

# 1 SCOPE

- a. This specification establishes the material requirements for low temperature curing, fire resistant, epoxy resin preimpregnated glass fabrics to be used in fabricating structural reinforced solid glass laminates and glass laminate faced honeycomb sandwich parts.
- b. This specification requires qualified products.

## WARNING

WARNINGS may be included throughout this specification. Do not take these WARNINGS to be all inclusive, nor to completely describe hazards or precautionary measures applicable to specific procedures or operating environments.

Non-Boeing personnel must refer to their employer's safety instructions for information concerning hazards which may occur during operations described in this specification.

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Authorizing Signatures on File

GLASS FABRIC PREIMPREGNATED EPOXY  
RESIN LOW TEMPERATURE CURING

**BMS**  
8-79AE

**BOEING MATERIAL SPECIFICATION**

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## 2 CLASSIFICATION

### 2.1 CLASSES

Class designation is based upon mechanical property capabilities at elevated temperatures.

- a. Class I – Obsolete – Use Class III
- b. Class II – Obsolete – Use Class III
- c. Class III – Material shall possess elevated temperature mechanical properties meeting requirements specified in Table II and Table V of this specification.
- d. Class IV material shall possess mechanical properties which meet the requirements listed in Table IV and Table VI.

### 2.2 STYLES

Styles are based upon fabric reinforcement used:

Designation	Fabric Reinforcement, BMS9-3	Obsolete Designation
Style 120	Type D, Style 120	Type 120 and 0
Style 220	Type D-1, Style 220	None
Style 1543	Type F-2, Style 143-150	Type 1543, 43 and 143
Style 1581	Type H-2, Style 181-150	Type 1581, 1 and 181
Style 7781	Type H-3, Style 181-77	Type 7781
Style 1582	Type J-2, Style 182-150	Type 1582, 2 and 182
Style 1584	Type K-2, Style 184-150	Type 1584, 4 and 184

2.3

FORMS

Form designation indicates single ply rolls or multiple preplied rolls and is based on the purchaser's manufacturing needs. Form is a manufacturing option and is interchangeable.

- a. Normal Form – Obsolete – Use Form A
- b. Preplied Form – Obsolete – Use Form B
- c. Form A – single ply of prepreg with polyethylene parting film on one or both faces.
- d. Form B – Multiple plies, of two (Form B2) or three (Form B3) plies of prepreg, plied together and separated from other multiple plies with carrier or interleaf material on one or both sides.
  - (1) The preplied prepreg shall be nested with fill face and warp face interfaces as specified in the Suppliers PCD.
  - (2) All supplier and purchaser tests shall be performed on single ply of prepreg of the same batch.
- e. Prepreg width shall be as stated in the purchase order.
- f. The carrier or interleaf material, as specified in Section 10.1, shall be applied to the roll immediately after impregnation so that the longest dimension of the embossed diamond pattern is parallel with the glass fabric warp direction and in direct contact with the warp face.
- g. Slit prepreg material narrower than the test requirements of Section 8 may be purchased if accompanied by material from the same batch wide enough to perform the required testing.

2.4

GRADE

Grade designation is based on flammability requirements.

- a. Grade A – Intended for possible use inside the pressure shell of the airplane and required to meet the flammability requirements of Section 5.2, Table III.
- b. Grade B – Not intended for use inside the pressure shell of the airplane and not required to meet the flammability requirements of Section 5.2, Table III. If Grade B is specified, Grade A may be used.
- c. Grade I – obsolete for new design.

If Grade I or no Grade is specified, use Grade A or Grade B as follows:

- (1) If the manufacturing facility is operating under the auspices of D6–49225, use Grade A.
- (2) If the manufacturing facility is operating under the auspices of D6–53993, use Grade A or Grade B.
- (3) If the manufacturing facility is operating under the auspices of both D6–49225 and D6–53993 simultaneously, use Grade A only.
- (4) If the manufacturing facility begins manufacturing under the auspices of D6–49225, discontinue any use of Grade B and use Grade A only

3

REFERENCES

The issue of the following references in effect on the date of invitation for bid shall form a part of this specification to the extent herein indicated.

- |                 |   |
|-----------------|---|
| ASTM D 638      | – Tensile Properties of Plastics, Test Method for   |
| ASTM D 695      | – Compressive Properties of Rigid Plastics, Test Method for   |
| ASTM D 1781     | – Climbing Drum Peel Test for Adhesives, Test Method for  |
| ASTM D 3846     | – In-Plane Shear Strength of Reinforced Plastics, Test Method for   |
| ASTM E 4        | – Load Verification of Testing Machines   |
| BMS9–3          | – Glass Fabric Reinforcements for Laminated Plastic Products  |
| BSS7061         | – Requirements for Time and Temperature Recorders used with Time and Temperature Sensitive (TATS) Materials |
| BSS7101         | – Requirements for The Process Control Document (PCD) System for Suppliers of Raw Material Specifications   |
| BSS7230         | – Determination of Flammability Properties of Aircraft Materials  |
| BSS7276         | – Gel Time, Prepreg, Test Method for Determination of   |
| BSS7286         | – Statistical Process Control of Designated Engineering Characteristics.                                    |
| BSS7335         | – Resin Flow of prepreg Fabric and Tape, Test Methods for   |
| BSS7336         | – Resin, Content and Fiber Areal Weight of Prepreg Fabric and Tape, Test Methods for                        |
| BSS7337         | – Volatile Content of Prepreg Fabric and Tape, Test Methods for   |
| D6–40201–1      | – Instruction Manual for X-Band Dielectrometer  |
| D6–49225        | – Qualification of Sources for Interior Plastic Parts   |
| D6–53993        | – Qualification of Sources for Composite Parts  |
| MIL–HDBK–5      | – Military Standardization Handbook   |
| SAE–AMS–STD–401 | – Sandwich Constructions and Core Materials, General Test Methods   |
| OSHA 1910.1200  | – Hazard Communication Standard   |

