

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 3826A

Issued 11-15-72
Revised 1-1-83

**CLOTH, TYPE "E" GLASS
"B" Stage Polyester Resin Impregnated
181 Type Fabric**

This specification was declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of January 1, 1983. It is recommended, therefore, that this specification not be specified for new designs. Style 181 fabric is no longer manufactured. The following specification should be considered for application where the AMS 3826 material would have been suitable:

**AMS 3827 CLOTH, GLASS, STYLE 7781 FABRIC, Polyester Resin Impregnated,
Flame Resistant**

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

This specification is under the jurisdiction of AMS Committee "C", NOMETCOM.

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AEROSPACE MATERIAL

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS3826A

Superseding AMS 3826

Issued 11-15-72

Revised 1-15-80

CLOTH, TYPE "E" GLASS
"B" Stage Polyester Resin Impregnated
181 Type Fabric

1. SCOPE:

- 1.1 Form: This specification covers one style of glass cloth impregnated with a polyester resin system, the resin being processed to a "B" stage condition.
- 1.2 Application: Primarily for laminates requiring high strength and long-term heat resistance up to 70°C (160°F) and fabricated by autoclave, press, or vacuum bag techniques. This product is not intended for use in applications requiring flame or fire resistance.

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 Society of Automotive Engineers, Inc., 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 D123 - Definition of Terms Relative to Textiles

ASTM D638 - Tensile Properties of Plastics

ASTM D695 - Compressive Properties of Rigid Plastics

ASTM D790 - Flexural Properties of Plastics and Electrical Insulating Materials

- 2.3 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 Materials:

- 3.1.1 **Reinforcement:** Shall be either Style 1581 or 7781 "E" glass cloth in accordance with AMS 3824, treated with an appropriate finish for the resin used.
- 3.1.2 **Resin:** Shall be a polyester resin modified as necessary to meet the requirements of 3.2, 3.3, and 3.4.

REAFFIRMED

3.2 Shelf Life: The product shall have a shelf life of not less than three months from date of shipment when stored in a waterproof, heat-sealed bag maintained at not higher than 7°C (45°F).

Ø 3.3 Tack and Drape: Shall be as agreed upon by purchaser and vendor.

3.4 Properties: The product shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified test methods, insofar as practicable:

3.4.1 As Received (Uncured):

3.4.1.1 Resin Solids (volatile free), by wt	33 - 45%	4.5.1
3.4.1.2 Volatile, by wt, max	4.5%	4.5.1
3.4.1.3 Gel Time	1 - 3 min.	4.5.2
3.4.1.4 Resin Flow, by wt	6 - 14%	4.5.3

3.4.2 As Cured: Specimens for the following tests shall be prepared as in 4.5.4 and tested as specified. Values shall be reported for individual specimens and for the average of four specimens for each test.

3.4.2.1 Tensile Strength: Shall be as follows, determined in accordance with ASTM D638 except that the specimen shown in Fig. 1 of this specification shall be used:

Test Temperature	<u>Minimum Individual</u>		<u>Minimum Average</u>	
	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	42,750	(295)	45,000	(310)
70°C ± 3 (158°F ± 5)	38,000	(262)	40,000	(276)

3.4.2.2 Compressive Strength, Dry: Shall be as follows, determined in accordance with ASTM D695:

Test Temperature	<u>Minimum Individual</u>		<u>Minimum Average</u>	
	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	42,750	(295)	45,000	(310)
70°C ± 3 (158°F ± 5)	33,250	(229)	35,000	(241)

3.4.2.3 Compressive Strength, Wet: Shall be as follows, determined in accordance with ASTM D695 on specimens conditioned by immersing for 2 hr ± 0.1 in boiling water followed by immersing in water at 23°C ± 3 (77°F ± 5) for 20 hr ± 0.5:

Test Temperature	<u>Minimum Individual</u>		<u>Minimum Average</u>	
	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	38,000	(262)	40,000	(276)

