AEROSPACE MATERIAL SPECIFICATION

AMS6891™	REV. A
Issued 2020-12 Revised 2025-12 Superseding AMS6891	

Carbon Fiber and Fiberglass Epoxy Prepreg Products with 350 °F (177 °C) Cure for Aerospace Applications

RATIONALE

This standard is being revised to update the prepreg life requirements following a study on shelf life and out-time behavior.

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1. SCOPE

The intent of this specification is for the procurement of carbon fiber and fiberglass epoxy prepreg products with 350 °F (177 °C) cure for aerospace applications; therefore, no qualification or equivalency threshold values are provided. Users that intend to conduct a new material qualification or equivalency program must refer to the production quality assurance section (4.3) of this base specification, AMS6891.

1.1 Form

This specification and its associated detail specifications establish the requirements for a 350 °F (177 °C) autoclave cure, continuous fiber ("unidirectional tape and fabric prepreg") impregnated with a modified B-staged epoxy resin.

1.1.1 Detail Specification

This base specification contains basic fiber reinforced epoxy prepreg material requirements that apply to every product. The detail specifications contain additional or superseding properties and requirements that apply to a specific product.

1.2 Purpose

a. The purpose of this specification is to allow procurement of a defined material corresponding to the statistically derived material properties published in CMH-17 (formerly MIL-HDBK-17).

b. The materials qualified to this specification are designed specifically for vacuum-bag autoclave cure (see 4.4.9).

c. This specification is 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 properties beyond those available publicly or when the application has other requirements. The additional requirements are subject to supplier review and approval.

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d. The use of this specification does not guarantee material or structural performance. Users should 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.

e. This material is intended for use in laminate applications with a service temperature up to 250 °F (121 °C).

1.3 Classification

1.3.1 Form

Form specifies the basic material form. For example:

Form 1: Unidirectional prepreg for hand layup applications
Form 2: Unidirectional prepreg tape for automated tape laying equipment
Form 3: Unidirectional prepreg tape for automated fiber placement
Form 4: Woven fabric prepreg for hand layup applications
Form 5: Woven fabric for automated tape laying equipment

1.3.2 Type

Type specifies the nominal prepreg resin content. For example:

Type 35: Nominal resin content 35% by weight

1.3.3 Class

Class specifies the basic fiber type used in the prepreg. For example:

Class 1: Intermediate modulus carbon fiber
Class 2: Standard modulus carbon fiber
Class 3: S-glass fiber
Class 4: E-glass fiber
Class 5: High modulus carbon fiber

1.3.4 Grade

Grade specifies nominal fiber areal weight in grams per square meter (gsm). For example:

Grade 190: 190 gsm nominal fiber areal weight

1.3.5 Style

Style defines the fiber filaments and construction of the fabric prepreg or lists the appropriate industry standard style (not applicable to non-fabric products). For example:

Style 6K-PW: 6000 filaments per yarn, plain weave
Style 108: Fiberglass fabric as defined in AMS3824, Style 108 with epoxy resin compatible finish
Style 7781: Fiberglass fabric as defined in AMS-C-9084, Type VIII B, Class 2

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 that 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.

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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 must 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.

1.6 Conversion of Values Between Inch-Pound and SI Units

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 must be directly converted per ASTM SI10 to determine an appropriate equivalent value between inch-pound units and SI units.

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 (U.S. and Canada only) or +1 724-776-4970 (outside U.S. and Canada), www.sae.org.

AMS3824	Cloth, Glass, Finished for Resin Laminates
AMS-C-9084	Cloth, Glass, Finished, for Resin Laminates
AS9100	Quality Management Systems - Requirements for Aviation, Space, and Defense Organizations
CMH-17	Composite Materials Handbook

2.1.1 Detail Specifications

AMS6891/1	Carbon Fiber and Fiberglass Epoxy Prepreg Products with 350 °F (177 °C) Cure for Aerospace Applications: Type 35, Class 1, Grade 191
AMS6891/2	Carbon Fiber and Fiberglass Epoxy/Prepreg Products with 350 °F (177 °C) Cure for Aerospace Applications: Type 40, Class 1, Grade 196, Style 6K-PW
AMS6891/3	Carbon Fiber and Fiberglass Epoxy/Prepreg Products with 350 °F (177 °C) Cure for Aerospace Applications: Type 34, Class 4, Grade 294, Style 7781
AMS6891/4	Carbon Fiber and Fiberglass Epoxy/Prepreg Products with 350 °F (177 °C) Cure for Aerospace Applications: Type 42, Class 4, Grade 48, Style 108

