



AEROSPACE MATERIAL SPECIFICATION

AMS3970™/2**REV. B**

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Superseding AMS3970/2A

(R) 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

RATIONALE

AMS3970/2B is a Five-Year Review and update of this specification. The main updates are:

- Harmonization of requirements with AMS6885
- Additional requirements for storage life and work life in Tables 4, 5, and 9
- Single lap shear test added in Table 14

FOREWORD

AMS3970/2 belongs to the technical specification system explained in AMS3970.

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Documents

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1. SCOPE

AMS3970/2B gives specific information about the qualification program for carbon fiber fabric reinforced epoxy structural repair prepreg systems, curing under vacuum at 120 °C (250 °F), and a companion non-structural glass fabric prepreg used for repair of carbon fiber reinforced epoxy structures. The prepreg system shall include an epoxy film adhesive to be applied in a co-curing process with the prepreg for joint solid laminate and sandwich bonding.

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: 1-877-606-7323 (U.S. and Canada only) or 1-724-776-4970 (outside U.S. and Canada), 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
AMS3970/6	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 gm/m ² , Adhesive Film for Repair and Non-Structural Glass Fiber Fabric Reinforced Epoxy Prepreg, 105 gm/m ²

2.2 PRI Publications

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

PRI QPL AMS3970, Qualified Products List of AMS3970

Individual Product Sheets (IPS) of Qualified Products, Appendix of PRI QPL AMS3970

2.3 European Standard (EN) Publications

Copies of these documents are available online at www.en-standard.eu.

EN 2823	Aerospace series - Fibre reinforced plastics - Determination of the effect of exposure to humid atmosphere on physical and mechanical characteristics
EN 6032	Aerospace series - Fibre reinforced plastics - Test method - Determination of the glass transition temperatures

2.4 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9500, www.astm.org.

ASTM D5229/D5229M	Standard Test Method for Moisture Absorption Properties and Equilibrium Conditioning of Polymer Matrix Composite Materials
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2.5 Other Publications

Refer to Section 2 of AMS3970/1 for reference to all other documents listed within this part specification.

3. DEFINITIONS

Refer to AMS3970/1.

4. REQUIREMENTS

Refer to AMS3970/1 and the relevant Material Specification (MS) (AMS3970/6).

5. QUALIFICATION

Refer to AMS3970/1. The qualification program is given in Tables 1 through 20.

Table 1 - Material qualification program for carbon fiber

No.	Property	Number of Batches Tested ⁽¹⁾
1.1	Tensile Impregnated Yarn (σ_t , E_t , ϵ_t)	q3
1.2	Fiber Density (ρ_f)	q3
1.3	Sizing Content	q3
1.4	Linear Density	q3
1.5	Twist	q3
1.6	Filament Diameter	q3

⁽¹⁾ Substantiating qualification data is required; this data shall be on three batches.

NOTE: See Table 17 for nomenclature definition. See Table 18 for number of specimens per test.

Table 2 - Material qualification program for carbon fabric

No.	Property	Number of Batches Tested ⁽¹⁾
2.1	Weaving Style and Yarn Count	w
2.2	Mass per Unit Area	w

⁽¹⁾ No qualification tests are required. Data from batches used in the qualification program shall be provided by the fabric manufacturer.

NOTE: See Table 17 for nomenclature definition. Test methods per AMS3970/1.

Table 3 - Composite batch combinations for qualification program

	Base Material Batches and Batch Combinations Tested		
	1	2	3
Prepreg Batch	1	2	3
Fiber Batch	Fi1	Fi2	Fi2
Fabric Batch ⁽¹⁾	F1	F2	F2
Prepreg Resin Batch	R1	R2	R1
Film Adhesive Batch ⁽²⁾	A1	A2	A3
Adherend Prepreg Material A ⁽³⁾	AMA1		

⁽¹⁾ Preferably two fabric batches (F1, F2) shall be qualification tested. Fabric batch F1 is an acceptable replacement for fabric batch F2.

⁽²⁾ For co-cure specimens manufactured using a film adhesive. Three film adhesive batches shall be used.

⁽³⁾ See Table 20 for Adherend Prepreg Material A.

Table 4 - Material qualification program for uncured carbon or glass prepreg - physical and chemical properties

No.	Properties	Storage Life ⁽³⁾⁽⁴⁾⁽⁵⁾⁽¹⁰⁾	Tack Life/ Work Life ⁽⁶⁾⁽⁷⁾⁽⁸⁾⁽⁹⁾⁽¹⁰⁾	Number of Batches
4.1	Mass per Unit Area	-	-	q3, s, r, p
4.2	Volatile Content ⁽²⁾	-	-	q3, s, r, p
4.3	Resin Content	-	-	q3, s, r, p
4.4	Mass per Unit Area Dry Fabric	-	-	q3, s, r, p
4.5	Resin Flow	-	-	q3
4.6	Viscosity Profile ⁽¹⁾⁽²⁾ (Dynamic 2 °C/min)	-	-	q3, s, r, p
4.7	Viscosity Profile ⁽¹⁾⁽²⁾ (Nominal Cure Cycle)			q3, s, r, p
4.8	Gel Time ⁽²⁾ (Isothermal)	-	-	q3, s, r, p
4.9	DSC - uncured	0	0	q3, r, p
4.10	DSC - uncured	0	1	q1
4.11	DSC - uncured	1	0	q1
4.12	DSC - uncured	1	1	q1
4.13	HPLC ⁽²⁾	-	-	q3, r, p
4.14	Infrared ⁽²⁾	-	-	q3, r, p
4.15	Tack ⁽²⁾	0	0	q1
4.16	Tack ⁽²⁾	0	1	q1
4.17	Tack ⁽²⁾	1	0	q1
4.18	Tack ⁽²⁾	1	1	q1

(1) Test to be performed on resin film. This test not required for non-structural glass prepreg.

