

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3844B

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Superseding AMS 3844A

Submitted for recognition as an American National Standard

CLOTH, TYPE "E" GLASS, STYLE 7781 FABRIC
Hot-Melt, Addition-Type, Polyimide Resin Impregnated

1. SCOPE:

1.1 Form:

This specification covers one type of glass cloth impregnated with a heat-reactive, thermosetting, hot-melt, addition-type polyimide resin system, furnished in continuous rolls of full width material.

1.2 Application:

This cloth has been used typically for structural laminates requiring high strength and heat resistance for long-term service up to 230 °C (446 °F) and short-time service up to 260 °C (500 °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.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

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

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 792 Specific Gravity (Relative Density) and Density of Plastics by Displacement
ASTM D 2344 Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method
ASTM D 2584 Ignition Loss of Cured Reinforced Resins
ASTM D 2734 Void Content of Reinforced Plastics
ASTM D 3531 Resin Flow of Carbon Fiber-Epoxy Prepreg

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:

Shall be the reinforcement specified in 3.1.1, impregnated with the resin system specified in 3.1.2, supplied in rolls of full width impregnated cloth or slit tape, as ordered.

3.1.1 Reinforcement: Shall be Type "E" Glass, Style 7781 Fabric, conforming to AMS 3824, treated with a suitable finish to produce the required performance characteristics with the resin system specified herein.

3.1.2 Resin: Shall be a 100% reactive, hot-melt, resin system formed by co-reaction of bis-maleimide monomer with a tri-functional monomer and an aromatic diamine, resulting in a thermosetting resin system which thermally cures to form a polyimide structure.

3.2 Storage Life:

The impregnated cloth shall have a storage life of not less than three months from date of shipment when stored or shipped in a barrier container and maintained at a temperature below 4 °C (39 °F).

3.3 Working Life:

The impregnated cloth shall meet the requirements of 3.4 and 3.5 when tested, after warming to room temperature, at any time up to five days after removal from refrigerated storage.

3.4 Properties of Uncured Product:

The impregnated cloth, as supplied, shall conform to the requirements shown in Table 1; tests shall be performed on the cloth supplied, sampled in accordance with 4.3.1 after warming to above the dew point, and tested in accordance with specified test methods.

TABLE 1 - Properties of Uncured Cloth

Paragraph	Property	Requirement	Test Method
3.4.1	Resin Content	33% by weight \pm 3	4.5.2
3.4.2	Resin Flow	12% \pm 3	4.5.3
3.4.3	Tack	Shall obtain tack under slight heating (will adhere to itself)	

3.5 Properties of Cured Laminate:

Shall conform to the requirements shown in Table 2, determined on specimens cut from a test laminate prepared as in 4.5.1. Specimens for elevated temperature tests shall be tested after exposure at the test temperature for 30 minutes \pm 1. For tests No. 1 through 6, property values specified are the minimum average of five determinations per test; no individual value shall be less than 90% of the minimum average value specified.

TABLE 2A - Properties of Cured Laminate, Inch/Pound Units

Test Number	Property	Requirements at 77 °F ± 9	Requirements at 446 °F ± 9	Test Method
1	Tensile Strength, minimum average	55.0 ksi	50.0 ksi	4.5.4
2	Edgewise Compressive Strength, minimum average	45.0 ksi	30.0 ksi	ASTM D 695
3	Edgewise Compressive Modulus, minimum average	3.0 msi	2.5 msi	ASTM D 695
4	Flexural Strength, minimum average	70.0 ksi	60.0 ksi	ASTM D 790
5	Flexural Modulus, minimum average	3.0 msi	2.5 msi	ASTM D 790
6	Short-Beam Shear Strength, minimum average	6000 psi	4000 psi	4.5.5
7	Specific Gravity at 73/73 °F	Preproduction Value ± 0.10	--	ASTM D 792
8	Void Content, maximum	5.0%	--	ASTM D 2734, Method A

