



AEROSPACE MATERIAL SPECIFICATION

AMS6562™

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Medium Temperature, Out-of-Autoclave, Oven-Vacuum-Bag Cure Epoxy Resin
Impregnated Fiber Reinforced Composite Materials

RATIONALE

Widely distributed and available industry material specifications are required for procurement of composite materials whose allowance data is published in CMH-17.

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Documents

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1. SCOPE

1.1 Purpose

- 1.1.1 The purpose of this specification is to allow procurement of defined carbon fiber and fiberglass epoxy prepreg materials corresponding to their statistically derived material properties published in CMH-17 (formerly MIL-HDBK-17). As a result, no qualification or equivalency threshold values are provided. Users that intend to conduct a new material qualification or equivalency program shall notify the Qualifying Agency per 4.2.1.
- 1.1.2 The use of this specification does not alone guarantee material or structural performance. Users should also be actively involved in evaluating material performance and quality including, but not limited to, performing regular user quality control tests, performing periodic equivalency/additional testing, participating in material change management activities, conducting statistical process control, and conducting regular supplier audits.
- 1.1.3 The composite materials described by this specification are typically used in structural applications requiring high strength and stiffness in environments up to 250 °F. This specification was developed based on the material properties that are available publicly. The user may specify additional requirements beyond those defined in this specification, especially when the user has generated additional material property data beyond that available publicly, or when the application has other requirements. The additional requirements are subject to supplier review and approval.

1.2 Form

This specification and its associated detail specifications establish the requirements for continuous carbon and glass fiber unidirectional tape and fabric impregnated with a medium temperature, out-of-autoclave, oven-vacuum-bag cure modified B-staged epoxy resin. This basic specification contains fiber reinforced epoxy prepreg material requirements that apply to every product. The associated detail specifications contain additional or superseding properties and requirements that apply to a specific product reinforcement form.

1.3 Classification

Each detail specification has a unique classification. Prepregs shall be classified to the following Types, Classes, Grades, and Styles.

- 1.3.1 Type shall specify nominal prepreg resin content. For example:

Type 32 – Nominal resin content 32% percent by weight

Type 38 – Nominal resin content 38% percent by weight

- 1.3.2 Class shall specify prepreg product form. For example:

Class 1 – Unidirectional carbon fiber prepreg tape

Class 2 – Woven carbon fiber fabric prepreg

Class 3 – Unidirectional glass or quartz fiber prepreg tape

Class 4 – Woven glass or quartz fiber fabric prepreg

- 1.3.3 Grade shall specify nominal fiber areal weight in grams per square meter (g/m²). For example:

Grade 193 – 193 g/m² nominal fiber areal weight

Grade 298 – 298 g/m² nominal fiber areal weight

1.3.4 Style shall specify the woven fabric style (not applicable to unidirectional forms like Class 1 or 3). For example:

Style 3k-70-PW – 3k yarn, 7.0 mil nominal dry fabric thickness, plain weave

Style 7781 – E-glass fiber, 10.0 mil nominal dry fabric thickness

1.4 Safety – Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address all the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

1.5 Rounding of Values

The following applies to all specified limits or requirements in this specification. For purposes of determining conformance with this specification, an observed value or a calculated value shall be rounded “to the nearest unit” in the last right-hand digit used in expressing the specification limit, in accordance with the rounding method of ASTM E29, and directly converted per ASTM SI10 to determine an appropriate equivalent value between inch-pound units and SI units.

1.6 Change Control Approval

The supplier shall prepare and control a process control document (PCD). The established PCD shall be presented to the qualifying agency upon request. The qualifying agency shall treat any information contained in the PCD as proprietary. Methods in the PCD may be used in place of methods in this specification when appropriate as an alternate means of compliance to this specification.

Prepreg product per this specification shall be produced in accordance with a qualifying agency approved PCD. Changes to the PCD of a qualified material are subject to the written approval of the qualifying agency. Formal change notification and approval is required before any change may be implemented. Qualifying agency approval is required for any changes, and is granted through advance change notices (ACN). Prior to implementing any change, the material supplier shall contact the qualifying agency with the following information:

- a. A detailed description of the change,
- b. A draft test plan to substantiate that the change will not affect the prepreg material properties, and
- c. A list of material users.

