Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 3671

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Revised

PLASTIC MOLDING COMPOUND, NOVOLAC EPOXY RESIN, SHORT GLASS FIBER REINFORCED, STRUCTURAL

1. SCOPE:

1.1 Form: This specification covers a modified novolac epoxy resin in the form of a chopped-glass-fiber filled molding compound processed to a dry "B" stage condition.

1.2 Application: Primarily for high-pressure compression molding, useful in fabrication of parts with good properties up to 135°C (275°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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
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 D651 - Tensile Strength of Molded Electrical Insulating Materials
ASTM D696 - Coefficient of Linear Thermal Expansion of Plastics
ASTM D731 - Molding Index of Thermosetting Molding Powder
ASTM D790 - Flexural Properties of Plastics and Electrical Insulating Materials
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D2584 - Ignition Loss of Cured Reinforced Resins
ASTM D3530 - Volatiles Content of Carbon Fiber-Epoxy Prepreg
ASTM F501 - Aerospace Materials Response to Flame, with Vertical Test Specimen (for Aerospace Vehicles Standard Conditions)

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 Specifications:

MIL-R-60346 - Roving, Glass, Fibrous (for Filament Winding Applications)

2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Product: The molding compound shall be manufactured from a modified epoxy resin filled with chopped glass roving and processed to a dry "B" stage without tack.

3.1.1 Resin: Shall be a novolac epoxy resin modified as necessary to meet the requirements of 3.2.

3.1.2 Roving: Shall be chopped "E" glass fiber capable of producing the properties specified in Table I. When specified by purchaser, the roving shall meet the requirements of MIL-R-60346, Type I, Class 1.

3.1.3 Storage Life: The product shall meet the requirements of this specification when tested at any time up to 12 months from date of receipt of product by the purchaser, provided it has been stored in the original sealed container at a temperature not higher than 5°C (40°F).

3.1.4 Shelf Life: The product shall meet the requirements of this specification when tested after exposure to a relative humidity not higher than 70% and a temperature not higher than 30°C (86°F) for a continuous period of not less than 3 months.

3.2 Properties: The product shall conform to the following requirements:

3.2.1 Uncured Product: Shall be as follows; tests shall be performed on the as-received product, after warming to above the dew point prior to sampling, in accordance with the test methods specified herein:

3.2.1.1	Resin Content	36% ± 3	ASTM D2584
3.2.1.2	Roving Length	0.5 in. ± 0.1 (12.7 mm ± 0.25)	Visual
3.2.1.3	Cup Flow, Cup Closing Time	18 - 24 sec	ASTM D731
3.2.1.4	Volatile Content, max	0.5%	ASTM D3530

3.2.2 Cured Product: Shall be as specified in Table I; tests shall be performed in accordance with the specified test methods on molded specimens prepared in accordance with 4.5.1. Specimens for elevated temperature tests shall be held at the test temperature for not less than 30 min. prior to testing. Values for tensile strength, flexural strength, and flexural modulus shall be the average of five specimens for each test; no individual value shall be less than 90% of the minimum average value specified.

TABLE I

Test Number	Property	Test Temperature 77°F ± 9	Test Temperature 275°F ± 9	Test Method
1	Tensile Strength, min avg	25,000 psi	18,000 psi	ASTM D651
2	Flexural Strength, min avg	60,000 psi	45,000 psi	ASTM D790
3	Flexural Modulus, min avg	3,500,000 psi	2,800,000 psi	ASTM D790
4	Coefficient of Linear Thermal Expansion, in. per in. per °F, max	20×10^{-6}	--	ASTM D696
5	Specific Gravity	1.85 to 1.95	--	ASTM D792

TABLE I(SI)

Test Number	Property	Test Temperature 25°C ± 5	Test Temperature 135°C ± 5	Test Method
1	Tensile Strength, min avg	172 MPa	124 MPa	ASTM D651
2	Flexural Strength, min avg	414 MPa	310 MPa	ASTM D790
3	Flexural Modulus, min avg	24.1 GPa	19.3 GPa	ASTM D790
4	Coefficient of Linear Thermal Expansion, (mm/mm)/°C, max	36×10^{-6}	--	ASTM D696
5	Specific Gravity	1.85 to 1.95	--	ASTM D792

3.2.2.1 Flame Resistance: Time to extinguish, defined as the total of flame time and glow time, shall not exceed 5.0 sec. average or 6.0 sec. individual. Burn length shall not exceed 6.0 in. (152 mm) average, or 7.2 in. (183 mm) individual. Specimens shall be tested in the vertical position with 60 sec ± 1 flame exposure in accordance with 4.5.2.

3.3 Quality: The molding compound shall be uniform in quality and condition, clean, and free from foreign materials and other contaminants detrimental to fabrication or to performance of parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all 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 such confirmatory testing as he deems 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 requirements for resin content (3.2.1.1), roving length (3.2.1.2), cup flow (3.2.1.3), volatile content (3.2.1.4), flexural strength at 77°F (25°C) (Table I, Test No. 2), specific gravity cured (Table I, Test No. 5), and quality (3.3) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the initial shipment of the product to a purchaser, when a change in material 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, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: A sufficient quantity of molding compound shall be selected at random from each lot to perform all required tests. The number of specimens for each test shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all molding compound produced in a single production run from the same batches of polymer and chopped roving and presented for vendor's inspection at one time. A lot shall not exceed 1000 lb (450 kg) and may be packaged and delivered in small quantities under a basic lot approval as long as the lot identification is maintained.

4.3.1.2 When a statistical sampling plan and acceptance 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.

4.4 Approval:

4.4.1 Sample product shall be approved by purchaser before product for production use is supplied, unless such approval be waived. Results of tests on production product 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 product which are essentially the same as those used on the approved sample. If any change is necessary 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 and processing and, when requested, sample product. Production product made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Specimen Preparation: Each container of molding compound to be sampled shall be allowed to warm above the dew point before opening the sealed package for sampling. Immediately after sampling, the container shall be resealed and returned to proper storage.

4.5.1.1 Tests of Uncured Product: Shall be performed on room temperature molding compound immediately after sampling.

4.5.1.2 Tests of Cured Product: Shall be performed on molded specimens 0.125 in. ± 0.010 (3.18 mm ± 0.25) thick using the manufacturer's recommended cure time, temperature, and pressure.

4.5.1.2.1 Tensile Specimens: Shall be in accordance with ASTM D651.

4.5.1.2.2 Flexural Specimens: Shall be 0.125 x 1.000 x 4.00 in. (3.2 x 25 x 100 mm).

4.5.2 Flame Resistance: Shall be determined in accordance with ASTM F501, using three specimens, 0.060 in. ± 0.010 (1.5 mm ± 0.25) thick x 3.0 x 12.0 in. (75 x 300 mm), with the 12-in. (300 mm) dimension vertical.

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 to determine conformance to the acceptance test requirements and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3671, vendor's product identification, lot number, and quantity.

4.6.1.1 A material safety data sheet conforming to AMS 2825 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 product for production use. Each request for modification of formulation shall be accompanied by a revised data sheet for the proposed formulation.