



400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

American National Standard

SAE AMS 3616A

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Superseding AMS 3616

RESIN, POLYIMIDE, LAMINATING AND MOLDING
High Temperature Resistant, 370°C (700°F)
Unfilled, Addition Polymer

1. SCOPE:

- 1.1 **Form:** This specification covers a single-component, unfilled, heat-reactive, thermosetting, acetylene-substituted, aromatic-polyimide resin in the form of dry solid powder or particles. The resin thermally cures to a polyimide polymer.
- 1.2 **Application:** Primarily as a laminating and molding resin useful in closed-die or press-cured fabrication of composite structures requiring long-term exposure (500 - 1000 hr) up to 315°C (600°F), moderate-term exposure (25 - 50 hr) up to 370°C (700°F), or short-term exposure (1 - 2 hr) up to 425°C (800°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 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 3892/1 - Tow or Yarn, Carbon (Graphite) Fibers, For Structural Composites, GF 400 (2760) Tensile Strength, 33 (228) Tensile Modulus

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

ASTM D150 - A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials
ASTM D638 - Tensile Properties of Plastics
ASTM D695 - Compressive Properties of Rigid Plastics
ASTM D790 - Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D2583 - Indentation Hardness of Plastics by Means of a Barcol Impressor

- 2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Form Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

- 2.4 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

- 3.1 Material: The uncured resin shall be a dry, solid, single-component, fusible, thermosetting, aromatic-polyimide powder, soluble in a solvent system of N-methylpyrrolidinone (N-methylpyrrolidone) or dimethylformamide, which cures to form a polyimide molecular structure.
- 3.2 Storage Life: The dry, solid resin, stored in vendor-packaged, air-tight containers at not higher than 30°C (85°F), shall meet the requirements specified herein when tested at any time up to one year from date of manufacture; it shall also meet these requirements when tested at any time up to 60 days from date of receipt by purchaser when stored at not higher than 50°C (120°F).
- 3.3 Properties of Uncured Resin: The as-received, dry resin shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified test methods:
- 3.3.1 Softening Temperature: Shall be in the range 175° - 200°C (347° - 392°F), determined in accordance with 4.5.1.1.
- 3.3.2 Ratio of Aromatic C-H to Acetylenic C-H: The ratio of the area under the aromatic C-H peaks to the area under the acetylenic C-H peaks shall be within the range 18:1 to 24:1, determined in accordance with 4.5.1.2.
- 3.3.3 Solubility: The resin shall be soluble in N-methylpyrrolidinone (N-methylpyrrolidone) to the extent of not less than 13%, determined in accordance with 4.5.1.3.
- 3.3.4 Gel Time: Shall be 100 - 230 sec, determined in accordance with 4.5.1.4.

3.3.5 Infrared Spectrum: The infrared transmission spectrogram of uncured production resin shall not deviate from that of the preproduction test sample of 4.4.1 by more than agreed upon by purchaser and vendor, determined in accordance with 4.5.1.5.

3.4 Properties of Cured Resin: The resin, molded and cured in accordance with 4.5.2 and machined into suitable test specimens, shall conform to the following requirements; tests shall be performed at 20° - 30°C (70° - 85°F), unless otherwise specified herein, and in accordance with specified test methods:

3.4.1 Specific Gravity	1.30 - 1.40	ASTM D792
3.4.2 Hardness, Barcol	50 $\pm$ 5	ASTM D2583
3.4.3 Tensile Strength, min	10,000 psi (69 MPa)	ASTM D638, Specimen Type IV, Speed A or Strain rate: 0.04 in. (1.0 mm) per min.
3.4.4 Elongation, min	0.8%	Same as 3.4.3
3.4.5 Secant Modulus, min	500,000 psi (3450 MPa)	Same as 3.4.3
3.4.6 Flexural Strength, min	13,000 psi (90 MPa)	ASTM D790, Method I
3.4.7 Flexural Modulus, min	500,000 psi (3450 MPa)	ASTM D790, Method I
3.4.8 Compressive Strength, min	25,000 psi (170 MPa)	ASTM D695
3.4.9 Dielectric Constant at 9.4 $\pm$ 0.1 GHz	3.3 $\pm$ 0.2	ASTM D150
3.4.10 Dissipation Factor at 9.4 $\pm$ 0.1 GHz	0.01 max	ASTM D150

3.5 High Temperature Composite Properties: The resin, reinforced with randomly oriented chopped graphite fibers and molded as specified in 4.5.3, shall conform to the following requirements, determined in accordance with ASTM D790:

3.5.1 <u>Flexural Properties:</u>	Flexural Strength	Flexural Modulus
3.5.1.1 Flexural Properties at Room Temperature, min	50,000 psi (345 MPa)	4,000,000 psi (27,580 MPa)