

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 3970/3

Issued

DEC 1999

Carbon Fiber Fabric Repair Prepreg, 125 °C (250 °F) Vacuum Curing Part 3 - Purchasing Specification for Epoxy Prepreg

FOREWORD

AMS 3970/3 belongs to the Technical Specification system explained in AMS 3970.

TABLE OF CONTENTS

1.	SCOPE	2
1.1	Limitation	2
2.	REFERENCES	2
2.1	SAE Publications	2
2.2	ASTM Publications	3
2.3	ISO Publications	3
2.4	EN Publications	3
3.	DEFINITIONS	3
4.	REQUIREMENTS	3
4.1	Defects	4
4.2	Defect Credit	4
5.	RELEASE TESTING	4
5.1	General	4
5.2	Release Testing	4
5.3	Release Test Certificate	5
5.4	Retest	6
5.5	Rejection	6
5.6	Warranty	6
5.7	Audit	6
5.8	Sampling	7

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright 1999 Society of Automotive Engineers, Inc.
All rights reserved.

Printed in U.S.A.

QUESTIONS REGARDING THIS DOCUMENT:
TO PLACE A DOCUMENT ORDER:
SAE WEB ADDRESS:

(724) 772-7154
(724) 776-4970
<http://www.sae.org>

FAX: (724) 776-0243
FAX: (724) 776-0790

TABLE OF CONTENTS (Continued)

6.	PREPARATION FOR DELIVERY	8
6.1	Packing	8
6.2	Marking	9
6.3	Shipment.....	10
7.	RECEIPT OF MATERIAL	11
7.1	Material Receipt.....	11
8.	HEALTH, SAFETY AND ENVIRONMENT.....	11
FIGURE 1	Batch Release for Uncured Prepreg - Physical and Physiochemical Properties.....	5
FIGURE 2	Batch Release for Composite (Cured Prepreg) - Mechanical Properties	5
FIGURE 3	Number of Units to be Tested Per Batch.....	8

1. SCOPE:

AMS 3970/3 specifies the batch release and delivery requirements for carbon fiber fabric epoxy prepreg used for repair.

1.1 Limitation:

This specification relates to qualified carbon fiber fabric epoxy prepreg listed in the associated QPL.

2. REFERENCES:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order unless otherwise specified.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 3970 Carbon Fiber Fabric Repair Prepreg, 125 °C (250 °F) Vacuum Curing Part 0 - Introduction

AMS 3970/1 Carbon Fiber Fabric Repair Prepreg, 125 °C (250 °F) Vacuum Curing Part 1 - General Requirements

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM D 3990 Terminology Relating to Fabric Defects

2.3 ISO Publications:

Available from ISO, Central Secretariat, 1 rue de Varembe, Case postale 56, CH-1211 Geneve 20, Switzerland

ISO 1890	Carbon Fiber – Twist
ISO 10119	Carbon Fiber – Density
ISO 10120	Carbon Fiber – Linear Density
ISO 10548	Carbon Fiber – Size Content
ISO 10618	Carbon Fiber – Tensile Properties by Resin Impregnated Yarn Specimens

2.4 EN Publications:

Available from CEN-comite, Europeen de Normalisation, Secretariat Central, Rue de Stassart 36, B-1050 Bruxelles, Belgium

EN 2557	Aerospace Series: Carbon fibre preimpregnates Test method for the determination of mass per unit area
EN 2560	Aerospace Series: Carbon fibre preimpregnates Test method for the determination of the resin flow
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)

3. DEFINITIONS:

Refer to AMS 3970/1.

4. REQUIREMENTS:

The prepreg to be delivered shall meet the general requirements in accordance with AMS 3970/1 and the requirements of this PS and the IPS of the material to be purchased.

4.1 Defects:

Definition of defect description terms are per ASTM D 3990.

Defects are defined in AMS 3970/1.

A defect area is defined as the length of the defect, if that defect exceeds specified limits, multiplied by the roll width. The cumulative defective area in a roll shall not exceed 10% of the roll area.

All defects within a length of one linear meter are counted as one defective area. 3

Each defect shall be identified and flagged with colored mark positioned on the roll.

