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AEROSPACE MATERIAL SPECIFICATION

AMS 3847A
Superseding AMS 3847

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CLOTH, QUARTZ, "B" STAGE POLYIMIDE RESIN IMPREGNATED
Style 581 Fabric, 315°C (600°F)

1. SCOPE:

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

1.2 Application: Primarily for structural laminates requiring high strength and long term heat resistance up to 315°C (600°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 3619 - Resin, Polyimide, Laminating, High Temperature Resistant, 315°C (600°F)
AMS 3846 - Cloth, Quartz, Finished for Resin Laminates
AMS 2825 - Material Safety Data Sheets

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

ASTM D618 - Conditioning Plastics and Electrical Insulating Materials for Testing
ASTM D638 - Tensile Properties of Plastics
ASTM D695 - Compressive Properties of Rigid Plastics
ASTM D790 - Flexural Properties of Plastics and Electrical Insulating Materials
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D2344 - Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method
ASTM D2584 - Ignition Loss of Cured Reinforced Resins
ASTM D2734 - Void Content of Reinforced Plastics

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 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 Shelf Life: The impregnated cloth shall have a shelf life of not less than six months from date of impregnation when stored at a temperature not higher than 4°C (40°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 following properties; 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 the methods specified:

Volatile Content, % by weight,	13.5 ± 2.0	4.5.2
Resin Solids, % by weight,	34 ± 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 the specified test procedures. Specimens to be tested at room temperature shall be conditioned and tested at standard conditions in accordance with ASTM D618. Specimens to be tested at 315°C (600°F) shall be conditioned at the test temperature for at least 30 min. prior to testing.

3.3.2.1 Tensile Strength and Modulus: Shall be as follows, determined in accordance with ASTM D638, except that the specimen shown in Fig. 1 shall be used:

	Tensile Strength				Tensile Modulus	
	Minimum Individual		Minimum Average		Minimum Average	
Test Temperature	psi	(MPa)	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	45,000	(310)	50,000	(345)	2,500,000	(17,240)
315°C ± 3 (600°F ± 5)	36,000	(250)	40,000	(275)	2,000,000	(13,790)

3.3.2.2 Edgewise Compressive Strength and Modulus: Shall be as follows, determined in accordance with ASTM D695 on four specimens per test:

	Edgewise Compressive Strength				Compressive Modulus	
	Minimum Individual		Minimum Average		Minimum Average	
Test Temperature	psi	(MPa)	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	40,500	(280)	45,000	(310)	2,800,000	(19,310)
315°C ± 3 (600°F ± 5)	27,000	(185)	30,000	(205)	2,250,000	(15,510)

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

	Flexural Strength				Flexural Modulus	
	Minimum Individual		Minimum Average		Minimum Average	
Test Temperature	psi	(MPa)	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	63,000	(435)	70,000	(485)	2,000,000	(13,790)
315°C ± 3 (600°F ± 5)	36,000	(250)	40,000	(275)	1,800,000	(12,410)

3.3.2.4 Interlaminar Shear Strength: Shall be as follows, determined in accordance with ASTM D2344, using five flat specimens per test:

Test Temperature	Interlaminar Shear Strength			
	Minimum Individual		Minimum Average	
	psi	(MPa)	psi	(MPa)
25°C ± 3 (77°F ± 5)	4500	(31.0)	5000	(34.5)
315°C ± 3 (600°F ± 5)	3150	(21.5)	3500	(24.0)

3.3.5 Specific Gravity: Shall be 1.5 - 1.9, determined in accordance with ASTM D792. Report individual and average values.

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

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all Ø samples 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 product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following Ø requirements are classified as 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 (600°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 (3.3.5), void content (3.3.6), resin content, and panel thickness of each test laminate.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests Ø and shall be performed prior to or on the initial shipment of impregnated 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: Sufficient cloth shall be taken at random from each lot to permit performing all required tests. The number of tests 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: The vendor shall sample and test the product according to the following schedule:

		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
Flexural Strength	Lot basis	4
Resin Content	Lot basis	2 for each test laminate
Specific Gravity	Lot basis	2 for each test laminate
Void Content	Lot basis	2 for each test laminate

4.3.1.2 Roll: A roll is the basic unit submitted for inspection and shall not exceed 100 yd (90 m) in length. It shall be the full width of the broadgoods.

4.3.1.3 Lot: 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 submitted for vendor's inspection at one time. An inspection lot shall not exceed 2000 yd (1825 m).

4.3.1.4 Statistical Sampling: When a statistical sampling plan and acceptance Ø quality level (AQL) have 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 4.6.1 shall state that such plan was used.

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

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, 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 material or processing, or both, 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 8 plies, approximately 0.08 in. (2 mm) thick and not less than 14 in. (350 mm) long by 12 in. (300 mm) wide. Test panels for other tests of cured laminates shall be of 12 plies, approximately 0.12 in. (3 mm) thick and not less than 12 in. (300 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 the resin manufacturer's recommendations.

4.5.2 Volatile Content:

4.5.2.1 Cut one 4.0 x 4.0 in. (100 x 100 mm) specimen from each sample and punch a small hole in one corner. Weigh each specimen to the nearest 0.01 g (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 (600°F ± 15) for 15 min. ± 1.

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

4.5.2.4 Calculate volatile content as follows,

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

4.5.2.5 Report individual and average values for all specimens.

4.5.3 Resin Content:

4.5.3.1 Use the dried specimens from the volatile content determination (4.5.2) for determination of resin content.

4.5.3.2 Ignition of resin and calculation of resin content shall be in accordance with ASTM D2584, except that the ignition temperature shall be 620°C ± 30 (1150°F ± 50).

4.5.3.3 Report individual and average values for all specimens.

4.5.4 Resin Flow:

4.5.4.1 Cut four 4.0 x 4.0 in. (100 x 100 mm) specimens from each sample. Stack the four pieces on top of each other and weigh to the nearest 0.01 g (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 psig ± 1 (105 kPag ± 7), or a load of 240 lb ± 15 (1070 N ± 70), within 10 - 15 sec of insertion and hold for not less than 5 minutes.

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

4.5.4.4 Calculate resin flow as follows:

$$\text{Resin Flow, \%} = \frac{W_3 - W_4}{W_3} \times 100$$

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 vendor.

4.5.6 Void Content of Cured Laminate: Shall be determined, in duplicate for each cured laminate, in accordance with ASTM D2734 except that laminate resin content shall be determined in accordance with 4.5.7. Calculate void content as follows:

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

where, D_L = Laminate specific gravity (3.3.5), avg.

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 D2584 except that the ignition temperature shall be 620°C ± 30 (1150°F ± 50). Report individual and average values.

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, AMS 3847A, vendor's material designation, values to be reported, lot number, date of manufacture, form or part number, and quantity.

4.6.1.1 Ø 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.

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 3847A, contractor or other direct supplier of impregnated 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 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 and no additional testing shall be permitted. 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 inside diameter of not less than 3 in. (75 mm); width shall be as specified, +0.5 in. (+13 mm), -0.

5.1.2 Cloth shall be interleaved with a colored, nonadhering separator in a manner to provide an outer wrapping with at least 2 in. (50 mm) overlap.