4

**DEFINITIONS**

The following definitions apply to terms that are uncommon or have special meaning as used in this specification:

Crease – A condition of the surface of the material where the nominal thickness is not appreciably changed, but the material is permanently formed into a ridge.

Date of Manufacture – The date when the fiberglass reinforcement is impregnated with one resin mix in one continuous operation.

Dry (Boardy) Areas – Portions of the prepreg that do not drape easily or exhibit an unnatural drape or exhibit very little tack.

Fabric Warp Face – That side of the fabric where the majority of the area is composed of yarns running parallel to the selvage.

Fill – The yarns running perpendicular to the longer dimension or selvage of the fabric reinforcements.

Fill Face – That side of the fabric where the majority of the area is composed of yarns running perpendicular to the selvage.

Fold – A condition in which the fabric is laid back over itself.

Handling Life – The cumulative out of refrigeration time within which the material shall be laid up.

Mechanical Life – The out of refrigeration time over which the material remains capable of attaining cure and mechanical properties, if laid up and compacted within its handling life.

Mill Roll – An uninterrupted roll of glass fabric cut from a loom and subjected to all subsequent fabric inspection, heat cleaning, and finishing operations as a single unit.

Out-Time – The maximum (cumulative) time that a prepreg may be kept at ambient conditions and still retain properties within limits of this specification.

Prepreg Batch – Prepreg containing fabric meeting the requirements of BMS9–3, impregnated with one batch of resin in one continuous manufacturing operation with traceability to individual BMS9–3 fabric lots.

Prepreg Lot – Prepreg from one prepreg batch submitted for acceptance at one time.

Process Control Document (PCD) – A document which describes the raw materials, manufacture and testing of a material to assure product quality and consistency.

Puckers – Areas on prepreg material where the material has locally blistered from the carrier (separator film or release paper).

Resin Rich Areas – An area with more than maximum allowable resin content.

Roll – A roll is defined as any section from the above batch furnished as a continuous roll of prepreg.

#### 4 DEFINITIONS (Continued)

Selvage – The edge of woven fabric of different threads or weave from the body of the fabric.

Storage Life – The period of time that the material may be kept under refrigeration so that it retains the properties within the limits of this specification.

Warp – The lengthwise parallel yarns of the fabric reinforcements running parallel to the selvage.

Wrinkle – A condition where one or more plies of prepreg are formed into a ridge.

#### 5 MATERIAL REQUIREMENTS

##### 5.1 PREPREG PROPERTIES

##### 5.1.1 REINFORCEMENT PROPERTIES

Reinforcement used in the manufacture of Class III prepreg to this specification shall meet the requirements of BMS9–3 with traceability to original yarn lots. Reinforcement used in the manufacture of Class IV prepreg to this specification shall meet the requirements of BMS9–3 with traceability to original yarn lots, except the minimum laminate tensile strength for the dry condition required for BMS9–3 fabric shall be 45 ksi for Style 220 and 52 ksi for Style 7781.

##### 5.1.2 PHYSICAL PROPERTIES

The Class III prepreg shall conform to the requirements of Table I when tested in accordance with the designated method. The Class IV prepreg shall conform to the requirements of Table I for resin content, areal weight and volatile content when tested in accordance with the designated method. The Class IV prepreg shall conform to the requirements listed in the QPL for gel time and resin flow when tested in accordance with the method designated in Table I.



5.1.3

DIMENSIONAL REQUIREMENTS

- a. The measured width of the material shall not include selvages and shall be within  $\pm 1$  inch of that specified on the purchase order. Other tolerances shall be as specified on the purchase order.
- b. Unless otherwise specified on the purchase order, the roll lengths for prepreg are as follows:

Form A

Style 120 or 220; 125 Nominal yards each roll

Styles 1543, 1581, 7781, 1582; 60 Nominal yards each roll

Style 1584; 35 Nominal yards each roll

Form B

Style 120 or 220; 40 Nominal yards each roll (2 plies preplied)

Style 120 or 220; 40 Nominal yards each roll (3 plies preplied)

Style 1581; 30 Nominal yards each roll (2 plies preplied)

Style 7781; 30 Nominal yards each roll (2 plies preplied)