A continuous defect shall be identified with a colored mark at the start and with a different colored mark at the end of the defect.

Each roll shall have a defect record attached, recording the type, location and length of each defect (if any) in that roll.

4.2 Defect Credit:

Defective areas as defined in AMS 3970/1 shall not be considered as part of the total length of the roll or its weight. The purchaser shall not be charged for any defective area. In addition, credit shall be given to the purchaser by the prepreg manufacturer for any manufacturing defect of the delivered material discovered during use that had not been previously identified and credited.

5. RELEASE TESTING:

5.1 General:

Products shall be manufactured in accordance with the manufacturing schedule of qualification and revisions agreed upon by the PRI.

5.2 Release Testing:

Release testing shall consist of tests given in Figures 1 and 2. The test results shall demonstrate compliance with the technical requirements of this PS and the relevant MS and IPS.

Release testing shall be the responsibility of the manufacturer. The test samples extracted should be representative of the entire prepreg batch delivered in accordance with this specification. Refer to 5.8 for the number of samples required based on the size of the batch. A minimum of one unit per batch of the mechanical properties tests (Figure 2) shall be tested by an independent laboratory contracted by the manufacturer. The independent laboratory must be approved by the PRI.

The purchaser reserves the right to perform any of the inspections and/or tests required by this specification and may reject any material which fails to meet the requirements. When required, the manufacturer shall inform the purchaser or his chosen agent of the planned dates for the extraction of samples and release testing, in order that these operations may be witnessed.

id	Property	Number of Samples Per Unit ¹	Test Method ²
1.1	Mass per Unit Area	3	EN 2557
1.2	Volatile Content	3	In accordance with IPS
1.3	Resin Content	3	In accordance with IPS
	Mass per unit area dry fabric		
1.4	Resin Flow	3	EN 2560
1.5	Tack	3	In accordance with IPS
1.6	DSC - uncured	3	EN 6041
1.7	HPLC	3	EN 6040
1.8	Infrared	3	In accordance with IPS

¹ Number of units to be tested is dependent on the batch size and is defined in 5.8.

² Methods for id 1.2, 1.3, 1.5, and 1.8 are specified in the relevant IPS.

Note: Test results shall meet the requirements specified in the relevant IPS.

FIGURE 1 - Batch Release for Uncured Prepreg - Physical and Physiochemical Properties

id	Property	Number of Samples Per Unit ¹	Test Environment	Test Method
2.1	Tensile Weft σ_x^t , Ex^t	6	RT/Dry	AMS 3970/1
2.2	Compression Weft σ_x^c , Ex^c	6	RT/Dry	AMS 3970/1
2.3	Compression Weft σ_x^c , Ex^c	6	80°C/Dry	AMS 3970/1

¹ Number of units to be tested is dependent on the batch size and is defined in 5.8.

Note: Test results shall meet the requirements specified in the relevant IPS.

FIGURE 2 - Batch Release for Composite (Cured Prepreg) - Mechanical Properties

5.3 Release Test Certificate:

The manufacturer shall provide the purchaser with a test report certifying that the prepreg batch meets the general requirements in accordance with AMS 3970/1 and the requirements of this PS and the IPS of the material to be purchased.

The prepreg release test report shall contain at least the following:

Specification and IPS number

Manufacturer's batch number and production date

Manufacturer's identification

List of defects traceable to each individual roll

Fiber designation of fabric manufacturer, batch number(s), bobbin numbers

Test results

5.4 Retest:

If batch release test data fails to meet the requirements of this PS and/or the IPS, a review of all test results, test procedures, specimen manufacturing and test specimen(s) shall be performed. If a cause for discrepancy is found, retests shall be performed on the same roll and either the preceding or the next roll. The material may be retested one time. The results of the original test, together with those of the retest and the reasons for the first failure shall be included in the test report.