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

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ASTM D3530	Volatiles Content of Composite Material Prepreg
ASTM D3531	Standard Test Method for Resin Flow of Carbon Fiber-Epoxy
ASTM D3532	Gel Time of Carbon Fiber-Epoxy Prepreg
ASTM D6641	Compressive Properties of Polymer Matrix Composite Laminates Using a Combined Loading Compression (CLC) Test Fixture
ASTM D7028	Standard Test Method for Glass Transition Temperature (DMA Tg) of Polymer Matrix Composites by Dynamic Mechanical Analysis (DMA)
ASTM E29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM E168	General Techniques of Infrared Quantitative Analysis
ASTM E1252	Standard Practice for Obtaining Infrared Spectra for Qualitative Analysis
ASTM E1356	Assignment of the Glass Transition Temperatures by Differential Scanning Calorimetry
ASTM SI10	American National Standard for Metric Practice

2.3 ISO Publications

Copies of these documents are available online at www.iso.org/store.

ISO 14001:2015	Environmental Management System

2.4 Japanese Standards Association Publications

JIS Z7251	Labelling of Chemicals Based on GHS

2.5 SACMA Standards

Available from American Composites Manufacturers Association, 2000 N. 15th Street, Suite 250, Arlington, VA 22201, Tel: 703-525-0511, www.acmanet.org.

SACMA SRM 20R-94	High Performance Liquid Chromatography of Thermoset Resins

2.6 FAA Publications

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

DOT/FAA/AR-03/19	Material Qualification and Equivalency for Polymer Matrix Composite Material Systems
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

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2.7 Code of Federal Regulations (CFR) Publications

Copies of these documents are available online at www.ecfr.gov.

14 CFR Part 23 Airworthiness Standards: Normal, Utility, Acrobatic, and Commuter Category Airplanes

29 CFR 1910.1200 Hazard Communication, Occupational Safety and Health Standards

2.8 European Union Publications

Copies of these documents are available online at https://european-union.europa.eu.

2006/121/EC Directive 2006/121/EC of the European Parliament and of the Council

2.9 PRI Publications

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

PD2000 Governance and Administration of an Industry Managed Product Qualification Program

PD2001 Manufacturer Request for Product Approval and Qualification Process

2.10 Definitions

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.

AS MANUFACTURED: A condition that does not require additional conditioning steps prior to testing of a specimen.

BAG SIDE: The side of the panel that is cured against the vacuum bag.

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

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.

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

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

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

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

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 carbon fiber or resin constituents.

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FUZZ BALLS: The broken filaments and abraded particles that collect as loose filament bundles or balls that 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.

MAJOR CHANGE: As defined by DOT/FAA/AR-06/10 and DOT/FAA/AR-07/3.

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-storage time over which the material remains capable of demonstrating mechanical properties in 3.3 if laid up and compacted within its handling life. See Figure 3 for mechanical life.

PREPREG: In the context of this specification, prepreg is epoxy resin impregnated carbon fiber/fabric or glass fabric that, upon supply to composite parts fabricators, contains 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 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 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 must be reported/approved, and who approves (in writing) the PCD.

PRODUCT ROLL: See "ROLL."

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 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.

ROLL: A subunit of a prepreg batch in the final configuration delivered to the user that meets the size requirements in 5.2.

SELVAGE: The woven edge portion of a fabric parallel to the warp; usually has an increased number of ends/inch.

SMASH: A place in the fabric where a number of warp or filling yarns have been broken.

STORAGE LIFE: The time in storage at 10 °F (-12 °C) or below, while contained in sealed packaging, over which the prepreg material maintains its handling life, its mechanical life, as well as other requirements of this specification. See Figure 1.

STREAKS: Resin-rich or resin-starved areas on the prepreg surface.

SUPPLIER: The entity producing the material in this specification.

