



# AEROSPACE MATERIAL SPECIFICATION

AMS3970™/6

Issued 2011-04  
Reaffirmed 2016-12

Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing  
Part 6 - Material Specification: Carbon Fiber Fabric Reinforced Epoxy Prepreg  
for Repair, Plain Weave Fabric, 193 g/m2, Adhesive Film for Repair and  
Non-Structural Glass Fiber Fabric  
Reinforced Epoxy Prepreg, 105 g/m2

## RATIONALE

AMS3970/6 has been reaffirmed to comply with the SAE five-year review policy.

## FOREWORD

This Material Specification (MS), AMS3970/6, belongs to the Technical Specification system explained in AMS3970.

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## 1. SCOPE

This Material Specification defines the requirements of carbon fiber reinforced epoxy prepreg for repair, 120 °C (250 °F) Vacuum curing, Plain Weave Fabric, 193 g/m<sup>2</sup> and a companion non-structural glass fiber fabric reinforced epoxy prepreg, 105 g/m<sup>2</sup>, qualified according to AMS3970/1 and AMS3970/2 for aerospace application.

The prepreg system may include an epoxy film adhesive to be applied in a co-curing process with the prepreg for joint and sandwich bonding. The need for a film adhesive shall be established during screening tests. If included, the requirements to be met by the adhesive are also defined in this document.

### 1.1 Field of Application

This document is only applicable to epoxy or modified epoxy resin prepreg systems used for repair of carbon fiber composite structures and a companion non-structural glass fiber fabric prepreg. Generally, an epoxy or modified epoxy resin film adhesive will be part of the prepreg system for co-cure bonding applications.

## 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 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

|            |                                                                                                                                                                                     |
|------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| AMS3970    | Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing, Part 0 - Introduction                                                                                            |
| AMS3970/1  | Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing, Part 1 - General Requirements                                                                                    |
| AMS3970/2  | Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing, Part 2 - Qualification Program for Fiber, Fabric, Carbon Prepreg, Film Adhesive and Non-Structural Glass Prepreg |
| AMS3970/3  | Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing, Part 3 - Purchasing Specification for Carbon Prepreg                                                             |
| AMS3970/4  | Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing, Part 4 - Purchasing Specification for Film Adhesive                                                              |
| AMS3970/5  | Carbon Fiber Fabric Repair Prepreg, 120 °C (250 °F) Vacuum Curing, Part 5 - Purchasing Specification for companion Non-Structural Glass Fiber Fabric Prepreg                        |
| AMS-C-9084 | Cloth, Glass, Finished for Resin Laminates                                                                                                                                          |