When failure cannot be attributed to faulty testing, or test piece preparation, additional test samples shall be selected at twice the original frequency from products on which the incorrect results were obtained unless already withdrawn by the manufacturer after suitable identification of the cause of failure. If all retest results are satisfactory, the batch shall be accepted. If one or more retest results are unsatisfactory, the batch shall be:

- a. Rejected, or
- b. 100% retested and the conforming products accepted

5.5 Rejection:

Any failure of the prepreg to meet the batch release requirements of this specification shall be cause for rejection of the material. Any defect not detected during acceptance inspection, but which becomes apparent during the subsequent use of the material, shall be cause for rejection of the unused portion of the batch, provided such a defect is cause for rejection under the requirements of this specification.

5.6 Warranty:

Each production batch or shipment, whichever is smaller, of the qualified material submitted to this PS shall be warranted through a release test certificate by the manufacturer and/or supplier to meet the requirements of this PS and the relevant MS and IPS.

The manufacturer and/or supplier shall also warrant that the raw materials and processes used in manufacture of the subsequent production batches or shipment are the same in type, form and quality as those used for the qualification.

5.7 Audit:

PRI retains the right to audit the manufacturing process of a qualified product at certain intervals. Audits will be performed in accordance with the IPS. The manufacturer shall make available all necessary documents, records and supporting information with regard to the material manufacture for inspection by representatives of PRI. A non-disclosure agreement can be established between the PRI and the manufacturer if required.

5.8 Sampling:

5.8.1 Sampling - Mechanical and Physical Tests: A sample unit is defined as a quantity of impregnated material with a surface area not exceeding 175 m², independent of the width and the mass per unit area of that impregnated material. The number of units to be tested in relation to the number of units in a batch is given in Figure 3.

The unit number to be sampled shall be in accordance with the following:

- a. two units sampled: First and last roll
- b. more than 2 units sampled: First and every $\frac{n}{x-1}$ (to the lowest whole number)

where: n is the number of units in the batch (batch total area / 175 m²)

x is the number of units to be tested

Note: Out of each determined test unit only one roll has to be tested.

Example: n = 35 → x = 5 (Refer to Figure 3)

Take the first and every $\frac{35}{5-1}$ (to the lowest whole number)

Units to be tested: 1, 8, 16, 24 and 32.

For prepreg fabric material produced in accordance with case 1:3 (up to 3 fiber batches in the weft direction, refer to AMS 3970/1, 4.2.2.1) the sampling has to assure that at least one sample is taken from each fiber batch in the weft direction. The calculated units have to be modified accordingly or additional samples have to be selected. Unit numbers are to be chosen in the sequence of production.

Number of Units In Batch ¹ , (n)	Number of Units Tested, (x)	
	Normal ²	Statistical ²
1 to 3	1	each
4 to 15	2	3
16 to 25	4	4
26 to 40	5	5
41 to 65	7	7

¹ Number of Units in Batch is the total surface area of the batch in square meters divided by 175 m² rounded up to nearest whole number.

² The first ten batches of a newly qualified material shall be tested according to the "Statistical" distribution. Subsequent batches (11 and up) shall be tested according to the "normal" distribution.

FIGURE 3 - Number of Units to be Tested per Batch

5.8.2 Sampling - Physiochemical Tests: Physiochemical tests shall be executed on the first and last roll of each batch.

6. PREPARATION FOR DELIVERY:

6.1 Packing:

6.1.1 General: Prepreg shall be packaged in clean, dry, shipping containers so constructed as to ensure acceptance by common or other carrier for safe transportation to the place of delivery specified by purchase order or contract and to retain the requirements of the TS and this PS.

6.1.2 Prepreg Rolls: Each roll shall be individually packaged in a sealed moisture-proof bag of non-contaminating material (polyethylene or equivalent) with minimum thickness of 0.15 mm. The packaging shall be such that the material shall not deform under its own mass and shall meet the requirements of this specification after delivery. Each individual roll shall be accompanied with its defect log. Each package or container shall contain a sachet of silica gel as a desiccant if required by the relevant IPS.

6.1.3 Size of Prepreg Roll: The prepreg roll shall meet the following requirements:

- a. Length and Width: The length and width shall be specified in the IPS. The width of the material shall include selvages.
- b. Mass: The mass of a roll shall not exceed 50 kg.