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400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 3821B

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Superseding AMS 3821A

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

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of May, 1991. It is recommended that this specification not be specified for new designs.

This cover sheet should be attached to the "A" revision of the subject specification.

"NONCURRENT" refers to those materials which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division does not recommend these as standard materials for future use in new designs. Each of these "NONCURRENT" specifications is available from SAE upon request.

REAFFIRMED
APR '95

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "CC".

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400 COMMONWEALTH DRIVE. WARRENDALE. PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 3821A
Superseding AMS 3821

Issued 12-1-73
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CLOTH, TYPE "E" GLASS, "B" STAGE EPOXY-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 epoxy 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 (180°F).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

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

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2825 - Material Safety Data Sheets
AMS 3824 - Cloth, Type "E" Glass, Finished for Resin Laminates

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D638 - Tensile Properties of Plastics
ASTM D695 - Compressive Properties of Rigid Plastics
ASTM D790 - Flexural Properties of Plastics and Electrical Insulating Materials
ASTM D2344 - Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method
ASTM F501 - Aerospace Materials Response to Flame with Vertical Test Specimen (for Aerospace Vehicles Standard Conditions)

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

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 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 three months from date of receipt by purchaser when stored below 7°C (45°F) 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 Fig. 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 the 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, min.	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 D638

Minimum Average	40,000 psi (275 MPa)
Individual Minimum	36,000 psi (250 MPa)

3.4.2.2	Compressive Strength (Edgewise):		4.5.5
	Minimum Average	47,000 psi (325 MPa)	
	Individual Minimum	42,300 psi (290 MPa)	
3.4.2.3	Flexural Strength:		ASTM D790
	Minimum Average	50,000 psi (345 MPa)	
	Individual Minimum	45,000 psi (310 MPa)	
3.4.2.4	Flexural Modulus:		ASTM D790
	Minimum Average	2,500,OOO psi (170 GPa)	
	Individual Minimum	2,250,OOO psi (155 GPa)	
3.4.2.5	Flame Resistance: (See 8.3)		

3.4.2.5.1 Vertical Test, 60 Sec Ignition: ASTM F501

	Average	Individual
Time to Extinguish after Flame Removal, max	5.0 sec	6.0 sec
Burn Length, max	6.0 in. (155 mm)	7.2 in. (185 mm)
Drip Flaming Time, max	3.0 sec	3.6 sec

3.4.2.5.2 Penetration Flame Test: 4.5.6

	Average	Individual
Time to Extinguish after Flame Removal, max	15 sec	18 sec
Time of Afterglow, max	10 sec	12 sec
Penetration (complete) of Laminate	None	None

3.4.2.6 Interlaminar Shear Strength: ASTM D2344

Minimum Average	Preproduction Value minus 20%
Individual Minimum	Preproduction Value minus 20%

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

4 1 QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of cloth shall supply all samples Ø for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6. 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 to determine conformance to requirements for Ø 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 classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical Ø requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of cloth to a purchaser, when a change in material or processing, or both, 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 Ø requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows:

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:

Ø

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 yd (230 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 yd (1830 m), A lot may be packaged in smaller quantities under the basic 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.

4.3.2 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 cloth or processing, or both, 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 in. (350 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 hot less than 12 in. (300 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 in. (300 mm) square.

4.5.2 Ø Volatile Content and Resin Solids Test: Volatile and resin content shall be determined by accurately weighing (W_1) 4.0 x 4.0 in. (100 x 100 mm) samples (or equivalent area) cut from the cloth. Using porcelain crucibles previously brought to constant weight by igniting at 845°C ± 25 (1555°F ± 45), dry samples in a circulating air oven at 120°C ± 5 (250°F ± 9) for 15 min., cool in a desiccator, and reweigh (W_2).

Burn out resin in muffle furnace for 3 hr at 565°C ± 25 (1050°F ± 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).