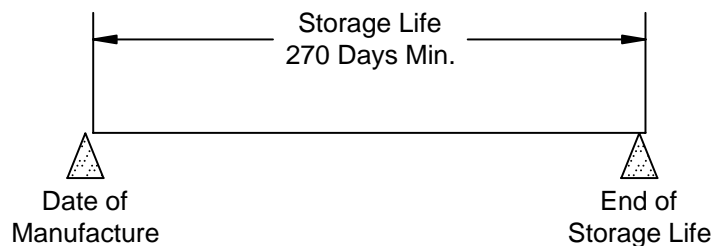
#### 5.1.4 GENERAL REQUIREMENTS

- a. Portions of rolls not conforming to the requirements of this section may be supplied only if marked or corrected in accordance with Section 5.3.
- b. The impregnated material shall be uniform in quality and condition and shall not exhibit characteristics detrimental to handling, layup, or structural properties.
- c. The impregnated material shall be free from visible indications of moisture, puckers, cured resin, foreign material, unwetted fibers, resin rich areas, and dry or boardy areas.
- d. The impregnated material shall be free from curled or folded selvages that overlap nonsalvage areas, wrinkles, creases, tears or other permanent distortions.
- e. The color of the fabric shall be uniform and natural. Natural color may vary from off-white to tan.
- f. Glass Fabric
  - (1) Fabric Styles shall be limited to those listed in Section 2.2.
  - (2) The glass fabric finish shall meet the high temperature requirements of this specification. The glass fabric finish shall be considered as an integral part of a qualified prepreg system, and a change of finish shall require requalification of the material. The qualified material designation listed on the QPL shall indicate the glass fabric finish used.

#### 5.1.5 STORAGE STABILITY AND OUT OF REFRIGERATION TIME REQUIREMENTS

All materials shall be capable of meeting the qualification requirements of this specification after the following exposures.

- a. Storage Life; 270 days minimum from date of manufacture, stored at 10 F or below in a sealed moisture proof container.
- b. Supplier out-time; 72 hours maximum at room temperature.
- c. Handling Life; 200 hours minimum at  $75 \pm 5$  F
- d. Mechanical Life; 200 hours minimum at  $75 \pm 5$  F
- e. Unless specified on the purchase contract, there shall be a minimum of 180 days of storage life remaining from the date of receipt at the purchaser's facility.



**FIGURE 1 PREPREG REFRIGERATION LIFE**

5.1.5

STORAGE STABILITY AND OUT OF REFRIGERATION TIME REQUIREMENTS (Continued)

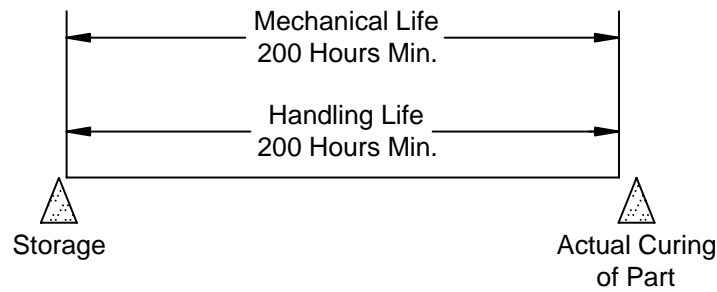


FIGURE 2 PREPREG OUTTIME LIFE

TABLE I PHYSICAL PROPERTY REQUIREMENTS OF PREPREGS

PROPERTY	STYLE 120 OR 220	STYLE 1543	STYLE 1581	STYLE 7781	STYLE 1582	STYLE 1584	TEST METHOD SECTION
Resin Solids Content (percent) All Classes <b>FL 1 FL 4</b>	45 ± 3	37 ± 3	38 ± 2	38 ± 2	38 ± 2	36 ± 3	8.2.1
Gel Time (minutes), Class III <b>FL 1 FL 2</b>	4 ± 2	4 ± 2	4 ± 2	4 ± 2	4 ± 2	4 ± 2	8.2.2
Flow (percent), at 50 psi and 275 F, Class III <b>FL 1 FL 2 FL 3</b>	14 ± 6	14 ± 6	14 ± 6	14 ± 6	14 ± 6	14 ± 6	8.2.3
Volatiles (maximum percent), All Classes	1.5	1.5	1.5	1.5	1.5	1.5	8.2.4
Areal Weight (g/m <sup>2</sup> ), Class IV only <b>FL 4</b>	99 to 110	---	---	284 to 305	---	---	8.2.1

**FL 1** All prepreg property values listed above are average for the styles indicated.

**FL 2** Class IV prepreg shall conform to the requirements listed in the QPL for gel time and resin flow.

**FL 3** Class III prepreg shall conform to the requirements listed in Table I unless specified otherwise in QPL.

**FL 4** Supplier key characteristic in accordance with BSS7286.

5.2

LAMINATE/SANDWICH PROPERTIES

Laminates and sandwich panels fabricated in accordance with Sections 8.3.1 and 8.3.2 shall meet the requirements of Table II, Table III, Table IV, Table V and Table VI, respectively.

