Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 3847

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Revised

CLOTH, QUARTZ, "B" STAGE POLYIMIDE RESIN IMPREGNATED
Style 581 Fabric

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: Primarily for structural laminates requiring high strength and long term heat resistance up to 600° F (316° C).

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., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
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 American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 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
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D2344 - Apparent Horizontal Shear Strength of Reinforced Plastics by Short-Beam Method
ASTM D2584 - Ignition Loss of Cured Reinforced Resins
ASTM D2734 - Void Content of Reinforced Plastics

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

3.3 Properties:

3.3.1 Uncured Properties of Impregnated Product: The product, as supplied, shall conform to the following requirements; tests shall be performed on the product supplied, sampled in accordance with 4.3.1 after warming to above the dew point, 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 Properties of Cured Product: The product shall conform to the following requirements. Test specimens shall be cut from laminates produced as in 4.4.1 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 600° F (315.6° C) 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:

Test Temperature	Tensile Strength, Minimum Individual psi	(MPa)	Tensile Strength, Minimum Average psi	(MPa)	Tensile Modulus, Minimum Average psi	(MPa)
77° F ± 5 (25° C ± 2.8)	45,000	(310)	50,000	(345)	2,500,000	(17,240)
600° F ± 5 (315.6° C ± 2.8)	36,000	(248)	40,000	(276)	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:

Test Temperature	Edgewise Compressive Strength, Minimum Individual psi	(MPa)	Edgewise Compressive Strength, Minimum Average psi	(MPa)	Compressive Modulus, Minimum Average psi	(MPa)
77° F ± 5 (25° C ± 2.8)	40,500	(279)	45,000	(310)	2,800,000	(19,310)
600° F ± 5 (315.6° C ± 2.8)	27,000	(186)	30,000	(207)	2,250,000	(15,510)

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

Test Temperature	Flexural Strength, Minimum Individual psi	(MPa)	Flexural Strength, Minimum Average psi	(MPa)	Flexural Modulus, Minimum Average psi	(MPa)
77° F ± 5 (25° C ± 2.8)	63,000	(434)	70,000	(483)	2,000,000	(13,790)
600° F ± 5 (315.6° C ± 2.8)	36,000	(248)	40,000	(276)	1,800,000	(12,410)

3.3.2.4 Short Beam Shear Strength: Shall be as follows, determined in accordance with ASTM D2344, except the specimens shall be flat, on five specimens per test:

	Short Beam Shear Strength			
	Minimum Individual		Minimum Average	
Test Temperature	psi	(MPa)	psi	(MPa)
77° F ± 5 (25° C ± 2.8)	4500	(31.0)	5000	(34.5)
600° F ± 5 (315.6° C ± 2.8)	3150	(21.7)	3500	(24.1)

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 4.4.6.

3.4 Quality: The product shall be uniform in quality and condition, clean, smooth, and free from foreign materials and from 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 assure 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 requirements are classified as acceptance or routine control tests:

4.2.1.1 Tests for properties of uncured product (3.3.1).

4.2.1.2 Tests of the cured product both at room temperature and at 600° F (315.6° C) for tensile strength (3.3.2.1) and longitudinal flexural strength (3.3.2.3).

4.2.1.3 Tests of the cured product for specific gravity, void content, resin content, and panel thickness of each test laminate.

4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification or periodic control tests and may be the basis for approval of the product (See 4.4.1).

4.3 Sampling:

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

		Number of Specimens per Test min
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

4.3.2 Roll: A roll is the basic unit submitted for inspection and shall not exceed 100 yd (91.4 m) in length. It shall be the full width of the broadgoods.

4.3.3 Lot: A lot shall consist of all material treated at one time without significant changes in treater settings using a single batch of resin and reinforcement and submitted for inspection at one time. An inspection lot shall not exceed 2000 yd (1828 m).

4.4 Approval:

4.4.1 Sample material shall be approved by purchaser before material for production use is supplied, unless such approval be waived. Results of tests on production material 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 material which are essentially the same as those used on the approved sample material. If any change is necessary in ingredients, in type of equipment for processing, or in manufacturing procedures which could affect quality or properties of the material, vendor shall submit samples for reapproval unless purchaser grants written approval after review of a detailed statement of materials and processing used on the approved sample and those proposed. No production material made by the revised procedure shall be shipped prior to receipt of approval of such procedure.

4.5 Test Methods:

4.5.1 Preparation of Test Laminate: Laminate test panels for tensile tests shall be of 8 plies, approximately 0.083 in. (2.11 mm) thick and not less than 14 in. (356 mm) long by 12 in. (305 mm) wide. Test panels for other tests of cured laminates shall be of 12 plies, approximately 0.125 in. (3.18 mm) thick and not less than 12 in. (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 the resin manufacturer's recommendations.

4.5.2 Volatile Content:

4.5.2.1 Cut one 4.0 x 4.0 in. (102 x 102 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 600° F ± 15 (315.6° C ± 8.3) 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 (4.4.2) 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 1150° F ± 50 (621.1° C ± 28).

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. (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 equivalent on top and bottom, in a press preheated to 350° F ± 10 (176.7° C ± 5.6) and apply 15 psi ± 1 (103 kPa ± 7), or a load of 240 lb ± 16 (1068 N ± 71), 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 scrape off the flash. Reweigh to the nearest 0.01 gram (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 (4.4.7), %

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 1150° F ± 50 (621.1° C ± 28). Report individual and average values.

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 made on the product to determine conformance to the acceptance test requirements of this specification and a statement that the product conforms to all other technical requirements. This report shall include the purchase order number, material specification number, vendor's material designation, values to be reported, lot number, date of manufacture, form or part number, and quantity.

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, 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, 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 product 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 All material shall be shipped in rolls with inside diameter of not less than 3 in. (76 mm); width shall be as specified, +0.5 in. (+13 mm), -0.

5.1.2 All material shall be interleaved with a colored nonadhering separator in a manner to provide an outer wrapping with at least 2 in. (51 mm) overlap.

5.1.3 Each roll of material shall be identified by attached removable tags using characters of such size as to be clearly legible and which will not be obliterated by normal handling. Each tag shall show the following information:

CLOTH, QUARTZ, "B" STAGE POLYIMIDE RESIN IMPREGNATED, STYLE 581 FABRIC
AMS 3847
DATE OF IMPREGNATION
MANUFACTURER'S MATERIAL DESIGNATION _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____
DATE OF SHIPMENT _____
ROLL NUMBER, SEQUENTIAL _____
LOT NUMBER _____
QUANTITY _____

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 39° F (4° C) for the shelf life specified.