3.4.2.4 Flexural Strength and Modulus: Shall be as follows, determined in accordance with ASTM D790:

Test Temperature	<u>Flexural Strength</u>				<u>Flexural Modulus</u>	
	<u>Minimum Individual</u>		<u>Minimum Average</u>		<u>Minimum Average</u>	
	psi	(MPa)	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	57,000	(393)	60,000	(414)	2,900,000	(20,000)
70°C ± 3 (158°F ± 5)	45,600	(314)	48,000	(331)	2,300,000	(16,870)

3.5 Quality: The product shall be uniform in quality and condition, clean, and free from foreign materials and air bubbles and from internal and external imperfections detrimental to fabrication, appearance, or performance of parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples 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 perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for resin solids (3.4.1.1), volatile content (3.4.1.2), gel time (3.4.1.3), resin flow (3.4.1.4), tensile strength at 25°C (77°F) (3.4.2.1), and wet compressive strength at 25°C (77°F) (3.4.2.3) are classified as acceptance tests and shall be performed on each lot.

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

4.3 Sampling:

4.3.1 For Acceptance Tests:

4.3.1.1 Frequency of Sampling: The vendor shall sample and test the product according to the following schedule:

Resin Solids	Every roll (4 specimens)
Volatiles	Every roll (4 specimens)
Gel Time	Every roll (1 specimen)
Resin Flow	Every roll (1 specimen)
Tensile Strength	Lot basis } 1 laminate per lot,
Compressive Strength, Wet	Lot basis } 4 specimens per test

4.3.1.2 A roll shall be the basic unit offered for acceptance and shall not exceed 100 yd (90 m) in length. It shall be the full width of the broadgoods and shipped in a separate container.

4.3.1.3 A lot shall consist of all cloth treated at one time without significant 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 yd (1830 m).

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

4.4 Approval:

4.4.1 Sample treated cloth shall be approved by purchaser before treated cloth for production use is supplied, unless such approval be waived. Results of tests on production treated 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 treated cloth which are essentially the same as those used on the approved sample treated cloth. If any change is necessary in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material and processing and, when requested, sample treated cloth. Production treated cloth made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Volatile Content and Resin Solids: Accurately weigh (W_1) to the nearest 0.01 g each of four samples approximately 4 in. (100 mm) square cut on the bias of the product. Using porcelain crucibles (preferably covered) previously brought to constant weight by igniting at $845^\circ\text{C} \pm 15$ ($1550^\circ\text{F} \pm 25$), dry samples in a circulating air oven at $110^\circ\text{C} \pm 3$ ($230^\circ\text{F} \pm 5$) for 8 min. ± 0.5 , cool in a desiccator, and reweigh (W_2). Burn out resin in muffle furnace for 180 min. ± 5 at $565^\circ\text{C} \pm 15$ ($1050^\circ\text{F} \pm 25$) or until fabric is white. Cool in a desiccator and reweigh. Repeat the burn out as necessary to obtain constant weight (W_3).

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

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

where, W_1 = original weight of sample

W_2 = weight of specimen after drying at 110°C (230°F)

W_3 = weight of ash

4.5.2 Gel Time: Cut sufficient pieces approximately 2 in. (50 mm) square across the roll width to make a sample approximately 0.2 in. (5 mm) thick. Place the sample between sheets of cellophane or other suitable film and insert between the platens of a press which has been stabilized at $120^\circ\text{C} \pm 3$ ($250^\circ\text{F} \pm 5$). 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.