(2) Specific test parameters to be agreed between the manufacturer and the CACRC-QPG.

(3) Minimum requirement for material storage life from the date of manufacture as indicated in the relevant Material Specification or as agreed between the manufacturer and the CACRC-QPG.

(4) Storage Life = 0 means: material is at the beginning of its Storage Life. Tolerance: (-0/+90) days from manufacturing date.

(5) Storage Life = 1 means: material is at the end of its Storage Life. Tolerance: (-0/+90) days from expiration date. Requirement for qualification in AMS3970/6: Storage life ≥12 months from the date of shipment.

(6) Minimum requirement for material work life as indicated in the relevant Material Specification or as agreed between the manufacturer and the CACRC-QPG.

(7) Age material with backing paper prior to layup and bag (refer to AMS3970/1).

(8) Work Life = 0 means: material is at the beginning of its Work Life. Tolerance: any number of days between 0 and 5.

(9) Work Life = 1 means: material is at the end of its Work Life. Tolerance: (-0/+5) days from end of work life.

Requirement for qualification in AMS3970/6: Work life ≥10 days.

(10) Specific test intervals to be agreed between the manufacturer and the CACRC-QPG.

NOTE: See Table 17 for nomenclature. See Table 18 for Number of Specimens per Test. See Table 19 for Aging Conditions of Uncured Prepreg. Test methods per AMS3970/1.

Table 5 - Material qualification program for uncured film adhesive - physical and chemical properties

No.	Properties	Storage Life ⁽³⁾⁽⁴⁾⁽⁵⁾⁽¹⁰⁾	Tack Life/ Work Life ⁽⁶⁾⁽⁷⁾⁽⁸⁾⁽⁹⁾⁽¹⁰⁾	Number of Batches
5.1	Mass per Unit Area	-	-	q3, s, r, p
5.2	Volatile Content ⁽²⁾	-	-	q3, s, r, p
5.3	Adhesive Flow ⁽²⁾	-	-	q3, s, r, p
5.4	Viscosity Profile ⁽¹⁾⁽²⁾ (Dynamic 2 °C/min)	-	-	q3, s, r, p
5.5	Viscosity Profile ⁽¹⁾⁽²⁾ (Nominal Cure Cycle)			q3, s, r, p
5.6	Gel Time ⁽²⁾ (Isothermal)	-	-	q3, s, r, p
5.7	DSC - uncured	0	0	q3, r, p
5.8	DSC - uncured	0	1	q1
5.9	DSC - uncured	1	0	q1
5.10	DSC - uncured	1	1	q1
5.11	HPLC ⁽²⁾	-	-	q3, r, p
5.12	Infrared ⁽²⁾	-	-	q3, r, p
5.13	Tack ⁽²⁾	0	0	q1
5.14	Tack ⁽²⁾	0	1	q1
5.15	Tack ⁽²⁾	1	0	q1
5.16	Tack ⁽²⁾	1	1	q1

⁽¹⁾ Test to be performed on resin film. This test not required for non-structural glass prepreg.

⁽²⁾ Specific test parameters to be agreed between the manufacturer and the CACRC-QPG.

⁽³⁾ Minimum requirement for material storage life from the date of manufacture as indicated in the relevant Material Specification or as agreed between the manufacturer and the CACRC-QPG.

⁽⁴⁾ Storage life = 0 means: material is at the beginning of its Storage Life. Tolerance: (-0/+90) days from manufacturing date.

⁽⁵⁾ Storage life = 1 means: material is at the end of its storage life. Tolerance: (-0/+90) days from expiration date. Requirement for qualification in AMS3970/6: Storage life ≥12 months from the date of shipment.

⁽⁶⁾ Minimum requirement for material storage life as indicated in the relevant material specification or as agreed between the manufacturer and the CACRC-QPG.

⁽⁷⁾ Age material with backing paper prior to layup and bag (refer to AMS3970/1).

⁽⁸⁾ Work Life = 0 means: material is at the beginning of its Work Life. Tolerance: any number of days between 0 and 5.

⁽⁹⁾ Work Life = 1 means: material is at the end of its work life. Tolerance: (-0/+5) days from end of work life.

Requirement for qualification in AMS3970/6: Work life ≥10 days.

⁽¹⁰⁾ Specific test intervals to be agreed between the manufacturer and the CACRC-QPG.

NOTE: See Table 17 for nomenclature. See Table 18 for Number of Specimens per Test. See Table 19 for Aging Conditions of Uncured Prepreg. Test methods per AMS3970/1.