



AEROSPACE MATERIAL SPECIFICATION

AMS 3826

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

Issued 11-15-72
Revised

CLOTH, TYPE "E" GLASS
"B" Stage Polyester Resin Impregnated
181 Style Fabric

1. SCOPE:

- 1.1 Form: This specification covers one style of glass cloth impregnated with a polyester resin system, the resin being processed to a "B" stage condition.
- 1.2 Application: Primarily for laminates requiring high strength and long term heat resistance at temperatures up to 158 F (70 C) and fabricated by autoclave, press, or vacuum bag techniques. This material is not intended for use in applications requiring flame or fire resistance.

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

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

ASTM D123 - Definition of Terms Relative to Textile Materials

ASTM D638 - Tensile Properties of Plastics

ASTM D695 - Compression Properties of Rigid Plastics

ASTM D790 - Flexural Properties of Plastics

3. TECHNICAL REQUIREMENTS:

3.1 Materials:

- 3.1.1 Reinforcement: Shall be either Style 181, 1581, or 7781 "E" glass cloth in accordance with AMS 3824 treated with an appropriate finish for the resin used.

- 3.1.2 Resin: Shall be a polyester resin modified as necessary to meet the requirements of this specification.

- 3.2 Shelf Life: The product shall have a shelf life of not less than three months from date of shipment when stored in a waterproof heat sealed bag maintained at a temperature not higher than 45 F (7 C).

- 3.3 Uncured Properties of the Impregnated Material: The product, as supplied, shall conform to the following requirements; in addition, when specified, tack and drape shall be as agreed upon by purchaser and vendor:

- 3.3.1 Volatile Content and Resin Solids: Volatile content shall be not greater than 4.5% by weight and resin solids (volatile free) shall be 33 - 45% by weight, determined as in 4.4.1.

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against infringement of patents."

3.3.2 Gel Time: Shall be 1 - 3 min., determined as in 4.4.2.

3.3.3 Resin Flow: Shall be 6 - 14% at 15 psi (103 kPa), determined as in 4.4.3.

3.4 Properties of Cured Laminate: Test laminates shall conform to the properties specified herein for tests at 77 F ± 5 (25 C ± 2.8) and be capable of meeting the requirements for tests at 158 F ± 5 (70 C ± 2.8). Tests shall be performed on specimens cut from laminates and tested in accordance with the applicable test procedures. Test laminates for tensile tests shall be prepared from 8 plies of impregnated cloth; for compressive and flexural strength from 12 plies of impregnated cloth. The laminates shall be molded in a platen press or autoclave at approximately 50 psi (345 kPa) pressure at 325 F ± 5 (162.8 C ± 2.8) for 3 hours. The resultant laminate shall be uniform in thickness within ± 0.003 in. (0.08 mm). The laminates shall be not less than 14 in. (356 mm) long with the plies laid up "unnested" parallel to the warp, with each ply positioned so that the satin shafts of the warp always face the top of the layup. Tests shall be conducted parallel to the warp with specimens held at test temperature for not less than 30 min. prior to test. All values shall be reported, individual and average of 4 specimens cut from each laminate panel.

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

Test Temperature	<u>Minimum Individual</u>		<u>Minimum Average Strength</u>	
	psi	(MPa)	psi	(MPa)
77 F ± 5 (25 C ± 2.8)	42,750	(295)	45,000	(310)
158 F ± 5 (70 C ± 2.8)	38,000	(262)	40,000	(276)

3.4.2 Compressive Strength: Shall be as follows, determined in accordance with ASTM D695:

Test Temperature	<u>Minimum Individual</u>		<u>Minimum Average Strength</u>	
	psi	(MPa)	psi	(MPa)
77 F ± 5 (25 C ± 2.8)	42,750	(295)	45,000	(310)
158 F ± 5 (70 C ± 2.8)	33,250	(229)	35,000	(241)

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

Test Temperature	<u>Flexural Strength</u>				<u>Flexural Modulus</u>	
	<u>Minimum Individual</u>		<u>Minimum Average</u>		<u>Minimum Average</u>	
	psi	(MPa)	psi	(MPa)	psi	(MPa)
77 F ± 5 (25 C ± 2.8)	57,000	(393)	60,000	(414)	2,900,000	(20,000)
158 F ± 5 (70 C ± 2.8)	45,600	(314)	48,000	(331)	2,300,000	(16,870)

3.5 Quality: The product shall be uniform in quality and condition, clean, and free from foreign materials and air bubbles and from internal and external 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 of Tests: Tests to determine conformance to volatile content and resin solids (4.4.1), gel time (4.4.2), resin flow (4.4.3), tensile strength at 77 F (25 C) (3.4.1), compressive strength at 77 F (25 C) (3.4.2), and flexural strength and modulus at 77 F (25 C) (3.4.3) requirements are classified as acceptance or routine control tests.
- 4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification or periodic control tests.