The qualifying agency will communicate the proposed change(s) and obtain necessary suggestions and/or approvals from the identified material users. The ACN along with test results will be reviewed by the identified material users. The qualifying agency will sign the ACN when a consensus is reached.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS-C-9084 Cloth, Glass, Finished, for Resin Laminates

CMH-17 Composite Materials Handbook

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

- ASTM D2344 Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
- ASTM D3039 Tensile Properties of Polymeric Matrix Composite Materials
- ASTM D3529 Matrix Solids Content and Matrix Content of Composite Prepreg
- ASTM D3530 Volatiles Content of Composite Material Prepreg
- ASTM D3531 Resin Flow of Carbon Fiber-Epoxy Prepreg
- ASTM D3532 Gel Time of Carbon Fiber-Epoxy Prepreg
- ASTM D3776 Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
- ASTM D3878 Standard Terminology Composite Materials
- ASTM D6641 Compressive Properties of Polymer Matrix Composite Laminates Using a Combined Loading Compression (CLC) Test Fixture
- ASTM E29 Using Significant Digits in Test Data to Determine Conformance with Specifications
- ASTM E168 General Techniques of Infrared Quantitative Analysis
- ASTM E1252 General Techniques for Obtaining Infrared Spectra for Qualitative Analysis
- ASTM SI10 Use of the International System of Units (SI): The Modern Metric System

2.3 ISO Publications

Available from International Organization for Standardization, ISO Central Secretariat, 1, ch. de la Voie-Creuse, CP 56, CH-1211 Geneva 20, Switzerland, Tel: +41 22 749 01 11, www.iso.org.

- ISO 9000 Quality Management Systems

2.4 SACMA Standards

Available from American Composites Manufacturers Association, 1010 North Glebe Road, Suite 450, Arlington, VA 22201, Tel: 703-525-0511, www.acmanet.org.

- SACMA SRM 10R-94 Calculation of Fiber Volume of Composite Test Laminates
- SACMA SRM 18R-94 Glass Transition Temperature (T_g) Determination by DMA of Oriented Fiber – Resin Composites
- SACMA SRM 20R-94 High Performance Liquid Chromatography of Thermoset Resins
- SACMA SRM 23R-94 Resin Content and Fiber Area Weight of Thermoset Prepreg with Destructive Technique
- SACMA SRM 25R-94 Onset Temperature and Peak Temperature for Composite System Resins Using Differential Scanning Calorimetry (DSC)

2.5 U.S. Government Publications

2.5.1 Department of Defense Publications

Available from DLA Document Services, Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, <https://assist.dla.mil/>.

MIL-D-3464 Desiccants, Activated, Bagged, Packaging Use and Static Dehumidification

MIL-PRF-131 Barrier Materials, Watervaporproof, Greaseproof, Flexible, Heat-Sealable

2.5.2 FAA Publications

Available from Federal Aviation Administration, 800 Independence Avenue, SW, Washington, DC 20591, Tel: 866-835-5322, www.faa.gov.

DOT/FAA/AR-06/10 Guidelines and Recommended Criteria for the Development of a Material Specification for Carbon Fiber/Epoxy Fabric Prepregs

DOT/FAA/AR-07/3 Guidelines and Recommended Criteria for the Development of a Material Specification for Carbon Fiber/Epoxy Unidirectional Prepregs Update

2.5.3 Code of Federal Regulations (CFR) Publications

Available from the United States Government Printing Office, 732 North Capitol Street, NW, Washington, DC 20401, Tel: 202-512-1800, www.gpo.gov.

29 CFR 1910.1200 Hazard Communication, Occupational Safety and Health Standards

2.6 PRI Publications

Available from Performance Review Institute, 161 Thorn Hill Road, Warrendale, PA 15086-7527, Tel: 724-772-1616, www.pri-network.org.