TABLE 2B - Properties of Cured Laminate, SI Units

Test Number	Property	Requirements at 25 °C ± 5	Requirements at 230 °C ± 5	Test Method
1	Tensile Strength, minimum average	379 MPa	345 MPa	4.5.4
2	Edgewise Compressive Strength, minimum average	310 MPa	207 MPa	ASTM D 695M
3	Edgewise Compressive Modulus, minimum average	20.7 GPa	17.2 GPa	ASTM D 695M
4	Flexural Strength, minimum average	483 MPa	414 MPa	ASTM D 790M
5	Flexural Modulus, minimum average	20.7 GPa	17.2 GPa	ASTM D 790M
6	Short-Beam Shear Strength, minimum average	41.4 MPa	27.6 MPa	4.5.5
7	Specific Gravity at 23/23 °C	Preproduction Value ± 0.10	--	ASTM D 792
8	Void Content, maximum	5.0%	--	ASTM D 2734, Method A

3.6 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.

3.7 Tolerances:

The 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:

(R)

The manufacturer of cloth shall supply all samples for required 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 requirements specified in Table 3 are acceptance tests and shall be performed on each lot.

TABLE 3 - Acceptance Tests

Property	Paragraph or Table Reference	Sampling	Minimum Number of Specimens per Test
Resin Content, Uncured	3.4.1	Every Roll	2
Resin Flow, Uncured	3.4.2	Lot Basis	4
Resin Content, Cured	4.5.1.2.3	Lot Basis	2 from each test laminate
Specific Gravity, Cured	Table 2, Test 7	Lot Basis	2 from each test laminate
Void Content, Cured	Table 2, Test 8	Lot Basis	2 from each test laminate
Flexural Strength, Cured	Table 2, Test 4	Lot Basis	5
Flexural Modulus, Cured	Table 2, Test 5	Lot Basis	5
Short-Beam Shear Strength, Cured	Table 2, Test 6	Lot Basis	5

- 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 by the manufacturer, 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:
- (R) Shall be as follows:
- 4.3.1 For Acceptance Tests: Each lot of impregnated cloth shall be sampled at random on the sampling basis specified in Table 3, using the number of specimens specified therein for each test. Samples for the test panels required for testing the cured product shall be taken in approximately equal amounts from three locations in the lot, selected randomly. There shall be no more than 500 yards (457 m) of cloth, full width, represented in any one test panel; lots of greater quantity shall require one panel for each 500 yards (457 m) or portion thereof. In addition, a dielectric test panel shall be prepared in accordance with 4.5.1.2.3 and submitted with each lot for dielectric testing by purchaser.
- 4.3.1.1 A lot shall be all cloth treated at one time without significant changes in treater setting using a single batch of resin and reinforcement and presented for manufacturer's inspection at one time. A lot shall not exceed 2000 yards (1829 m) of full width product.
- 4.3.1.2 When a statistical sampling plan has been agreed upon by purchaser and (R) supplier, 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 supplier.
- 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 Manufacturer 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. If necessary to make any change in ingredients, in type of equipment for processing, or in manufacturing procedures, manufacturer 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 Specimen Preparation: Each roll to be sampled shall be allowed to warm above the dew point before opening the sealed package for sampling. Immediately after sampling, the roll shall be resealed and returned to refrigerated storage.

4.5.1.1 Tests of Uncured Product: Specimens shall be cut from test cloth and tested immediately as specified in the applicable test procedure.

4.5.1.2 Preparation of Test Laminate Panels:

4.5.1.2.1 Laminate panels from which tensile specimens are to be cut shall be composed of eight plies and shall be not less than 14 inches (356 mm) long in the warp direction. Laminates from which test specimens for all other tests are to be cut shall be composed of 12 plies and shall be not less than 12 inches (305 mm) square.

4.5.1.2.2 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. The report shall include the cure and postcure parameters for each test laminate panel.

