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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3847C

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Superseding AMS 3847B

Submitted for recognition as an American National Standard

CLOTH, QUARTZ, "B" STAGE POLYIMIDE RESIN IMPREGNATED
Style 581 Fabric, 315 °C (599 °F)

1. SCOPE:

1.1 Form:

This specification covers one type of quartz cloth impregnated with a heat-reactive, thermosetting, polyimide resin system, the resin being processed to a "B" stage condition, and furnished in continuous rolls of full width material.

1.2 Application:

This cloth has been used typically for structural laminates requiring high strength and long-term heat resistance up to 315 °C (599 °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 3619 Resin, Polyimide, Laminating, High Temperature Resistant, 315 °C (599 °F)
AMS 3846 Cloth, Quartz, Finished for Resin Laminates

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 618 Conditioning Plastics and Electrical Insulating Materials for Testing
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

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 be Style 581 quartz cloth conforming to AMS 3846, treated with a suitable finish to produce the required performance characteristics with the resin system specified herein.

3.1.2 Resin: Shall conform to AMS 3619.

3.2 Storage Life:

The impregnated cloth shall have a storage life of not less than six months from date of impregnation when stored at a temperature not higher than 4 °C (39 °F) in moisture-proof, heat-sealed containers.

3.3 Properties:

Impregnated cloth shall conform to the following requirements:

3.3.1 Uncured Impregnated Cloth: Cloth, as supplied, shall have the properties 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 in its sealed, moisture-proof container, and tested in accordance with specified test methods.

TABLE 1 - Uncured Cloth Properties

Property	Requirement	Test Method
Volatile Content	13.5% by weight ± 2.0	4.5.2
Resin Content	34% by weight ± 3	4.5.3
Resin Flow	14% ± 2	4.5.4
Tack	To be reported	4.5.5

3.3.2 Cured Laminates: Shall have the following properties. Test specimens shall be cut from laminates produced as in 4.5.1 and tested in accordance with specified test procedures. Specimens to be tested at room temperature shall be conditioned and tested at standard conditions in accordance with ASTM D 618. Specimens to be tested at 315 °C (599 °F) shall be conditioned at the test temperature for at least 30 minutes prior to testing.

3.3.2.1 Tensile Strength and Modulus: Shall be as shown in Table 2, determined in accordance with ASTM D 638 or ASTM D 638M, except that the specimen shown in Figure 1 shall be used.

TABLE 2 - Tensile Strength and Modulus Properties

Test Temperature	Tensile Strength min Individual ksi	Tensile Strength min Individual MPa	Tensile Strength min Average ksi	Tensile Strength min Average MPa	Tensile Modulus min Average Msi	Tensile Modulus min Average MPa
25 °C ± 3 (77 °F ± 5)	45.0	310	50.0	345	2.50	17,237
315 °C ± 3 (599 °F ± 5)	36.0	248	40.0	276	2.00	13,790

3.3.2.2 Edgewise Compressive Strength and Modulus: Shall be as shown in Table 3, determined in accordance with ASTM D 695 or ASTM D 695M on four specimens per test.

TABLE 3 - Compression Strength and Modulus Properties

Test Temperature	Edgewise Compressive Strength min Individual ksi	Edgewise Compressive Strength min Individual MPa	Edgewise Compressive Strength min Average ksi	Edgewise Compressive Strength min Average MPa	Compressive Modulus min Average Msi	Compressive Modulus min Average MPa
25 °C ± 3 (77 °F ± 5)	40.5	279	45.0	310	2.80	19,305
315 °C ± 3 (599 °F ± 5)	27.0	186	30.0	207	2.25	15,513

3.3.2.3 Longitudinal Flexural Strength and Modulus: Shall be as shown in Table 4, determined in accordance with ASTM D 790 or ASTM D 790M.

TABLE 4 - Flexural Strength and Modulus Properties

Test Temperature	Flexural Strength min Individual ksi	Flexural Strength min Individual MPa	Flexural Strength min Average ksi	Flexural Strength min Average MPa	Flexural Modulus min Average Msi	Flexural Modulus min Average MPa
25 °C ± 3 (77 °F ± 5)	63.0	434	70.0	483	2.00	13,790
315 °C ± 3 (599 °F ± 5)	36.0	248	40.0	276	1.80	12,411

3.3.2.4 Interlaminar Shear Strength: Shall be as shown in Table 5, determined in accordance with ASTM D 2344, using five flat specimens per test.

TABLE 5 - Interlaminar Shear Strength

Test Temperature	Interlaminar Shear Strength min Individual psi	Interlaminar Shear Strength min Individual MPa	Interlaminar Shear Strength min Average psi	lnterlaminar Shear Strength min Average MPa
25 °C ± 3 (77 °F ± 5)	4500	31.0	5000	34.5
315 °C ± 3 (599 °F ± 5)	3150	21.7	3500	24.1

3.3.3 Specific Gravity: Shall be 1.5 to 1.9, determined in accordance with ASTM D 792. Report individual and average values.

3.3.4 Void Content: Shall be not greater than 5% by volume, determined in accordance with 4.5.6.

3.4 Quality:

The 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.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
(R)

The manufacturer of the 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.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for the following requirements are acceptance tests and shall be performed on each lot.

4.2.1.1 Tests for properties of uncured impregnated cloth (3.3.1).

4.2.1.2 Tests of cured laminates both at room temperature and at 315 °C (599 °F) for tensile strength (3.3.2.1) and longitudinal flexural strength (3.3.2.3).

4.2.1.3 Tests of cured laminates for specific gravity (3.3.3), void content (3.3.4), and panel thickness of each test laminate.