**TABLE II LAMINATE MECHANICAL PROPERTY REQUIREMENTS, CLASS III**

PROPERTY FL 1 FL 2	STYLE 120 OR 220	STYLE 1543	STYLE 1581 OR 7781	STYLE 1582	STYLE 1584	TEST METHOD SECTION
Mechanical Properties						8.4f.
Compression Ultimate, ksi						
Test						
75 ± 5 F FL 3	50.0	85.0	60.0	50.0	40.0	
160 ± 5 F	37.5	63.8	45.0	37.5	30.0	
200 ± 5 F	25.0	42.5	30.0	25.0	20.0	
Compression Modulus, msi						
Test						
75 ± 5 F FL 3	3.00	4.80	3.40	3.20	3.00	
160 ± 5 F	2.25	3.60	2.55	2.40	2.25	
200 ± 5 F	1.50	2.40	1.70	1.60	1.50	
Tensile Ultimate, ksi						8.4.1a.
Test						
75 ± 5 F FL 3	45.0	85.0	54.0	50.0	50.0	
160 ± 5 F	33.8	63.8	40.5	37.5	37.5	
200 ± 5 F	22.5	42.5	27.5	25.0	25.0	
Tensile Modulus, msi						
Test						
75 ± 5 F FL 3	2.80	4.50	3.00	3.00	2.80	
160 ± 5 F	2.10	3.38	2.25	2.25	2.10	
200 ± 5 F	1.40	2.25	1.50	1.50	1.40	
Interlaminar Shear, ksi						8.4.1b.
Test						
75 ± 5 F	3.50	3.50	3.50	3.50	3.50	
160 ± 5 F	2.63	2.63	2.63	2.63	2.63	
200 ± 5 F	1.75	1.75	1.75	1.75	1.75	

**FL 1** See Table VII for nominal thickness per ply and number of plies.

**FL 2** Unless otherwise designated, requirements are for minimum average.

**FL 3** Required supplier quality control test. Supplier key characteristic in accordance with BSS7286.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

**TABLE III LAMINATE HYDRAULIC FLUID RESISTANCE, FLAMMABILITY RESISTANCE AND ELECTRICAL PROPERTY REQUIREMENTS**

PROPERTY	ALL STYLES AND CLASSES	TEST METHOD SECTION
Hydraulic Fluid Resistance Test	Requirements listed in Section 8.4.1d.(7) and (8) shall be met when exposed to Monsanto Low Density Aviation Hydraulic Test Fluid or BMS3-11, Type IV, Class 1.	8.4.1d.
Flammability Properties Test		
60-second Vertical <b>FL 1</b>	Material shall be self-extinguishing within 15 seconds of flame removal, shall burn no more than 6 inches, and resin drips shall extinguish within 3 seconds	8.4.1e.
30-second 45-degree Angle	Material shall be self-extinguishing within 15 seconds of flame removal, afterglow shall cease within 10 seconds and there shall be no complete penetration of the material by flame.	
Dielectric Constant Test Styles 120 and 220 only All other styles	4.00 to 4.94 dry and wet 4.37 to 4.94 dry and wet	8.4.1c.
Loss Tangent Test	0.023 (maximum) dry and wet	

**FL 1** Required supplier test for Grade A material only.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

**TABLE IV LAMINATE MECHANICAL PROPERTY REQUIREMENTS, CLASS IV**

PROPERTY FL 1	STYLE 220, MINIMUM AVERAGE	STYLE 220, MINIMUM INDIVIDUAL	STYLE 7781, MINIMUM AVERAGE	STYLE 7781 MINIMUM INDIVIDUAL	TEST METHOD SECTION
Mechanical Properties					8.4f.
Compression Ultimate, ksi					
Test					
75 ± 5 F FL 2	64	56	64	56	
160 ± 5 F	52	47	52	47	
200 ± 5 F	46	41	46	41	
Comp. Modulus, msi					
Test					
75 ± 5 F FL 2	2.9	2.7	3.4	3.2	
160 ± 5 F	2.7	2.4	3.0	2.7	
200 ± 5 F	2.7	2.4	2.7	2.4	
Tensile Ultimate, ksi					8.4.1a.
Test					
75 ± 5 F FL 2	57	50	62	57	
160 ± 5 F	48	39	57	51	
200 ± 5 F	44	34	49	42	
Tensile Modulus, msi					
Test					
75 ± 5 F FL 2	2.8	2.5	3.1	2.8	
160 ± 5 F	2.5	2.4	2.9	2.7	
200 ± 5 F	2.5	2.4	2.7	2.4	
Interlaminar Shear, ksi					8.4.1b.
Test					
75 ± 5 F	7.5	5.8	7.5	5.8	
160 ± 5 F	5.4	4.8	5.4	4.6	
200 ± 5 F	3.6	2.2	3.6	2.2	

**FL 1** See Table VII for nominal thickness per ply and number of plies.

**FL 2** Required supplier quality control test. Supplier key characteristic in accordance with BSS7286.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

**TABLE V MECHANICAL PROPERTY REQUIREMENTS FOR SANDWICH TEST PANELS, CLASS III**

PROPERTY FL 1 FL 2	STYLE 120 OR 220	STYLE 1581 OR 7781	TEST METHOD SECTION
Drum Peel – lb–in./3–in. width at $75 \pm 5$ F	8	10	8.4.2a.
Flatwise Tensile, psi – Test			8.4.2b.
At $75 \pm 5$ F	700	700	
At $160 \pm 5$ F	525	525	
At $200 \pm 5$ F	350	350	
Long Beam Flexure Ultimate, lb			8.4.2c.
At $75 \pm 5$ F	100	190	
At $160 \pm 5$ F	75	143	
At $200 \pm 5$ F	50	95	
P/Y, lb/in. – Test			
At $75 \pm 5$ F	95	180	
At $160 \pm 5$ F after 1/2 hour at temperature	72	135	
At $200 \pm 5$ F after 1/2 hour at temperature	48	90	