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SURFACE RESIN STARVATION: Incomplete resin coverage of fibers at the surface of the prepreg or laminate.

TOOL SIDE: The side of the panel that is cured against the tool surface.

USER: The entity utilizing the material in this specification. “Purchaser” or “processor” are types of users.

WARP: The roll length direction, continuous fibers from the warp loom set, etc. Also known as 0 degrees.

WRINKLE: A ridge or crease on a prepreg surface caused by crumpling or folding.

WORK LIFE: See Figure 1. The out-of-storage time over which the prepreg material maintains its tack and drape (between 45 and 65% relative humidity) prior to being incorporated into a part and remains capable of demonstrating the mechanical properties in this specification. Also known as application, assembly, or handling life.

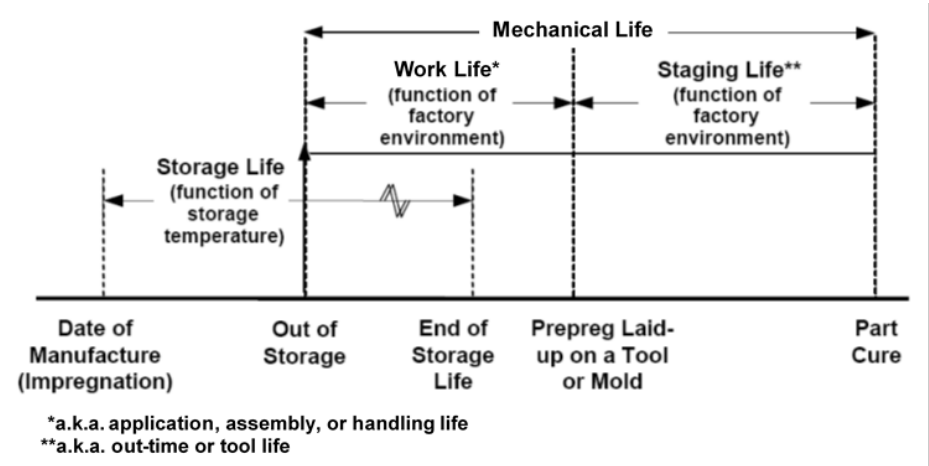

Figure 1 - Definitions of storage, handling, and staging life and out-of-storage time

3. MATERIAL REQUIREMENTS

3.1 General Requirements

3.1.1 Detail Specifications

The requirements for a specific fiber reinforced unidirectional tape and fabric epoxy prepreg product must consist of all requirements specified herein in addition to requirements specified in the applicable detail specification. In case of conflict between requirements of this basic specification and an applicable detail specification, requirements of the detail specification must govern.

3.1.2 Process Control Document (PCD)

The supplier must prepare and control a Process Control Document (PCD). The established PCD must be presented to the Qualifying Agency upon request. The Qualifying Agency must treat any information contained in the PCD as proprietary. Major changes to the PCD of a qualified material are subject to the written approval of the Qualifying Agency. 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.

3.1.3 Product Qualification

All products must conform to the requirements of this procurement specification and must be approved in accordance with the requirements of PD2000 and PD2001 for listing in a PRI Qualified Products List (QPL).

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3.2 Prepreg Requirements

3.2.1 Resin

The resin matrix used in the manufacture of prepreg to this specification must be 350 °F ± 10 °F (177 °C ± 5 °C) curing modified epoxy-based thermosetting resin, the components of which will be specified, tested, supplied, and processed in accordance with the PCD.

a. The resin must not produce any excessive health irritation/skin irritation when handled per the prepreg product Safety Data Sheet (SDS) and should not develop any emissions that require special environmental measurements during the processing of the prepreg product.

b. The resin composition, resin preparation, and processing of a product will be controlled by the PCD and evaluated during qualification.

c. Any major changes to the epoxy resin system after qualification must be reapproved by the Qualifying Agency.

3.2.2 Reinforcement

Reinforcement properties and corresponding test methods (including AMS requirements for the reinforcement where applicable) must be controlled by the PCD.

a. The reinforcement must be an approved constituent of the qualified prepreg material.

b. The finish or sizing is considered an integral part of the reinforcement.

c. The product quality must be evaluated during materials qualification and must be controlled by the PCD.

d. Any major changes to the reinforcement after qualification must be reapproved by the Qualifying Agency.