- 4.5.3 Volatile-Free Resin Flow: Cut four pieces approximately 4 in. (100 mm) square on the bias of the weave and weigh to the nearest 0.01 g (W_4). Stack samples between two separator sheets approximately 6 in. x 8 in. (150 mm x 200 mm) of aluminum foil or equivalent. 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 cure. Weigh the specimen assembly to the nearest 0.01 g (W_5). Place the specimen assembly between press platens preheated to $120^\circ\text{C} \pm 5$ ($250^\circ\text{F} \pm 10$) and apply pressure of $15 \text{ psi} \pm 5$ ($0.103 \text{ MPa} \pm 0.035$) on the specimen assembly, taking care that the edges of all pieces remain properly aligned. Hold at heat and pressure for 10 min. ± 0.5 . Remove specimen assembly, cool in a desiccator, and weigh to the nearest 0.01 g (W_6). Remove separators and resin flash by trimming specimen to the original size, taking care not to remove any reinforcing fibers, and weigh to the nearest 0.01 g (W_7).

$$\text{Resin Flow, \%} = \frac{W_4 - (W_5 - W_6) - W_7}{W_4 - (W_5 - W_6)} \times 100$$

where, W_4 = original weight of specimens

W_5 = original weight of specimen assembly

W_6 = weight of specimen assembly after press heating

W_7 = weight of specimen after trimming

4.5.4 As Cured:

- 4.5.4.1 Laminate Preparation: Test laminates for tensile tests shall be prepared from 8 plies of impregnated cloth; for compressive and flexural tests from 12 plies of impregnated cloth. The laminates shall be not less than 14 in. (355 mm) long with the plies laid up "unnested" parallel to the warp, with each ply positioned so that the satin shafts of the warp always face the top of the layup. Laminates shall be molded in a platen press or autoclave at $50 \text{ psi} \pm 3$ ($0.345 \text{ MPa} \pm 0.02$) pressure at $150^\circ\text{C} \pm 3$ ($320^\circ\text{F} \pm 5$) for 2 hr ± 0.25 . The resultant laminates shall each be uniform in thickness within $\pm 0.003 \text{ in.}$ ($\pm 0.08 \text{ mm}$).
- 4.5.4.2 Specimen Preparation and Curing: Specimens shall be cut from the laminates with the length of each specimen parallel to the warp of the treated cloth and shall be held at the test temperature for not less than 30 min. prior to being tested.

4.6 Reports:

- 4.6.1 The vendor of the product 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 product conforms to the other technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, vendor's material designation, cure cycle for each test panel, quantity, and lot number.
- 4.6.1.1 A Material Safety Data Sheet conforming to AMS 2825 shall be supplied to each purchaser prior to, or concurrent with, the report of qualification test results or, if qualification testing be waived by purchaser, concurrent with the first shipment of impregnated cloth for production use. Each request for modification of 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, material specification number and its revision letter, contractor or other direct supplier of material, supplier's material designation, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include 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 product may be based on the results of testing three additional specimens for each original nonconforming specimen, cut from the same panel or a newly prepared panel. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product 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 Rolls of treated cloth shall be identified by attached removable tags using characters of sufficient size as to be clearly legible and which will not be obliterated by normal handling.

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

CLOTH, TYPE "E" GLASS, "B" STAGE, POLYESTER RESIN IMPREGNATED, 181 STYLE FABRIC
AMS 3826A

CLOTH STYLE _____

DATE OF IMPREGNATION _____

PURCHASE ORDER NUMBER _____

MANUFACTURER'S DESIGNATION _____

DATE OF MANUFACTURE _____

ROLL NUMBER, SEQUENTIAL _____

LOT NUMBER _____

5.2 Packaging:

5.2.1 The product shall be shipped in rolls with ID not less than 3 in. (75 mm); width shall be as specified by the purchaser, $\pm 1/2$ in. (± 13 mm).

5.2.2 The product 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 Each roll shall be shipped in a sealed polyethylene bag.

5.3 Exterior Packaging:

5.3.1 Each roll shall be packaged in outer cartons in such a manner as to ensure that the product, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any other normal hazard.

5.3.2 Packages 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 product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3.3 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 5.3.1 and 5.3.2 will be acceptable if it meets the requirements of Level C.