**FL 1** Unless otherwise designated, requirements are for minimum average.

**FL 2** See Table VII for the number of face plies.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

**TABLE VI MECHANICAL PROPERTY REQUIREMENTS FOR SANDWICH TEST PANELS, CLASS IV**

PROPERTY FL 1	STYLE 220, MINIMUM AVERAGE	STYLE 220, MINIMUM INDIVIDUAL	STYLE 7781, MINIMUM AVERAGE	STYLE 7781 MINIMUM INDIVIDUAL	TEST METHOD SECTION
Drum Peel – lb–in./3–in. width at 75 ± 5 F	8.0	7.3	10.0	7.9	8.4.2a.
Flatwise Tensile, psi – Test					8.4.2b.
At 75 ± 5 F	700	455	700	455	
At 160 ± 5 F	540	370	540	370	
At 200 ± 5 F	460	320	460	320	
Long Beam Flexure Ultimate, lb					8.4.2c.
At 75 ± 5 F	105	85	190	150	
At 160 ± 5 F	80	60	150	120	
At 200 ± 5 F	70	55	115	95	
P/Y, lb/in. – Test					
At 75 ± 5 F	100	90	180	170	
At 160 ± 5 F after 1/2 hour at temperature	95	85	160	150	
At 200 ± 5 F after 1/2 hour at temperature	85	80	160	150	

**FL 1** See Table VII for the number of face plies.

**TABLE VII STACKING REQUIREMENTS AND NOMINAL PLY THICKNESS FOR PREPREG TESTING, LAMINATE AND SANDWICH PROPERTIES**

CHARACTERISTIC	STYLE 120 OR 220	STYLE 1543	STYLE 1581 OR 7781	STYLE 1582	STYLE 1584
Thickness per ply, inches <b>FL 1</b>	0.0041	0.0095	0.0095	0.0118	0.0236
No. of plies, Laminate Tests					
Compression and Tension Tests	21	10	10	8	4
Interlaminar Shear	30	---	16	---	---
Electrical Tests	67	43	30	22	11
Flammability Tests	6	3	3	2	2
No. of plies, Sandwich Tests	3	---	2	---	---

**FL 1** Supplier key characteristic in accordance with BSS7286.



5.3

NONCONFORMING MATERIALS

- a. Portions of rolls not conforming to Section 5.1.4 shall be identified along one selvage edge of the prepreg roll by markers. Markers shall be a single color distinguishable from the prepreg and carrier and removable without damaging the prepreg.
- b. For single point defects, use single markers.
- c. Successive single point defects, 3 feet or less apart, shall be considered as one continuous defect.
- d. For continuous defective areas, markers shall be placed at the beginning, at 2 feet (maximum) intervals and at the end of the continuous defect.
- e. Prepreg may be cut and spliced to remove defects. Prepreg splicing shall be approved by The Boeing Company and documented in the Supplier Process Control Document (PCD).
- f. Material shall have a roll maximum defect limit of 15 percent of the roll length. Defect length limit shall be on the full width.
- g. Ninety percent of each roll shall have 50 feet minimum lengths between defects or splices. The remaining 10 percent shall have 15 feet minimum lengths between defects or splices.
- h. The location and length (for continuous defects) of each marked defect and the locations of the splices shall be indicated on a defect log accompanying each roll of prepreg. Defect and splice locations shall be identified relative to the outside of the prepreg roll.
- i. Defective areas shall not be counted toward the amount purchased.

## 6

## QUALIFICATION

- a. Direct all requests for qualification to a Supply Management and Procurement (SM&P) organization of The Boeing Company. SM&P coordinates all communication between material suppliers and the appropriate Boeing departments. After receiving written authorization from SM&P, the manufacturer shall submit the data and samples required for qualification purposes.
- b. The qualification sample shall consist of one representative production sample roll of the particular Style under which the vendor elects to qualify. The qualification sample submitted for approval shall be accompanied by a test report in duplicate which shows that the sample supplied meets the requirements of this specification, and that a laminate or sandwich panel made from this material meets the requirements of Table II, Table III, Table IV, Table V and Table VI as applicable. The material supplier shall have facilities capable of testing in accordance with this specification, or the supplier shall identify a testing facility. Boeing Engineering and Quality Assurance shall verify the adequacy of all test facilities and test procedures.

**NOTE:** Each prepreg manufacturing facility shall be qualified individually. A manufacturer may qualify a new facility or glass finish to all styles of their material of a given resin system already appearing on the QPL by qualifying Styles 120, 220, 1581 or 7781 for Class III or Styles 220 or 7781 for Class IV of that resin system at that facility.

- c. Qualification testing at Boeing shall consist of a demonstration of the conformance of the sample, supplied in accordance with Section 6b., to all of the requirements of this specification. The sample shall be evaluated for manufacturing suitability under production conditions in an as received form and after exposure to the maximum handling life required by this specification.
- d. In addition to the above qualification requirements, each prepreg system shall demonstrate compatibility with sandwich structure processing called out in Section 8.3.2 of this specification. A sandwich test panel fabricated in accordance with Section 8.3.2 shall meet the requirements of Table V for Class III and Table VI for Class IV.
- e. Suppliers seeking qualification to this specification shall submit to an audit of their product manufacturing operations, raw material traceability, process records, test procedures, and quality assurance records. If deemed necessary by the suppliers, The Boeing Company will enter into a nondisclosure agreement with the supplier to protect the proprietary rights of both. The Boeing Company reserves the right to reaudit any or all follow-on production orders subsequent to qualification.
- f. The supplier shall have on file a Boeing approved Process Control Document (PCD) containing baseline chemical and in-process test information. No change in approved product formulation, raw materials, basic methods of manufacture, or plant site for a material qualified to this specification shall be made without notification and prior approval in writing from The Boeing Company. It may be necessary to requalify material manufactured with the proposed change and a revised product designation may be required.
- g. Process Control Documents shall be in accordance with BSS7101.

