



AEROSPACE MATERIAL SPECIFICATION

AMS3961™/2

Issued

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350 °F Autoclave Cure, Low Flow Toughened Epoxy Prepregs,
Type 35, Class 1, Grade 190, Fiber 2

RATIONALE

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

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1. SCOPE

The intent of this specification is for the procurement of the material listed on the QPL and, therefore, no qualification or equivalency threshold values are provided. Users that intend to conduct a new material qualification or equivalency program shall refer to the Quality Assurance section of the base specification, AMS3961.

All material qualification and equivalency data has been archived and is available for review upon request. Contact the CMH-17 Secretariat (www.cmh17.org) for additional information.

1.1 Form

This detail specification along with the base specification, AMS3961, establish the requirements for continuous unidirectional carbon fiber impregnated with a modified B-staged epoxy resin ("unidirectional tape prepreg"). The prepreg is produced using a hot-melt process.

1.2 Classification

1.2.1 Reinforcement

This reinforcement classification consists of the following Styles and Grades.

1.2.1.1 Style shall specify the carbon fiber tow twist. For example, Style NT – Never Twisted Tow

NT is the default style. When style is not specified in purchase order, Style NT shall be supplied.

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1.2.1.2 Grade shall specify the carbon fiber tow size (i.e., the nominal number of filaments in a tow or nominal filament count), where 1K denotes 1,000 filaments. For example, Grade 12K – 12,000 filaments in a tow.

All Prepreg products qualified to this detail specification have the following classification: Type 35, Class 1, Grade 190, Fiber 2.

1.2.2 Prepreg

All Prepreg products qualified to this detail specification have the following classification: Type 35, Class 1, Grade 190, Fiber 2, ST.

1.2.2.1 Type

Type shall specify the nominal prepreg resin content. For example: Type 35 – Nominal resin content 35% by weight.

1.2.2.2 Class

Class shall specify prepreg product form. For example: Class 1 – Unidirectional carbon fiber prepreg.

1.2.2.3 Grade

Grade shall specify nominal fiber areal weight in grams per square meter (gsm). For example: Grade 190 to 190 gsm nominal fiber areal weight.

1.2.2.4 Fiber Type

The carbon fiber type is designated as follows: Fiber 2: Intermediate Modulus (38-42 Msi).

1.2.2.5 Service Temperature Capability

The service temperature capability, used to establish the batch acceptance test temperature requirements, shall be designated as follows:

ST (Standard Temperature) - service temperature of -65 to 180 °F – All batch acceptance testing shall be performed at room temperature dry (70 ° ± 10 °F)

ET (Elevated Temperature) – service temperature of -65 to 250 °F – A portion of the batch acceptance tests shall be performed at elevated temperature dry (250 °F ± 10 °F).

Note: If no service temperature capability is identified in the product nomenclature, then “ST” shall be the default designation

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.

Base Specification

AMS3961 350 °F Autoclave Cure, Low Flow Toughened Epoxy Prepregs (Base Specification)

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 D1423	Standard Test Method for Twist in Yarns by Direct-Counting
ASTM D4018	Standard Test Methods for Properties of Continuous Filament Carbon and Graphite Fiber Tows
ASTM D2344	Short-Beam Strength of Polymer Matrix Composite Materials and their Laminates
ASTM D3039	Tensile Properties of Polymeric Matrix Composite Materials
ASTM D3529/D 3529M	Matrix Solids Content and Matrix Content of Composite Prepreg
ASTM D3530/D 3530M	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 D3776	Mass per Unit Area (Weight) of Fabric
ASTM D6641	Compressive Properties of Polymer Matrix Composite Laminates Using a Combined Loading Compression (CLC) Test Fixture
ASTM E168	General Techniques of Infrared Quantitative Analysis
ASTM E1252	Standard Practice for Obtaining Infrared Spectra for Qualitative Analysis

2.3 OSHA Publications

Available from U.S. Department of Labor/OSHA, 200 Constitution Avenue, Washington, DC 20210, Tel: 800-321-6742, www.osha.gov/pls/publications/pubindex.list.

29CFR-1910.1200 Hazard Communication

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)
SACMA SRM 14R-94	SACMA Recommended Method for Determination of Sizing Content on Carbon Fibers

2.5 Definitions

For definitions that are not provided in this specification or other applicable 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.

BASE SPECIFICATION - A specification containing the basic requirements for a carbon fiber and prepreg material system. The base specification is used in combination with a detail specification to create the unique requirements for a carbon fiber and prepreg product.

CARBON OR GRAPHITE FIBER - Interchangeable terms used for continuous filament strands produced in accordance with this specification. Typically, graphite fiber is processed at temperature above 2,000 °C, all standard and intermediate modulus carbon fiber is processed below 1,600 °C.