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:
(R)

Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient cloth shall be taken at random from each lot to perform 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 The manufacturer shall sample according to Table 6. (R)

TABLE 6 - Sampling Schedule

Property	Basis	Minimum Number of Specimens per Test
Volatile Content	Every roll	2
Resin Solids	Every roll	2
Resin Flow	Every roll	1
Tack	Every roll	1
Tensile Strength	Lot basis	4
Compressive Strength	Lot basis	4
Flexural Strength	Lot basis	4
Resin Content	Lot basis	2 for each test laminate
Shear Strength	Lot basis	2 for each test laminate
Specific Gravity	Lot basis	2 for each test laminate
Voids Content	Lot basis	2 for each test laminate

4.3.1.2 A roll is the basic unit presented for manufacturer's inspection and shall not exceed 100 yards (91 m) in length. It shall be the full width of the broadgoods.

4.3.1.3 (R) 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 manufacturer's inspection at one time.

4.3.1.4 (R) When a statistical sampling plan has been agreed upon by purchaser and 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, 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 procedures shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Preparation of Test Laminate: Laminate test panels for tensile tests shall be of eight plies, approximately 0.08 inch (2.0 mm) thick and not less than 14 inches (356 mm) long by 12 inches (305 mm) wide. Test panels for other tests of cured laminates shall be of 12 plies, approximately 0.12 inch (3.0 mm) thick and not less than 12 inches (305 mm) square. The plies of all laminates shall be laid up "unnested" parallel to the warp with each ply positioned in the layup so that the satin shafts of the warp always face the top of the layup. The panels shall be molded under appropriate pressure and cured in accordance with resin manufacturer's recommendation.

4.5.2 Volatile Content:

4.5.2.1 Cut one 4.0 x 4.0 inch (102 x 102 mm) specimen from each sample and punch a small hole in one corner. Weigh each specimen to the nearest 0.01 gram (W_1). The protective film shall be removed immediately prior to weighing.

4.5.2.2 Hang each specimen in a forced draft oven maintained at 315 °C ± 8 (599 °F ± 15) for 15 minutes ± 1.

4.5.2.3 Remove specimen from oven, cool to room temperature in a desiccator, and reweigh to the nearest 0.01gram (W_2).

4.5.2.4 Calculate volatile content using Equation 1.

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

4.5.2.5 Report individual and average values for all specimens.

4.5.3 Resin Content: Use the dried specimens from the volatile content determination (4.5.2) for determination of resin content. Ignition of resin and calculation of resin content shall be in accordance with ASTM D 2584, except that the ignition temperature shall be 620 °C ± 30 (1148 °F ± 54). Report individual and average values for all specimens.

4.5.4 Resin Flow:

4.5.4.1 Cut four 4.0 x 4.0 inch (102 x 102 mm) specimens from each sample. Stack the four pieces on top of each other and weigh to the nearest 0.01 gram (W_3).

4.5.4.2 Place the stacked plies, covered with cellophane or other suitable film on top and bottom, in a press preheated to 175 °C ± 5 (347 °F ± 9) and apply 15 psi ± 1 (103 kPa ± 7), or a load of 240 pounds force ± 15 (1068 N ± 67), within 10 to 15 seconds of insertion and hold for not less than five minutes.

4.5.4.3 Remove the laminate from the press, peel off the films, and cut off any flash extending beyond the fabric edges. Reweigh to the nearest 0.01 gram (W_4).

4.5.4.4 Calculate resin flow using Equation 2.

$$\text{Resin Flow, \%} = \frac{W_3 - W_4}{W_3} \times 100 \qquad \text{(Eq.2)}$$

4.5.4.5 Report individual and average values for all specimens.

4.5.5 Tack: Shall be determined by a procedure agreed upon by purchaser and supplier.

4.5.6 Void Content of Cured Laminate: Shall be determined, in duplicate for each cured laminate, in accordance with ASTM D 2734 except that laminate resin content shall be determined in accordance with 4.5.7. Calculate void content using Equation 3.

$$\text{Void Content, \%} = 100 - \frac{(D_L)\ (RC)}{D_R} \times \frac{(D_L)\ (100 - RC)}{D_F} \qquad \text{(Eq.3)}$$

where,

D_L = Laminate specific gravity (3.3.3), average
RC = Laminate Resin Content (4.5.7), %
D_R = Specific gravity of cured polyimide resin = 1.30
D_F = Specific gravity of quartz fiber = 2.17

4.5.6.1 Report individual and average values.

4.5.7 Resin Content of Cured Laminate: Shall be determined, in duplicate for each cured laminate, in accordance with ASTM D 2584 except that the ignition temperature shall be 620 °C ± 30 (1148 °F ± 54). Report individual and average values.

4.6 Reports:

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 3847C, manufacturer's identification, values to be reported, date of manufacture, form or part number, 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 impregnated cloth for production use. Each request for modification of formulation shall be accompanied 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, cut from the same panel or a freshly-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 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 not less than 3 inch (76 mm) inside diameter; width shall be as specified, +0.5 inch (+13 mm), -0.

5.1.3 Cloth shall be interleaved with a colored, nonadhering separator to provide an outer wrapping with at least a 2-inch (51-mm) overlap.

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

5.1.5 Each roll of cloth 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, QUARTZ, "B" STAGE POLYIMIDE RESIN IMPREGNATED, STYLE 581 FABRIC
AMS 3847C
DATE OF IMPREGNATION _____
MANUFACTURER'S IDENTIFICATION _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____
DATE OF SHIPMENT _____
ROLL NUMBER, SEQUENTIAL _____
LOT NUMBER _____
QUANTITY _____

5.1.6 Each roll shall be packaged in an individual exterior container in such manner that the roll will be supported by the core and the cloth will be protected, during shipment and storage, from exposure to weather or any other normal hazard.