6

## QUALIFICATION (Continued)

- h. The Supplier shall submit, in addition to qualification data in Section 6b., a report with qualification data that identifies test methods and apparatus used, testing laboratory, and responsible company official or representative.
- i. Prior to submitting a material for qualification to this specification, the material supplier shall provide a Material Safety Data Sheet and, if requested, a chemical formulation for the candidate material. Agreements for non-disclosure and control of proprietary information shall be considered and executed as appropriate. The information provided shall be submitted to the appropriate Boeing Safety, Health and Environmental Affairs organization to perform a health hazard evaluation. These organizations determine whether the information is adequate, or whether additional information is necessary, to identify and document appropriate precautions for the material's use.
- j. After review of supplier data and completion of Boeing tests, the supplier will be advised of qualification status. Qualified products will be listed in the Qualified Products List, showing the supplier's product designation.
- k. Production materials shall be capable of meeting all qualification requirements. For Class IV prepreg, the predicted minimum individual and minimum average values shall meet the minimum requirements listed in Table IV and Table VI. The predicted values shall be calculated from the qualification data in accordance with MIL-HDBK-5 using the one sided tolerance-limit-factor corresponding to a proportion at least 0.99 of the normal distribution and a confidence coefficient of 0.95, "A" allowables approach.

7

## QUALITY CONTROL

7.1

### SUPPLIER QUALITY CONTROL

Supplier Quality Assurance shall provide a system of in-process records that assure product integrity. These records shall be made available to authorized representatives of The Boeing Company.

- a. Verify that the material has been manufactured in accordance with the approved PCD.
- b. Test each batch of material before shipment.
  - (1) Test areal weight (Class IV only) and resin content (all classes) on material taken from each mill roll at intervals not exceeding 250 yards within the mill roll.
  - (2) Test gel time, percent flow, and volatile content on the first and last roll in the prepreg batch at a minimum.
  - (3) Supply mill roll or splice identification with each batch.
  - (4) Perform the designated tests in Table II or Table IV as appropriate for each Class, on at least one roll, selected at random, per prepreg batch and include the results with the supplier test report.
  - (5) Perform the 60 second vertical flammability test for Grade A material as designated in Table III.

7.1

SUPPLIER QUALITY CONTROL (Continued)

- c. Confirm with each production shipment that the materials and methods of manufacture have not changed from those used in the qualification sample (Section 6c.)
- d. Suppliers shall furnish actual test data comprised of individual and average values showing conformance with the above requirements for each prepreg batch and shall identify such data with the specification revision letter in effect, the rolls of material used in determining the data, and the test facility that generated the data. Should the material fail to comply with the above requirements, retesting of the failed property in accordance with BSS7101 is allowed. All data including chromatograms, spectra, and peak tables shall accompany the material shipment.
- e. The supplier shall maintain, for a period of 7 years, all records pertaining to raw material receiving inspection and certification, in-process records, and product testing in accordance with the approved Manufacturing and Quality Assurance Plan. Such records shall be available for inspection by authorized representatives of The Boeing Company.
- f. Suppliers shall provide Boeing Supply Management and Procurement (SM&P) summary reports of Statistical Process Control (SPC) data including control charts, nominal values, standard deviation, number of batches, and Cpk for each Key Characteristic (KC) and Key Process Parameter (KPP). SPC data shall be submitted every 6 months. If the control limits change from a previous report, suppliers shall report old and new control limits.
- g. In lieu of performing the tests in Section 7.1b., a supplier may request reduced testing. Requests for reduced testing plans shall be directed to the SM&P organization of The Boeing Company.
- h. Reduced inspection is allowed in accordance with a documented plan referenced in the PCD, and approved by the Boeing Material and Process Technology and Quality Assurance organizations. Requests for approval should include a summary of data demonstrating consistent conformance, copies of documented provisions for process controls, a copy of the plan for reduced testing (including revision control Supplier Quality Control approval), as well as any other relevant information (for example, studies identifying key process parameters).
- i. If reduced testing is in place such that the reporting of test results is affected, the supplier shall submit a certified test report which states the authorization for reduced testing (Section 7.1h or PCD provision). The report shall be easily understood and certify that the material meets the requirements of the specification.

7.1.1

STATISTICAL PROCESS CONTROL (SPC)

- a. The supplier shall establish and maintain procedures and requirements for an SPC system based on key characteristics (KC) and key process parameters (KPP) in accordance with the requirements of this specification and BSS7286.
- b. Key characteristics are specified in Table I, Table II, Table III, Table V, and Table VII. Key characteristics are average values only.
- c. The process for selecting and documenting KPPs is described in Section 7.1.1.1.

7.1.1.1

Key Process Parameters

- a. The selection of KPP's shall be primarily the responsibility of the supplier and shall be documented in the PCD.
- b. Key process parameters shall include those process parameters which have the greatest influence on the KCs and performance of the prepreg material.
- c. The supplier shall establish the nominal target value and tolerance limits for each KPP. The inspection and SPC method used for monitoring each KPP shall be documented in the PCD.

