 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. Specimens to be tested under wet conditions shall be immersed in boiling distilled water for not less than two hours, cooled by immersion in water at room temperature, and tested within two hours. Property values specified are the minimum average for four determinations per test; no individual value shall be less than 90% of the minimum average value specified.

TABLE 2 - Cured Properties

Paragraph	Property	Requirement	Test Method
3.4.2.1	Tensile Strength:		ASTM D 638 or ASTM D 638M
	Dry	73.0 ksi (503 MPa)	
	Wet	64.0 ksi (441 MPa)	
3.4.2.2	Compressive Strength:		ASTM D 695 or ASTM D 695M
	Dry	60.0 ksi (414 MPa)	
	Wet	50.0 ksi (345 MPa)	
3.4.2.3	Compressive Modulus:		ASTM D 695 or ASTM D 695M
	Dry	3.45 ksi (238 GPa)	
	Wet	3.45 ksi (238 GPa)	
3.4.2.4	Flexural Strength:		ASTM D 790 or ASTM D 790M
	Dry	87.0 ksi (600 MPa)	
	Wet	75.0 ksi (517 MPa)	

TABLE 2 - Cured Properties (Continued)

Paragraph	Property	Requirement		Test Method
3.4.2.5	Flexural Modulus:			ASTM D 790 or ASTM D 790M
	Dry	3.3 Msi (228 GPa)		
	Wet	3.0 Msi (207 GPa)		
3.4.2.6	Interlaminar Shear Strength:			ASTM D 2344
	Dry	3.4 ksi (23 MPa)		
	Wet	3.4 ksi (23 MPa)		
3.4.2.7	Flame Resistance (See 8.3):			
3.4.2.7.1	Vertical Test, 60 Seconds Ignition:			ASTM F 501
		Average	Individual	
	Time to Extinguish after Flame Removal, maximum	5.0 seconds	6.0 seconds	
	Burn Length, maximum	6.0 inches (152 mm)	7.2 inches (183 mm)	
	Drip Flaming Time, maximum	3.0 seconds	3.6 seconds	
3.4.2.7.2	Penetration Flame Test:			4.5.5
		Average	Individual	
	Time to Extinguish after Flame Removal, maximum	15 seconds	18 seconds	
	Time of Afterglow, maximum	10 seconds	12 seconds	
	Penetration (complete) of Laminate	None	None	

3.3 Quality:

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 properties of uncured impregnated cloth (Table 1) and for tensile strength (3.4.2.1), flexural strength (3.4.2.4), interlaminar shear strength (3.4.2.6), and flame resistance (3.4.2.7.1 and 3.4.2.7.2) 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:

4.3.1 For Acceptance Tests: Cloth shall be sampled 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
Interlaminar Shear Strength:	Lot basis
Flame Resistance:	Lot basis

- 4.3.1.1 Each roll of cloth offered for acceptance shall not exceed 250 yards (229 m) in length.
- 4.3.1.2 A lot shall be all cloth treated at one time without change 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).
- 4.3.1.3 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.
- 4.3.1.4 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, compressive modulus, 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: Shall be determined in accordance with ASTM D 3530 at Temperature A, 120 °C (248 °F).
- 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 °C ± 5 (248 °F ± 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: Shall be determined in accordance with ASTM D 3531 using a platen press preheated to 120 °C ± 3 (248 °F ± 5) and a pressure of 15 psi ± 1 (103 kPa ± 7), holding at heat and pressure for 15 minutes ± 5.
- 4.5.5 Penetration Flame Test: Specimens shall be supported at 45 degrees to horizontal by clamping in a metal frame such that an area 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 3831A, vendor's material designation, values to be reported, width, 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 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 EPOXY RESIN IMPREGNATED, 7781 STYLE
AMS 3831A

PURCHASE ORDER NUMBER _____

MANUFACTURER'S IDENTIFICATION _____

DATE OF MANUFACTURE _____

LOT NUMBER _____

ROLL NUMBER, SEQUENTIAL _____

5.2 Packaging:

- 5.2.1 A lot of cloth may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained.
- 5.2.2 Cloth shall be shipped on reels or spools with a 3 inch (76 mm) inside diameter. Width shall be as specified by purchaser $\pm 1/2$ inch (± 12.7 mm).