## 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](http://www.astm.org).

|                     |                                                                                                                                                         |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| ASTM C 297          | Standard Test Method for Flatwise Tensile Strength of Sandwich Constructions                                                                            |
| ASTM C 393          | Standard Test Method for Flexural Properties of Sandwich Constructions                                                                                  |
| ASTM D 1002         | Standard Test Method for Apparent Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)                    |
| ASTM D 2344/D 2344M | Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates                                                  |
| ASTM D 3039/D 3039M | Standard Test Method for Tensile Properties of Polymer Matrix Composite Materials                                                                       |
| ASTM D 3518/D 3518M | Standard Practice for In-Plane Shear Response of Polymer Matrix Composite Materials by Tensile Test of a $\pm 45^\circ$ Laminate                        |
| ASTM D 3529/D 3529M | Standard Test Method for Matrix Solids Content and Matrix Content of Composite Prepreg                                                                  |
| ASTM D 3530/D 3530M | Standard Test Method for Volatile Content of Composite Material Prepreg                                                                                 |
| ASTM D 3531         | Standard Test Method for Resin Flow of Carbon Fiber-Epoxy Prepreg                                                                                       |
| ASTM D 3532         | Standard Test Method for Gel Time of Carbon Fiber-Epoxy Prepreg                                                                                         |
| ASTM D 3776         | Standard Test Method for Mass per Unit Area (Weight) of Fabric                                                                                          |
| ASTM D 3933         | Standard Guide for Preparation of Aluminum Surfaces for Structural Adhesives Bonding (Phosphoric Acid Anodizing)                                        |
| ASTM D 4440         | Standard Practice for Rheological Measurement of Polymer Melts Using Dynamic Mechanical Procedures                                                      |
| ASTM D 5528/D 5528M | Standard Test Method for Mode I Interlaminar Fracture Toughness of Unidirectional Fiber-Reinforced Polymer Matrix Composites                            |
| ASTM D 5229/D 5229M | Standard Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials                              |
| ASTM D 5656         | Standard Test Method for Thick-Adherend Metal Lap-Shear Joints for Determination of the Stress-Strain Behavior of Adhesives in Shear by Tension Loading |
| ASTM D 5766/D 5766M | Standard Test Method for Open Hole Tensile Strength of Polymer Matrix Composite Laminates                                                               |
| ASTM D 5961/D 5961M | Standard Test Method for Bearing Response of Polymer Matrix Composite Laminates                                                                         |
| ASTM D 7137/D 7137M | Standard Test Method for Compressive Residual Strength Properties of Damaged Polymer Matrix Composite Plates                                            |
| ASTM E 1252         | Standard Practice for General Techniques for Qualitative Infrared Analysis                                                                              |
| ASTM E 1640         | Standard Test Method for Assignment of the Glass Transition Temperature by Dynamic Mechanical Analysis                                                  |

## 2.3 ISO Publications

Available from International Organization for Standardization, 1, rue de Varembe, Case postale 56, CH-1211 Geneva 20, Switzerland, Tel: +41-22-749-01-11, [www.iso.org](http://www.iso.org).

- |             |                                                                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISO 1183    | Density and Relative Density of Non-Cellular Plastics                                                                                                                             |
| ISO 11357-2 | Plastics - Differential Scanning Calorimetry (DSC) - Part 2: Determination of Glass Transition Temperature                                                                        |
| ISO 11357-5 | Plastics - Differential Scanning Calorimetry (DSC) - Part 5: Determination of Characteristic Reaction-Curve Temperatures and Times, Enthalpy of Reaction and Degree of Conversion |

## 2.4 EN Publications

Available from CEN-committee, European de Normalisation, Secretariat Central, Rue de Stassart 36, B-1050 Bruxelles, Belgium or [www.cenorm.be](http://www.cenorm.be).

- |         |                                                                                                                                                                             |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EN 2329 | Aerospace Series: Textile Glass Fibre Preimpregnates, Test Method for the Determination of Mass per Unit Area                                                               |
| EN 2330 | Aerospace Series: Textile Glass Fibre Preimpregnates, Test Method for the Determination of the Content of Volatile Matter                                                   |
| EN 2331 | Aerospace Series: Textile Glass Fibre Preimpregnates, Test Method for the Determination of the Resin and Fibre Content and the Mass of Fibre per Unit Area                  |
| EN 2489 | Aerospace serie, Fibre Reinforced Plastics, Determination of the Action of Test Fluids                                                                                      |
| EN 2557 | Aerospace Series: Carbon Fibre Preimpregnates, Test Method for the Determination of Mass per Unit Area                                                                      |
| EN 2558 | Aerospace Series: Carbon Fibre Preimpregnates, Test Method for the Determination of the Percentage of Volatile Matter                                                       |
| EN 2559 | Aerospace Series: Carbon Fibre Preimpregnates, Test Method for the Determination of the Resin and Fibre Content and the Mass of Fibre per Unit Area                         |
| EN 2560 | Aerospace Series: Carbon Fibre Preimpregnates, Test Method for the Determination of the Resin Flow                                                                          |
| EN 2561 | Aerospace Series: Unidirectional Laminates, Carbon Thermosetting Resin, Tensile Test Parallel to the Fiber Direction                                                        |
| EN 2563 | Aerospace Series: Carbon Fibre Reinforced Plastics, Unidirectional Laminates, Determination of Apparent Interlaminar Shear Strength                                         |
| EN 2850 | Aerospace Series: Fibre Reinforced Plastics, Testing Unidirectional Laminates and Woven Fabric Laminates, Compression Test                                                  |
| EN 3615 | Aerospace Series: Fibre Reinforced Plastics, Procedure for the Determination of the Conditions of Exposure to Humid Atmosphere and the Determination of Moisture Absorption |
| EN 6031 | Aerospace Series: Fibre Reinforced Plastic, Determination of In-Plane Shear Properties ( $\pm 45^\circ$ Tensile Test)                                                       |