7.1.1.2

Analysis and Review

- a. The supplier shall conduct SPC analysis of the KCs and KPPs in accordance with BSS7286.
- b. The procedures used to establish and calculate control limits shall be documented in the PCD. A minimum of the most recent and consecutive 20 batches of each Class, and Grade or Style shall be used to establish control limits.
- c. If statistical analysis determines that a KC or KPP is out of control, the supplier shall:
  - (1) Investigate the cause(s).
  - (2) Eliminate special causes of variation and reestablish control.
- d. If a KC is not capable, the supplier shall take corrective action to establish capability in accordance with BSS7286.

7.2

PURCHASER QUALITY CONTROL

- a. Check the packaging, marking and supplier's test data to verify conformance to the appropriate sections of this specification.
- b. Purchaser Quality Assurance shall review all supplier test data submitted with shipment and perform any additional inspection or testing necessary to assure that the production material meets the requirements specified herein.
- c. Perform quality assurance tests on one roll from each batch in accordance with Table VIII unless Purchaser testing requirements have been removed for that product in accordance with Section 7.2d.

**TABLE VIII PURCHASER QUALITY ASSURANCE TESTS**

TEST	TEMPERATURE	TABLE	TEST METHOD SECTION
Resin Content	---	I	8.2.1
Gel Time	---	I	8.2.2
Flow	---	I	8.2.3
Volatiles	---	I	8.2.4
Areal Weight <b>FL 1</b>	---	I	8.2.1
Compression Ultimate and Modulus	RT	II or IV	8.4f.
Tensile Ultimate and Modulus	RT	II or IV	8.4.1a.

**FL 1** Test for Class IV material only.

- d. When a supplier has demonstrated consistent conformance to required testing in accordance with Section 7.1, Purchaser testing may be removed as a requirement for material procured from that supplier. Appropriate Boeing Quality Assurance documentation such as D1-4426 shall indicate which products do not require Purchaser testing.
- e. Verify that each lot of prepreg meets the storage condition requirements in Section 5 and Section 10.7 of this specification during shipping.
  - (1) The purchaser shall document the procedure used to verify temperature exposure
  - (2) If the exposure time and temperature conditions exceed the maximum mechanical life conditions in Section 5.1.5, reject the material.
  - (3) Deduct exposures that exceed the storage temperature and are less than the maximum mechanical life exposure conditions from the mechanical life in Section 5.1.5 for the material in that lot. Temperature excursions during shipment of up to + 10 F above the maximum storage temperature are allowed without mechanical life deduction as long as the total time of the excursions does not exceed 60 minutes.

7.2

PURCHASER QUALITY CONTROL (Continued)

- (4) If the storage conditions cannot be verified, material in the shipment shall be tested in accordance with Section 7.2c. The amount of time where storage conditions cannot be verified shall be subtracted from the handling and mechanical life.
- f. All test data and records shall be kept on file for a minimum of 7 years and be readily available for review.

8

**MATERIAL TEST METHODS**

**WARNING**

This specification involves the use of chemical substances which are hazardous. Boeing personnel shall refer to the work area Hazard Communication Handbook for health effect and control measure information contained in the HazCom Info Sheets and Material Safety Data Sheets. For disposition of hazardous waste materials, consult site environmental engineers for proper disposal methods.

Non-Boeing personnel should refer to manufacturer's Material Safety Data Sheet(s) and their employer's safety instructions.

- a. The test methods described below shall be used. Requests for use of an equivalent test method shall be directed to a SM&P organization of The Boeing Company. Requests for deviations in test methods shall include data demonstrating that the alternate method is equivalent to the specification method. Use of the equivalent test method shall be referenced in the PCD and shall be approved by the responsible Boeing Engineering Group(s).
- b. If no tolerance is stated, use the given value as nominal.

8.1

SAMPLING FOR PREPREG PHYSICAL PROPERTY REQUIREMENTS

- a. Before taking a sample, warm the material as necessary to above the ambient dewpoint to assure that no condensation will occur on the sample or the unused prepreg when the protective bag is removed.
- b. Discard any dried, moisture-affected, or contaminated material from each roll to be sampled. Remove sufficient material from each roll to perform all required tests, then repackage the roll and sample(s) in moisture proof bags before returning the unused prepreg to storage. Minimize out-time from refrigerated storage.

8.2

PREPREG MATERIAL TEST METHODS

Cut 4 by 4 inch specimens as required for resin solids content, percent flow, and percent volatiles tests and 2 by 2 inch specimens (for BSS7276, Method I) or 0.25 inch by 0.25 inch, for BSS7276, Method II, as required for gel time test. Cut these specimens at 45 degrees to warp in a pattern so that the samples for each test will be representative of the swatch. Do not cut any specimens within 2 inches of the selvage.

**NOTE:** Allow prepreg to attain the temperature condition specified in Section 8.1a. prior to debagging and sampling.

8.2.1 RESIN SOLIDS CONTENT, AREAL WEIGHT

- a. Prepare a minimum of two specimens.
- b. Determine the resin solids content in accordance with BSS7336, Method I, Burn-Out Method. For Class IV only, determine the width and length of each specimen to the nearest 0.1 cm. before burn-out and calculate the area.
- c. The average resin solids content shall meet the requirements of Table I.
- d. For Class IV only, calculate the areal weight by dividing the specimen weight after burn-out ( $W_2$ , grams) by the specimen area ( $M_2$ ). The average areal weight shall meet the requirements of Table I.

