AEROSPACE MATERIAL SPECIFICATION

AMS3699™	REV. A

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Superseding AMS3699

Resin System, Epoxy, Carbon Microballoon Filled 135 °C (275 °F) Cure

RATIONALE

AMS3699A has been reaffirmed to comply with the SAE Five-Year Review policy.

1. SCOPE:

1.1 Form: This specification covers a two-part epoxy resin system in the form of a bisphenol "A" epoxy resin filled with fumed silica and carbon microspheres and a separate curing agent.

1.2 Application: Primarily for filament wound pressure vessels where potting or casting is required.

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 2825 - Material Safety Data Sheets
AMS 3753 - Microspheres; Carbon, Hollow
AMS 3755 - Powder, Fumed Silicon Dioxide

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For more information on this standard, visit
https://www.sae.org/standards/content/AMS3699A/

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

ASTM D648 - Deflection Temperature of Plastics under Flexural Load
ASTM D651 - Tensile Strength of Molded Electrical Insulation Materials
ASTM D695 - Compressive Properties of Rigid Plastics
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D1217 - Density and Relative Density (Specific Gravity) of Liquids by Bingham Pycnometer
ASTM D1763 - Epoxy Resins
ASTM D2083 - Calculation of Percent Primary, Secondary, and Tertiary Amines in Fatty Amines
ASTM D2393 - Viscosity of Epoxy Resins and Related Components
ASTM D2471 - Gel Time and Peak Exothermic Temperature of Reacting Thermosetting Resins

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: Shall be an epoxy resin system filled with hollow carbon microspheres and fumed silicon dioxide to be cured with an aromatic diamine curing agent.

3.1.1 Resin: Shall be an unmodified hisphenol "A" type epoxy resin meeting the requirements of 3.2.1.

3.1.2 Carbon Microspheres: Shall conform to AMS 3753.

3.1.3 Fumed Silica: Shall conform to AMS 3755/2.

3.1.4 Curing Agent: Shall consist primarily of an aromatic diamine meeting the requirements of 3.2.2.

3.2 Properties: The components and the resin system shall conform to the following requirements:

3.2.1 Epoxy Resin: Shall be in accordance with ASTM D1763, Type I, Grade 1, Class 1, except that the viscosity shall not exceed 10,000 centipoises (10 Pa•s).

3.2.2 Curing Agent: Shall be as follows:

3.2.2.1 Specific Gravity	1.10 - 1.14	ASTM D1217

3.2.2.2	Viscosity	25,000 - 150,000 cp (25 - 150 Pa•s)	4.5.2.1
3.2.2.3	Amine Equivalent	50 - 55	ASTM D2083

3.2.3 Uncured Resin System: Shall be as follows when mixed in the following proportions by weight: epoxy resin, 100; curing agent, 31; fumed silica, 4; carbon microballoon, 40.

3.2.3.1	Viscosity, cp (Pa•s)	Preproduction value, ± 10%	4.5.2.1
3.2.3.2	Gel Time, min.	Preproduction value, ± 10%	ASTM D2471

3.2.4 Cured Resin System: Shall be as follows when cured by the following cycle: 4 hr ± 0.2 at 65°C ± 5 (150°F ± 9), 4 hr ± 0.2 at 105°C ± 5 (225°F ± 9), 4 hr ± 0.2 at 135°C ± 5 (275°F ± 9). Tests shall be performed on specimens molded as in 4.5.3 and in accordance with specified test methods.

3.2.4.1	Specific Gravity	Preproduction value, ±2%	ASTM D792
3.2.4.2	Tensile Strength, psi (MPa)	Not less than 90% of preproduction value	ASTM D651
3.2.4.3	Heat Distortion Temperature, °C (°F)	TBR (1)	4.5.3.1
3.2.4.4	Compressive Strength, psi (MPa)	TBR	ASTM D695

(1) TBR - To be reported on preproduction test report.

3.3 Quality: The resin system, 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 resin system.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the resin system 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 any confirmatory testing deemed necessary to ensure that the resin system conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for viscosity (3.2.3.1) and gel time (3.2.3.2) of the uncured resin system and tensile strength of the cured resin system (3.2.4.2) 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 prior to or on the initial shipment of resin 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 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: Each lot of resin system shall be sampled at random to provide sufficient material 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 three.

4.3.1.1 A lot shall be the resin system produced in a continuous production run from the same batches of raw materials under the same fixed conditions and presented for vendor's inspection at one time. An inspection lot shall not exceed 100 lb (45 kg) of resin system and may be packaged in small quantities under the basic lot approval provided 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.l Sample resin system shall be approved by purchaser before resin system for production use is supplied, unless such approval be waived by purchaser. Results of tests on production resin system 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 resin system which are essentially the same as those used on the approved sample resin system. 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 resin system. Production resin system made by the revised procedures shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

4.5.1 Specimen Preparation: Each container of uncured resin system and of liquid curing agent shall be allowed to warm above the dew point before opening the sealed container for sampling. Immediately after sampling, the container shall be resealed and returned to proper storage.

4.5.2 Tests of Liquid Curing Agent and Uncured Product: Shall be performed at room temperature immediately after sampling.

4.5.2.1 Viscosity: Shall be determined at 25°C ± 1 (77°F ± 2) in accordance with ASTM D2393 using a Brookfield RVF viscometer with a No. 4 spindle at 4 revolutions per minute.

4.5.3 Tests of Cured Product: Shall be performed on molded specimens 0.125 in. ± 0.010 (3 mm ± 0.25) thick or as required by the test method, using the cure cycle specified in 4.5.3.

4.5.3.1 Heat Distortion Temperature: Shall be determined in accordance with ASTM D648 at 264 psi (1.82 MPa) fiber stress at a heating rate of 2°C (4°F) per minute.

4.6 Reports:

4.6.1 The vendor of the resin system 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 resin system conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3699, vendor's product identification, lot number, and quantity.

4.6.1.l 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 resin system for production use. Each request for modification of formulation shall be accompanied by a revised data sheet for the proposed formulation.