4.5.1.2.3 A dielectric test panel, 0.540 inch $+0.040$, -0 , (13.72 mm $+1.02$, -0) thick by approximately 6 inches (152 mm) square, shall be prepared essentially the same as the panels in 4.5.1.2.2 and shall exhibit essentially the same resin content, specific gravity, and void content.

4.5.2 Resin Content, Uncured and Cured: Shall be determined in accordance with ASTM D 2584, using $620\text{ }^{\circ}\text{C} \pm 25$ ($1148\text{ }^{\circ}\text{F} \pm 45$).

4.5.3 Resin Flow: Shall be determined in accordance with ASTM D 3531, using a platen press preheated to $175\text{ }^{\circ}\text{C} \pm 3$ ($347\text{ }^{\circ}\text{F} \pm 5$) and a pressure of $15\text{ psi} \pm 5$ ($103\text{ kPa} \pm 34$), holding at heat and pressure for 15 minutes ± 0.5 .

4.5.4 Tensile Strength: Shall be determined in accordance with ASTM D 638 or ASTM D 638M, using the specimen shown in Figure 1 of this specification.

4.5.5 Short-Beam Shear Strength: Shall be determined in accordance with ASTM D 2344, using the specimen shown in Figure 2 of this specification.

4.6 Reports:

The supplier 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 3844B, manufacturer's material designation, cure cycle for each test panel and panel parameters, 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 cloth for production use. Each request for modification of cloth formulation shall be accomplished by a revised data sheet for the proposed formulation.

4.7 Resampling and Retesting:

(R)

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 for each original nonconforming specimen. These specimens shall be cut from additional or newly prepared panels using the same procedures and curing cycles as used on the original panels. 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 A lot of cloth may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained.

5.1.2 Cloth shall be shipped in rolls with ID not less than 3 inches (76 mm).

5.1.3 Cloth shall be interleaved with a suitable non-adhering, colored separator to provide an outer wrapping with not less than a 2 inch (51 mm) overlap.

5.1.4 Each roll shall be legibly identified with not less than the following information, by attached removable tags, using characters which will not be obliterated by normal handling:

CLOTH, TYPE "E" GLASS, STYLE 7781 FABRIC, HOT-MELT, ADDITION-TYPE,
POLYIMIDE RESIN IMPREGNATED

AMS 3844B

MANUFACTURER'S IDENTIFICATION _____

PURCHASE ORDER NUMBER _____

DATE OF IMPREGNATION _____

DATE OF SHIPMENT _____

LOT NUMBER _____

ROLL NUMBER, SEQUENTIAL _____

QUANTITY _____

5.1.5 Each roll shall be shipped in a sealed vapor barrier bag. Sufficient desiccant shall be added to each sealed bag to maintain the dew point below 4 °C (39 °F) for the storage life specified.

5.1.6 The protected rolls shall be packed in an exterior shipping container to ensure that the cloth will be protected, during shipment and storage, from exposure to weather or any other normal hazard. Each roll shall be shipped in a separate container and shall be supported by the core.

5.1.7 Each exterior shipping container shall be legibly marked with not less than the information specified in 5.1.4 and with the following additional markings:

APPROPRIATE WARNINGS OR PRECAUTIONARY NOTICES
PERISHABLE - STORE BELOW 4 °C (39 °F)

5.1.8 Exterior containers of cloth shall be prepared for shipment in accordance (R) 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.

5.1.9 For direct U.S. Military procurement, packaging shall be in accordance with (R) MIL-STD-2073-1, Commercial Level, unless Level A is specified in the request for procurement.

6. ACKNOWLEDGMENT:

Supplier 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 Revision Indicator:

The (R) symbol 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. If the symbol is next to the specification title, it 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.

8.3 The term "Msi" as used in this specification for tensile modulus units is defined as "million pounds force per square inch."

8.4 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 5.1.9)