

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 3845B

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Reaffirmed JUL 1997

Superseding AMS 3845A

Cloth, Type "E" Glass "B" Stage Addition Cure Polyimide-Resin-Impregnated

1. SCOPE:

1.1 Form:

This specification cover glass cloth impregnated with a heat-reactive, thermosetting, addition-cure polyimide resin system, the resin to be supplied in a "B" stage condition.

1.2 Application:

Primarily for laminated structural parts requiring high strength and long-term heat resistance up to 230 °C (446 °F) and short-term exposure up to 290 °C (555 °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.

1.4 Classification:

Shall be as follows:

Class 1 - Low-Flow Addition-Cure Resin

Class 2 - High-Flow Addition-Cure Resin

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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 3619 Resin, Polyimide, Laminating, High Temperature Resistant, 315 °C (600 °F)

AMS 3824 Cloth, Type "E" Glass, Finished for Resin Laminates

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 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 2734 Void Content of Reinforced Plastics

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 181, 1581, or 7781.

3.1.2 Resin: Shall conform to AMS 3619.

3.1.3 Storage Life: The impregnated cloth shall have a shelf life of not less than three months from date of shipment when stored or shipped in a barrier container and maintained at 4 to 15 °C (39 to 59 °F).

3.2 Properties:

3.2.1 Uncured Impregnated Cloth: Cloth, as supplied shall conform to the following requirements; tests shall be performed in accordance with specified ASTM methods, insofar as practicable. In addition, when specified, tack and drape shall be as agreed upon by purchaser and vendor.

3.2.1.1 Volatile Content and Resin Solids: Volatile content shall be not greater than 10%. Devolatilized resin content shall be as specified by purchaser.

3.2.1.2 Gel Time: Shall be either 50 minutes ± 5 or $\pm 20\%$ of the preproduction value, as agreed upon by purchaser and vendor, determined using a platen temperature of 290 °C ± 5 (554 °F ± 9).

3.2.1.3 Wet Resin Flow: Shall be as agreed upon by purchaser and vendor, with a tolerance of $\pm 20\%$, determined using a platen temperature of 290 °C ± 5 (554 °F ± 9).

3.2.2 Cured Product: Shall be as follows, determined on laminates prepared as in 4.5.1. Properties of laminates of constructions other than as specified in 4.5.1 shall be as agreed upon by purchaser and vendor. The resin content, molding pressure, and cure cycle for each panel shall be reported. Test specimens shall be held at the specified test temperature for not less than 30 minutes before testing.

3.2.2.1 Tensile Strength Minimum Average:

TABLE 1 - Tensile Strength

Test Temperature	ksi	MPa
25 °C ± 3 (77 °F ± 5)	45.0	310
230 °C ± 5 (446 °F ± 9)	40.0	276
290 °C ± 5 (554 °F ± 9)	34.0	234

3.2.2.2 Short Beam Shear Strength, Minimum Average:

TABLE 2 - Short Beam Shear

Test Temperature	Class 1 psi	Class 1 MPa	Class 2 psi	Class 2 MPa
25 °C ± 3 (77 °F ± 5)	5000	34.5	3300	22.8
230 °C ± 5 (446 °F ± 9)	3500	24.1	2500	17.2

3.2.2.3 Flexural Strength Minimum Average:

TABLE 3 - Flexural Strength

Test Temperature	Class 1 ksi	Class 1 MPa	Class 2 psi	Class 2 MPa
25 °C ± 3 (77 °F ± 5)	60.0	414	54,000	372
290 °C ± 5 (554 °F ± 9)	42.0	290	38,000	262

3.2.2.4 Flexural Modulus Minimum Average:

TABLE 4 - Flexural Modulus

Test Temperature	psi	MPa
25 °C ± 3 (77 °F ± 5)	2.5×10^6	17,237
290 °C ± 5 (554 °F ± 9)	2.0×10^6	13,790

3.2.2.5 Void Content: Shall be not greater than 10%.

3.3 Quality:

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

3.4 Tolerances:

Width shall not vary more than +1/2 inch (+12.7 mm), -0 from the width ordered.

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 (3.2.1) and properties of the cured product at 25 °C (77 °F) (3.2.2) 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 impregnated 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: Sufficient cloth shall be taken at random from each lot to permit performing all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than shown in 4.3.1.1.

4.3.1.1 Frequency of Sampling: Shall be according to the following schedule shown in Table 5:

TABLE 5 - Frequency of Sampling

Requirement		Minimum Number of Determinations per Requirement	Test Procedure
Resin Solids	Each roll	2	4.5.2
Volatile Content	Each roll	1	4.5.2
Gel Time	Each roll	1	4.5.3
Resin Flow	Each roll	1	4.5.4
Tensile Strength	Lot basis	4	4.5.5
Short Beam Shear Strength	Lot basis	4	4.5.6
Flexural Strength	Lot basis	4	ASTM D 790 or ASTM D 790M
Flexural Modulus	Lot basis	4	ASTM D 790 or ASTM D 790M
Void Content	Lot basis	3	ASTM D 2734

4.3.1.2 A roll is the basic unit and shall not exceed 250 yards (229 m) in length. It shall be the full width of the broadgoods.