3.2.3 Visual Defect Limitations and Dimensional Requirement

3.2.3.1 General Requirements

The preimpregnated materials must be uniform in quality and condition, defined as:

a. It will not exhibit characteristics detrimental to handling, layup, or structural properties.

b. Material shall be free of resin-rich areas, resin-starved areas, dry or boardy areas, cured resin particles, and visible indications of moisture.

c. Prepreg material must be free from all foreign material, except as follows:

1. Random, sparse flecks of carrier material inherent to the prepreg manufacturing process are acceptable.

2. The flecks no greater than 0.031 inch (0.79 mm) in any direction are acceptable.

3. Random, sparse flecks from the core and/or carrier deposited on the edge of the prepreg roll are acceptable.

d. Fuzz balls may be acceptable, provided:

1. The fuzz balls do not cause apparent fiber distortion. This must be determined without removing the fuzz balls.

2. Fuzz ball does not exceed 1.5 inches (38.1 mm) in any direction.

3. The accumulated number of fuzz balls, of which the largest dimension is between 0.4 to 1.5 inches (10.2 to 38.1 mm), must not exceed six fuzz balls in any 10 square feet (0.93 m^2) of one side of the prepreg material.

4. The overall thickness change due to fuzz ball is no more than 50% of the prepreg material nominal thickness.

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e. Prepreg width must be specified on the purchase order. Please contact the supplier for available widths. Tolerances are as follows:

1. Form 1, 4: ±1.0 inch (±25 mm)

2. Form 2, 5: ±0.040 inch (±1.0 mm)

3. Form 3: ±0.005 inch (±0.13 mm)

3.2.3.2 Material Requirements - Form 1, 2, 3

a. The orientation of the fiber within the unidirectional tape must not deviate from a straight line by more than 0.025 inch (0.64 mm) per linear foot (0.3 m). The edges of the tape must not deviate from a straight line by more than 0.03 inch (0.76 mm) per linear foot (0.3 m).

b. The accept/reject criteria for gaps are as follows:

1. Less than 0.010 inch (0.25 mm) wide and less than or equal to 10 inches (254 mm) long: Acceptable.

2. Between 0.010 and 0.030 inch (0.25 and 0.76 mm) wide and less than or equal to 10 inches (254 mm) long: Acceptable if limited to one per 10 square feet (0.93 m^2) of prepreg.

3. Exceed 10 inches (254 mm) in length or 0.030 inch (0.76 mm) in width: Reject.

c. The accept/reject criteria for puckers in the unrolled condition are as follows:

1. Less than 0.25 inch (6.4 mm): Acceptable.

2. 0.25 to 0.50 inch (6.4 to 13 mm): Acceptable if less than three per square foot.

3. Greater than 0.5 inch (13 mm): Reject.

3.2.3.3 Material Requirements - Form 4, 5

a. The warp yarns must be parallel to the warp direction of the preimpregnated cloth within 1.0 inch (25 mm) in any 21.0 inches (533 mm).

b. The fill yarns must be perpendicular to the warp yarns of the preimpregnated cloth within 1.0 inch (25 mm) per 21.0 inches (533 mm) of the cloth width.

c. For fiberglass reinforced styles, localized color difference or streaks are acceptable when shown to result from differences in surface gloss or texture, which are not perceptible from a distance of 10 feet (3.05 m), under indirect lighting conditions

3.2.4 Materials Nonconforming to the Visible Defect Limitations and Dimensional Requirements

a. In cases where foreign material or resin-rich areas can be removed without causing any apparent deformation of the prepreg surface, it may be removed by a tool or adhesive tape. The tool or adhesive tape must not transfer any contaminants to the prepreg product.

b. Prepreg material must have a roll maximum defect quantity of 15% by length or weight. Defect weight limit must be based on full-width material.

c. Prepreg may be cut and spliced to remove defects. Prepreg splicing must be in accordance with splicing procedure documented in the PCD.

d. Defective areas, considered as the length of the defect multiplied by the width of the roll, must not be counted toward the amount purchased.

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