PD2000 Governance and Administration of an Industry Managed Product Qualification Program

PD2001 Qualified Product Management Council Procedures for Qualified Products Group

2.7 Definitions

For definitions that are not provided in this specification or other referenced AMS specifications, the definitions in DOT/FAA/AR-06/10 or DOT/FAA/AR-07/3 shall apply. For definitions not provided in DOT/FAA/AR-06/10, the definitions in ASTM D3878 shall apply. For definitions not provided in ASTM D3878, the definitions in CMH-17 shall apply.

ACCEPTANCE TESTING: Tests to prove that the quality aspects of subsequent prepreg batches correspond to the quality characteristics of the “original” qualified prepreg product.

AMBIENT: The condition of the immediate surrounding environment.

BREATHER: A porous material that serves as a continuous air path over and/or around the panel.

CREASE: A condition of the surface of the prepreg where the nominal thickness is not appreciably changed but the material is permanently formed into a ridge.

FABRIC LOT: Fabric woven from one warp loom set. Also known as weaving lot.

FIBER FINISH: A coating material applied to the fiber in order to promote resin adhesion.

FIBER SIZING: A coating or treatment applied to yarns to improve handling characteristics during weaving, prepregging, or other fiber handling operations.

FIBER (YARN) LOT: Fiber produced in one continuous manufacturing operation, under substantially identical conditions (except normal rest periods and daily shift changes).

FILL: The crosswise yarns running at 90 degrees to the warp of the fabric reinforcements, also known as weft or 90 degree.

FOLD: A condition in which the prepreg is laid back over itself.

FOREIGN MATERIAL: All visually detectable material not characteristic of the prepreg, such as something other than reinforcement fiber or resin constituents.

FUZZ BALLS: The broken filaments and abraded particles that collect as loose filament bundles or balls which are occasionally incorporated onto the impregnated material.

MASTER ROLL: A subunit of a prepreg batch that has been wound on a core, until changed with another empty core that is further processed into product rolls.

MATERIAL QUALIFICATION AGENCY: Organization responsible for assuring that the qualification requirements of this specification have been fulfilled for a given material, and for publication of that material's designation in a QPL to control procurement.

MECHANICAL-LIFE: The out-of-refrigeration time before cure is initiated over which the material remains capable of demonstrating the required mechanical properties if laid up and compacted within its work-life. See Figure 1.

STAGING-LIFE: See Figure 1. Mechanical-life remaining after the part is laid up and compacted on the tool.

PREPREG: In the context of this specification, prepreg is epoxy resin impregnated fiber or fabric that, upon supply to composite part fabricators, contain a certain amount of reactive resin mass and can be cured by heat and vacuum/pressure without further additives.

PREPREG BATCH: Prepreg product that is produced in one continuous manufacturing operation, under substantially identical conditions (except normal rest periods and daily shift changes), using fiber, fabric and resin batches traceable to a specific lot.

PRI: Performance Review Institute, represented by the Qualified Products Group (QPG) managing the Qualified Products List (QPL) attached to specifications related to the SAE P-17 committee.

PROCESS CONTROL DOCUMENT (PCD): A document that describes the raw materials, manufacturing processes, in process testing, and alternate test methods used to document and to control variation of a supplier's product. The user should coordinate with the material supplier to establish that the PCD meets their requirements, such as: content of the PCD, what PCD changes shall be reported/approved, and who approves (in writing) the PCD.

PRODUCT ROLL: A subunit of a prepreg batch in the final configuration delivered to the purchaser which meets the size requirements in 3.3.4.

PUCKERS: Areas on prepreg product where the material has locally blistered or pulled away from the separator film or release material.

QUALIFYING AGENCY: The responsible agency for the Qualified Products List (QPL), or their designee.

RESIN BATCH: Resin mixed in one mixer in one operation or blended together in one homogeneous mix with traceability to individual component lots.

RESIN RICH AREA: Area of excess resin at the surface of the prepreg.

RESIN STARVED AREA: Area of unwetted fibers at the surface of the prepreg.