CARBON FIBER LOT - See 3.2.2.10.

CARBON FIBER TOW - An untwisted, never twisted or twisted bundle of continuous carbon filaments.

DATE OF MANUFACTURE - The date (day or month) a lot of fiber (carbon or PAN) is manufactured. If the production run extends into the following month, the start date (day or month) is recorded.

DETAIL SPECIFICATION - A specification containing requirements that is used in combination with a base specification to create the unique requirements for a fiber product.

DOFF (noun) - All spools of fiber within a lot that are taken off the take-up winders within a given time period. A unique doff number is typically assigned to the spools. However, some manufacturers do not assign doff numbers because the spools are doffed independently when they reach the correct weight during production.

DOFF (verb) - To remove spools of fiber from the take-up winders.

DOFF AVERAGE - The average of test results for all specimens tested from the same doff sample.

DOFF SAMPLE - A fiber tow sample removed from the take-up winders in accordance with SACMA SRM 12. Doff sample zero (0) is the sample taken at start-up.

DOWN SPOOLING - A procedure that creates multiple spools from a single spool.

FOREIGN MATERIALS - All materials not characteristic of the product, such as materials that are not carbon fiber or not PAN fiber.

NEVER TWISTED TOW - A tow that has never been twisted; denoted by the symbol "NT."

POLYACRYLONITRILE (PAN) - A polymer used as a precursor product for carbon fiber production.

PAN LOT - PAN fiber manufactured in a single production run on the same equipment within a defined set of process parameters.

PURCHASER - Any organization that procures product in conformance to this basic specification and its associated detail specification.

QUALIFIED PRODUCT LIST - Qualified product list established for a given detail material specification.

RE-SPOOLING - A procedure that creates a single spool from multiple spools. Also a procedure that winds material from a single spool onto a different (sometimes smaller or larger diameter) spool.

RUN - (As used in fiber production) a continuous (uninterrupted) manufacturing process in which carbon fiber is produced.

SIZING - A polymeric coating applied to carbon fiber tows to improve adhesion to resin systems and handling characteristics for subsequent processes (for example, weaving, or impregnation).

SPLICE - A tow that has been cut or broken and subsequently had the ends rejoined.

MANUFACTURER - The organization manufacturing and certifying production to this specification.

MANUFACTURER PRODUCT DESIGNATION - The identification or name given to the product by the manufacturer.

SURFACE TREATMENT - A treatment applied to fiber to improve the bond between the fiber surface and the resin matrix in a composite material.

TOW - A strand of continuous fibers carbon fibers are supplied in the form of tows. A tow can nominally contain from 500 to 48,000 carbon fiber filaments. Typical tow counts (number of filaments within a tow) are 3,000 (or 3K), 6,000 (or 6K), 12,000 (or 12K), and 24,000 (or 24K). Larger tows are also available but not commonly used in aerospace applications.

TRANSITION MATERIAL - Material which is removed from the line during non-steady-state production because of process interruptions or start-up.

TWISTED TOW - Tow with intentional twist in its final form; denoted by the symbol "TT" or "ST".

UNTWISTED TOW - Previously twisted tow that has had its twist removed in its final form; denoted by the symbol "UT."

WINDERS - Equipment used to collect the carbon fiber on the spool cores at the end of the carbon fiber conversion processes (end of the carbon fiber line). Also known as take-up winders.

3. TECHNICAL REQUIREMENTS

3.1 General Requirements

In case of conflict between requirements of the basic specification and this detail specification, requirements of this detail specification shall govern.

3.2 Constituent Material Requirements

3.2.1 Epoxy Resin System

Up to 15% resin blending is allowed per resin batch.

3.2.2 Reinforcement

3.2.2.1 Carbon Fiber Tow Composition

Carbon fiber tows shall be composed of carbon filaments manufactured from polyacrylonitrile (PAN) precursor. All raw material ingredients and auxiliary materials used in the manufacture of carbon fibers shall be controlled by material or procurement specifications. The carbon fiber manufacturer shall ensure that the PAN manufacturer produces uniform and consistent PAN fiber precursor within the PCD control limits. These controls shall include constituent ingredients and ratios, PAN lot definition, and shelf life requirements. A fiber lot must contain 85% PAN from a single lot; blending is permitted from up to three additional PAN lots not to exceed 15% of the tows in the lot.

3.2.2.2 Fiber Surface Treatment

Carbon fiber tow may be surface treated to enhance the fiber/matrix interface of the composite material. The surface treatment methods and levels, if used during the material qualification program, shall be considered an integral part of the qualified product and cannot be changed without prior approval from the Qualifying Agency.