|         |                                                                                                                                      |
|---------|--------------------------------------------------------------------------------------------------------------------------------------|
| EN 6032 | Aerospace Series: Determination of Glass Transition Temperature (DMA).                                                               |
| EN 6033 | Aerospace Series: Carbon Fibre Reinforced Plastics, Determination of the Interlaminar Fracture Toughness Energy - Mode I - G1c Test  |
| EN 6034 | Aerospace Series: Carbon Fibre Reinforced Plastics, Determination of the Interlaminar Fracture Toughness Energy - Mode II - G2c Test |
| EN 6035 | Aerospace Series: Fiber Reinforced Plastics, Determination of Notched and Unnotched Tensile Strength                                 |
| EN 6036 | Aerospace Series: Fibre Reinforced Plastics, Test Method, Determination of Notched, Unnotched and Filled Hole Compression Strength   |
| EN 6037 | Aerospace Series: Fibre Reinforced Plastics, Test Method, Determination of Bearing Strength                                          |
| EN 6038 | Aerospace Series: Fibre reinforced plastics, Test method, Determination of the compression strength after impact                     |
| EN 6040 | Aerospace Series: Analysis of Non-Metallic Materials (Uncured) by High Performance Liquid Chromatography (HPLC)                      |
| EN 6041 | Aerospace Series: Analysis of Non-Metallic Materials (Uncured) by Differential Scanning Calorimetry (DSC)                            |
| EN 6042 | Aerospace Series: Analysis of Organic Compounds by Infrared Spectroscopy                                                             |
| EN 6043 | Aerospace Series: Fibre Reinforced Plastics, Determination of Gel Time and Viscosity                                                 |
| EN 6060 | Aerospace Series: Fiber Reinforced Plastics, Tensile Lap Shear Test                                                                  |
| EN 6061 | Aerospace Series: Fibre Reinforced Plastics, Test method, Determination of sandwich flexural strength 4 point bending                |
| EN 6062 | Aerospace Series: Fibre Reinforced Plastics, Flatwise Tensile Test of Composite Sandwich Panel                                       |
| EN 6064 | Aerospace Series: Analysis of Non-Metallic Materials (Cured) for the Determination of the Extent of Cure by DSC                      |
| EN 6066 | Aerospace Series: Fibre Reinforced Plastics, Determination of Stepped and Tapered Joint Strength                                     |

## 2.5 SACMA Publications

Available from American Composites Manufacturers Association, 1010 North Glebe Road, Suite 450, Arlington, VA 22201 or [www.acmanet.org](http://www.acmanet.org).

|                  |                                                                            |
|------------------|----------------------------------------------------------------------------|
| SACMA SRM 1R-94  | Compression Properties of Oriented Fiber-Resin Composites                  |
| SACMA SRM 3R-94  | Open Hole Compression Properties of Oriented Fiber-Resin Composites        |
| SACMA SRM 4R-94  | Tensile Properties of Oriented Fibre-Resin Composites                      |
| SACMA SRM 5R-94  | Open Hole Tensile Properties of Oriented Fibre-Resin Composites            |
| SACMA SRM 7R-94  | In-Plane Shear Stress-Strain Properties of Oriented Fibre-Resin Composites |
| SACMA SRM 20R-94 | High Performance Liquid Chromatography of Thermoset Resins                 |

## 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](http://www.pri-network.org).

PRI QPL AMS3970      Qualified Product List of AMS3970

## 3. DEFINITIONS

Refer to AMS3970/1.