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

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

4.5.3 Gel Time: Cut sufficient 2 x 2 in. (50 x 50 mm) pieces across the roll width to make a sample approximately 0.020 in. (0.50 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 (250°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: Cut four 4.0 x 4.0 in. (100 x 100 mm) pieces on the bias of cloth and weigh to the nearest 0.01 g (W_1). Stack pieces between separator sheets, approximately 6 x 8 in. (150 x 200 mm) of aluminum foil or equivalent and reweigh pieces and foil to nearest 0.01 g (W_2).

Note: 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 g during curing.

Place samples and separator sheets between press platens preheated to 120°C ± 3 (250°F ± 5), taking care that the edges of all pieces remain properly aligned. Apply pressure of 15 psig ± 1.25 (105 kPag ± 10) and hold for 10 min. while maintaining press platens at 120°C ± 3 (250°F ± 5). Remove sample and cool in desiccator. Weigh sample with separators to nearest 0.1 g (W_3). Remove separator and resin flash, trimming sample to original 4 x 4 in. (100 x 100 mm) size, taking care not to remove any reinforcing fibers. Weigh sample to nearest 0.01 g (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 D695 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 Fig. 2. In addition, the specimen configuration shall be modified to conform to Fig. 3.

4.5.6 Ø Penetration Flame Test: Specimens shall be supported at 45 deg to horizontal by clamping in a metal frame such that an area 8 x 8 in. (200 x 200 mm) is exposed. A 3/8 in. (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 in. (38 mm) high flame which shall be applied to the center of the specimen for 30 sec0 with 1/3 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:

4.6.1 The vendor of cloth shall furnish with each shipment three copies of 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 of this specification. This report shall include the purchase order number, lot number, AMS 3821A, vendor's material designation, value to be reported, and quantity.

4.6.1.1 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.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 3821A, contractor or other direct supplier of cloth, supplier's material designation, part number, and quantity. When cloth for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of cloth to determine conformance to the requirements of this specification and shall include in the report either a statement that the cloth conforms or copies of laboratory reports showing the results of tests to determine conformance.

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 and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

5.1.1 Each roll of cloth shall be identified by attached removable tags using characters of such size as to be legible and which will not be obliterated by normal handling.

5.1.2 Ø 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 3821A
PURCHASE ORDER NUMBER _____
MANUFACTURER'S DESIGNATION _____
DATE OF IMPREGNATION _____
LOT NUMBER _____
ROLL NUMBER, SEQUENTIAL _____

5.2 Packaging:

5.2.1 Cloth shall be shipped on reels or spools with 3 in. (75 mm) inside diameter. Width shall be as specified by purchaser ±1/2 in. (±12.5 mm).

5.2.2 Cloth shall be interleaved with a colored separator in a manner to provide an outer wrapping with not less than 2 in. (50 mm) overlap.

5.2.3 Ø Cloth shall be shipped in sealed polyethylene bags and packaged in outer cartons in such a manner as to ensure 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 Ø Each container shall be legibly marked with not less than the following information:

CLOTH, TYPE "E" GLASS, "B" STAGE EPOXY RESIN IMPREGATED, *7781* STYLE
AMS 3821A
DATE OF IMPREGNATION _____
PURCHASE ORDER NUMBER _____
DATE OF SHIPMENT _____
LOT NUMBER _____
QUANTITY _____
MANUFACTURER'S NAME _____
PERISHABLE - STORE BELOW 7°C (45°F)

5.2.5 Ø Containers of cloth shall be prepared for shipment in accordance with 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. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.6 Ø For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement, Commercial packaging as in 5.2.1, 5.2.2, 5.2.3, and 5.2.5 will be acceptable if it meets the requirements of Level C.

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 D123.

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, other than temperatures, in inch/pound units are primary; dimensions and properties in SI units are shown as the approximate equivalents of the inch/pound 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
Applicable level of packaging (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 "C" (NOMETCOM).

Figure 1. Working Life Exposure Conditions