4.3 Sampling:

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

Resin Solids	Every roll (4 specimens)
Volatiles	Every roll (4 specimens)
Gel Time	Every roll (1 specimen)
Resin Flow	Every roll (1 specimen)
Tensile Strength	Lot basis
Compressive Strength	Lot basis
Flexural Strength	Lot basis
Flexural Modulus	Lot basis

} 1 laminate per lot
} 4 specimens per test

- 4.3.2 A roll is the basic unit offered for acceptance and shall not exceed 100 yd (91.4 m) in length. It shall be the full width of the broadgoods and shipped in a separate container.
- 4.3.3 A lot shall consist of all material treated at one time without significant change in treater settings using a single batch of resin and reinforcement and offered for acceptance at one time. An inspection lot shall not exceed 2000 yd (1829 m).

4.4 Test Methods:

4.4.1 Volatile Content and Resin Solids: Accurately weigh (W_1) to the nearest 0.01 g each of four samples 4 in. x 4 in. (102 mm x 102 mm) cut on the bias of the product. Using porcelain crucibles (preferably covered) previously brought to constant weight by igniting at $1550 F \pm 25$ ($843.3 C \pm 14$), dry samples in a circulating air oven at $230 F \pm 5$ ($110 C \pm 2.8$) for 8 min. ± 0.5 , cool in a desiccator, and reweigh (W_2). Burn out resin in muffle furnace for 180 min. ± 5 at $1050 F \pm 25$ ($565.6 C \pm 14$) or until fabric is white. Cool in a desiccator and reweigh. Repeat the burn out as necessary to obtain constant weight (W_3).

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

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

where, W_1 = original weight of sample

W_2 = weight of specimen after drying at 230 F (110 C)

W_3 = weight of ash

- 4.4.2 Gel Time Test: Cut sufficient 2 in. x 2 in. (51 mm x 51 mm) pieces across the roll width to make a sample approximately 0.200 in. (5.08 mm) thick. Place the sample between sheets of cellophane or other suitable film and insert between the platens of a press which has been stabilized at 250 F \pm 5 (121.1 C \pm 2.8). 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.
- 4.4.3 Volatile-Free Resin Flow Test: Cut four 4 in. x 4 in. (102 mm x 102 mm) pieces on the bias of the weave and weigh to the nearest 0.01 g (W_4). Stack samples between two separator sheets approximately 6 in. x 8 in. (152 mm x 202 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 of greater than 0.005 g during cure. Weigh the specimen assembly to the nearest 0.01 g (W_5). Place the specimen assembly between press platens preheated to 250 F \pm 10 (121.1 C \pm 5.6) and apply pressure of 15 psi \pm 5 (103 kPa \pm 35) on the specimen assembly, taking care that the edges of all pieces remain properly aligned. Hold at heat and pressure for 10 min. \pm 0.5. Remove specimen assembly, cool in a desiccator, and weigh to the nearest 0.01 g (W_6). Remove separators and resin flash by trimming specimen to the original size, taking care not to remove any reinforcing fibers, and weigh to the nearest 0.01 g (W_7).

$$\text{Resin Flow, \%} = \frac{W_4 - (W_5 - W_6) - W_7}{W_4 - (W_5 - W_6)} \times 100$$

where, W_4 = original weight of specimen

W_5 = original weight of specimen assembly

W_6 = weight of specimen assembly after press heating

W_7 = weight of specimen after trimming

4.5 Approval:

- 4.5.1 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.
- 4.5.2 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, 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.

4.6 Reports:

- 4.6.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests made on the product to determine conformance to the acceptance test requirements of this specification. This report shall include the purchase order number, material specification number, vendor's material designation, cure cycle for each test panel, quantity, and lot number.

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, 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 for each original nonconforming specimen cut from the same panel or a newly prepared panel. 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 Identification:

5.1.1 Unless otherwise specified, each roll shall be identified by attached removable tags using characters not less than 1/8 in. (3.2 mm) in height which will not be obliterated by normal handling.

5.1.2 Each tag shall be legibly marked to give the following information:

CLOTH, TYPE "E" GLASS, "B" STAGE, POLYESTER RESIN IMPREGNATED
 181 STYLE FABRIC

AMS 3826
 CLOTH STYLE _____
 DATE OF IMPREGNATION _____
 PURCHASE ORDER NUMBER _____
 MANUFACTURER'S DESIGNATION _____
 DATE OF MANUFACTURE _____
 ROLL NUMBER, SEQUENTIAL _____
 LOT NUMBER _____

5.2 Packaging:

5.2.1 All material shall be shipped in rolls with inside diameter not less than 3 in. (76 mm), width shall be as specified by the purchaser, $\pm 1/2$ in. (13 mm).

5.2.2 All material shall be interleaved with colored separator in a manner to provide an outer wrapping with not less than 2 in. (51 mm) overlap.

5.2.3 Each roll shall be shipped in a sealed polyethylene bag.

5.3 Exterior Packaging:

5.3.1 Each roll shall be packaged in outer cartons in such a manner as to insure that the product, during shipment and storage, will not be permanently distorted and will be protected against damage from exposure to weather or any normal hazard.

5.3.2 Packages shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.