## 4. REQUIREMENTS

### 4.1 General Requirements

#### 4.1.1 Material Description

TABLE 1 - CARBON FIBER REINFORCED EPOXY PREPREG MATERIAL DESCRIPTION

| No. | Material description    | Requirements                                    |
|-----|-------------------------|-------------------------------------------------|
| 1.1 | Material type           | Carbon fiber reinforced epoxy prepreg           |
| 1.2 | Fiber                   | Carbon fiber, standard modulus                  |
| 1.3 | Fabric                  | Carbon fiber, plain weave, 193 g/m <sup>2</sup> |
| 1.4 | Resin                   | Epoxy                                           |
| 1.5 | Technical specification | AMS3970/1<br>AMS3970/2                          |

TABLE 2 - ADHESIVE FILM MATERIAL DESCRIPTION

| No. | Material description                   | Requirements                                      |
|-----|----------------------------------------|---------------------------------------------------|
| 2.1 | Material type                          | Adhesive film for repair                          |
| 2.2 | Formulation                            | Adhesive: epoxy based<br>Carrier: organic polymer |
| 2.3 | Mass per unit area (g/m <sup>2</sup> ) | 250                                               |
| 2.4 | Carrier type                           | Non woven scrim or knit                           |
| 2.5 | Technical specification                | AMS3970/1<br>AMS3970/2                            |

TABLE 3 - NON-STRUCTURAL GLASS FIBER REINFORCED EPOXY PREPREG MATERIAL DESCRIPTION

| No. | Material description    | Requirements                                       |
|-----|-------------------------|----------------------------------------------------|
| 3.1 | Material type           | Glass fiber reinforced epoxy prepreg               |
| 3.2 | Fiber                   | Glass fiber, type E                                |
| 3.3 | Fabric                  | Style 120 Satin weave AMS-C-9084 Type III, Class 2 |
| 3.4 | Finish                  | Epoxy compatible                                   |
| 3.5 | Resin                   | Epoxy                                              |
| 3.6 | Technical specification | AMS3970/1<br>AMS3970/2                             |

## 4.1.2 Cure Cycle

TABLE 4 - CARBON FIBER REINFORCED EPOXY PREPREG CURE CYCLE (1), (2)

| No.                                                                                                                                                                                                                                                                                                                                                                                                               | Cure parameters  | Units     | Requirements      |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|-----------|-------------------|
| 4.1                                                                                                                                                                                                                                                                                                                                                                                                               | Heating rate     | ° C / min | 1 to 3            |
| 4.2                                                                                                                                                                                                                                                                                                                                                                                                               | Cure temperature | ° C       | ≥120              |
| 4.3                                                                                                                                                                                                                                                                                                                                                                                                               | Cure time        | min       | (3)(4)            |
| 4.4                                                                                                                                                                                                                                                                                                                                                                                                               | Cure pressure    | KPa       | Under vacuum > 70 |
| 4.5                                                                                                                                                                                                                                                                                                                                                                                                               | Cooling rate     | ° C / min | 5 max             |
| (1) If film adhesive is part of the prepreg system, the carbon prepreg cure cycle shall be also suitable for the cure of the film adhesive<br>(2) The carbon prepreg cure cycle shall be also suitable for the cure of the non - structural glass prepreg<br>(3) Specific parameters values to be defined during qualification and recorded in the relevant Appendix of PRI QPL AMS3970<br>(4) Target value < 240 |                  |           |                   |