4.3.1.3 A lot shall be all cloth treated at one time without significant 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) and may be packaged in smaller quantities and delivered under the basic lot approval provided lot identification is maintained.

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 molded under appropriate pressure and 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 specimens for all other tests are cut shall be composed of twelve plies and shall be not less than 12 inches (305 mm) square.

4.5.2 Volatile Content and Resin Solids: Accurately weigh to the nearest 0.01 gram (W_1) each of four samples 4-inches (102-mm) square cut on the bias of the product. Using porcelain crucibles previously brought to constant weight by igniting at $565\text{ }^{\circ}\text{C} \pm 25$ ($1049\text{ }^{\circ}\text{F} \pm 45$), dry samples in a circulating air oven at $315\text{ }^{\circ}\text{C} \pm 5$ ($599\text{ }^{\circ}\text{F} \pm 9$) for 10 minutes ± 0.5 , cool in a desiccator, and reweigh (W_2). Burn out resin in muffle furnace for not less than 180 minutes at $565\text{ }^{\circ}\text{C} \pm 25$ ($1049\text{ }^{\circ}\text{F} \pm 45$) until fabric is white. Cool in a desiccator and reweigh. Repeat the burn out as necessary to obtain constant weight (W_3).

$$\text{Volatile Content, \%} = \frac{(W_1 - W_2)}{W_1} \times 100 \quad (\text{Eq.1})$$

4.5.2 (Continued):

$$\text{Resin Solids (Volatile Free), \%} = \frac{(W_2 - W_3)}{W_2} \times 100 \quad (\text{Eq.2})$$

where:

W_1 = original weight of sample

W_2 = weight of specimen after drying

W_3 = weight of ash

4.5.3 Gel Time: Cut sufficient 2-inch (51-mm) square pieces across the roll width to make a sample approximately 0.200 inch (5.08 mm) thick. Place the sample between sheets of suitable film and insert between the platens of a press which has been stabilized at the specified temperature. 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 Wet Resin Flow: Cut four 4-inch (102-mm) square pieces on the bias of the weave and weigh to the nearest 0.01 gram (W_4). Stack samples between separator sheets approximately 6 x 8 inches (152 x 203 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 gram during cure. Place samples and separator sheets between press platens preheated to the temperature, taking care that the edges of all pieces remain properly aligned. Apply pressure of 15 psi $\pm$ 5 (103 kPa $\pm$ 34) on the sample and hold at heat for 5 minutes $\pm$ 0.5, taking care that the edges of all pieces remain properly aligned. Remove sample and cool in desiccator. Remove separators and resin flash by trimming sample to original 4-inch (102-mm) square size, taking care not to remove any reinforcing fibers. Weigh sample to nearest 0.01 gram (W_5).

$$\text{Resin flow, \%} = 100 \times \frac{W_4 - W_5}{W_4} \quad (\text{Eq.3})$$

where:

W_4 = original weight of sample

W_5 = weight of sample after trimming

4.5.5 Tensile Strength: Shall be determined in accordance with ASTM D 638 or ASTM D 638M, except that the specimen in Figure 1 shall be used.

4.5.6 Short Beam Shear Strength: Shall be determined in accordance with ASTM D 2344, except that a flat specimen shown in Figure 2 shall be used.

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 3845B, manufacturer's identification, resin content, molding pressure and cure cycle for each test panel, quantity, and roll number.

- 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 impregnated 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 a 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 Packaging and Identification:

- 5.1.1 Cloth shall be shipped in rolls with 3-inch (76-mm) nominal ID.
- 5.1.2 Cloth shall be interleaved with a colored separator to provide an outer wrapping with not less than 2 inches (51 mm) overlap.
- 5.1.3 Each roll shall be identified by attached removable tags using legible characters which will not be obliterated by normal handling. Each tag shall show not less than the following information:

CLOTH, TYPE "E" GLASS, "B" STAGE ADDITION CURE POLYIMIDE RESIN IMPREGNATED
AMS 3845B _____
PURCHASE ORDER NUMBER _____
MANUFACTURER'S IDENTIFICATION _____
DATE OF MANUFACTURE _____
ROLL NUMBER, SEQUENTIAL _____
DATE OF SHIPMENT _____
LOT NUMBER _____
QUANTITY _____

5.1.4 Each roll of cloth shall be shipped in sealed, vapor-barrier 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. Each roll shall be shipped in a separate container. The rolls shall be supported by the core.

5.1.5 Each container of cloth shall be legibly marked with not less than the following information, except storage temperature may be as agreed upon by purchaser and vendor.

CLOTH, TYPE "E" GLASS, "B" STAGE ADDITION CURE POLYIMIDE RESIN IMPREGNATED
AMS 3845B _____

DATE OF IMPREGNATION _____

PURCHASE ORDER NUMBER _____

DATE OF SHIPMENT _____

LOT NUMBER _____

MANUFACTURER'S IDENTIFICATION _____

PERISHABLE - STORE BELOW _____

QUANTITY _____

5.1.6 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.

5.1.7 For direct U.S. Military procurement, packaging shall be in accordance with 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 The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this specification. An (R) symbol to the left of the document title indicates a complete revision of the specification.

8.2 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.