8.2.2 GEL TIME

- a. Prepare a minimum of two specimens.
- b. Set the test temperature at  $275 \pm 5$  F ( $135 \pm 3$  C). Determine the gel times in accordance with BSS7276, Method I or II, Platen-Press or Temperature-Controlled Hot-Plate method.
- c. The average value shall meet the requirements of Table I.

8.2.3 RESIN FLOW

- a. Lay up a minimum of two laminates each at least 0.10 inch thick.
- b. Set the platen press at  $275 \pm 5$  F ( $135 \pm 3$  C) and  $50 \pm 5$  psi. In addition, set the timer at 5 minutes plus the measured prepreg gel time.
- c. Determine the resin flow in accordance with BSS7335, Method I, Nonbleeder Method, Type I or II, Nonperforated release film or aluminum foil.
- d. The average percent flow shall meet the requirements of Table I, and the two flow determinations shall not vary more than 3 flow percent. Tests shall be rerun if the spread is greater than 3 flow percent.

8.2.4 VOLATILE CONTENT

- a. Prepare a minimum of two specimens from the test swatch from samples taken in accordance with Section 7.1b. or 7.2a. as applicable.
- b. Set the oven at  $275 \pm 5$  F ( $135 \pm 3$  C). Set the devolatilizing time at  $8 \pm 1$  minutes.
- c. Determine the volatile content in accordance with BSS7337, Method I, Hook/Clip Method.



### 8.3 TEST PANEL FABRICATION

#### 8.3.1 LAMINATE TEST PANELS

- a. Use the number of plies specified in Table VII for the test panel being fabricated and the style of prepreg being tested.
- b. Each laminate shall be large enough to accommodate test specimens so that no tested area is within 2 inches of any edge bleeder. The following sizes are recommended:

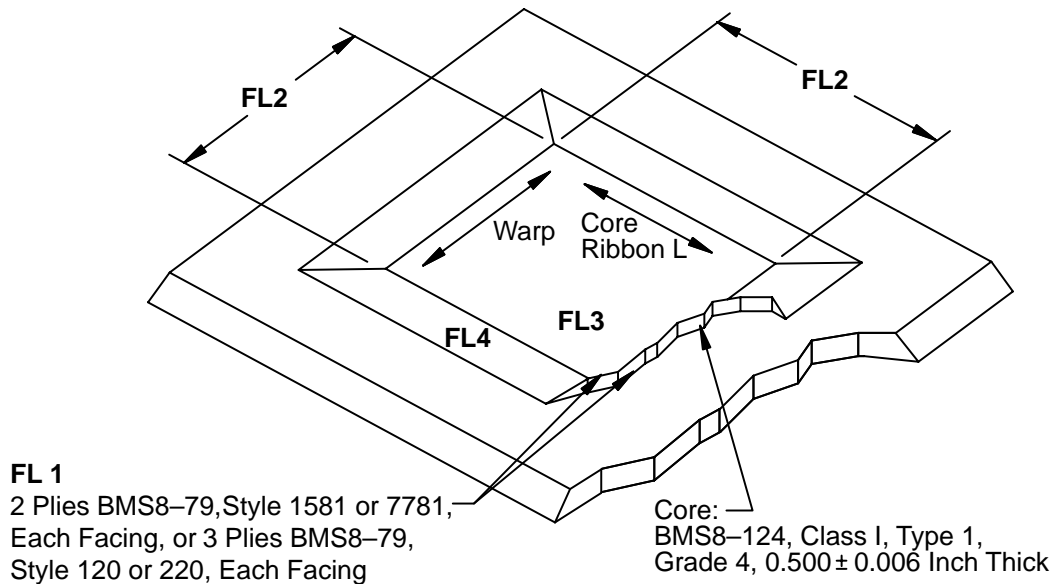
Test Panel	Length, inches (Warp Direction)	Width, inches
Mechanical Tests	14	20
Interlaminar Shear	10	20
Electrical Tests	6	6
Hydraulic Fluid Resistance Tests	Use excess from mechanical or interlaminar shear panel	
Flammability	24	26

- c. Position plies with warp face up and warp direction parallel within  $\pm 1$  degree.
- d. Initial qualification will require duplicate test panels, laid up in accordance with Section 8.3.1b. and cured using both heat-up rates specified in Section 8.3.3d. After qualification only one panel need be fabricated and tested with the heat-up rate within those specified in Section 8.3.3d. used in the cure.

### 8.3.2

### SANDWICH TEST PANELS

- a. Use the number of facing plies specified in Table VII as applicable for the style of prepreg being tested. Fabricate the sandwich test panel in accordance with Figure 3.
- b. Initial qualification will require duplicate test panels – laid up in accordance with Figure 3 and cured using both heat-up rates specified in Section 8.3.3d. After qualification, only one panel need be fabricated and tested with the heat-up rate within those rates specified in Section 8.3.3d. used in the cure.



**FIGURE 3 SANDWICH TEST PANEL CONFIGURATION**

- FL 1** The prepreg shall be oriented so that the warp face of the fabric is against the core on both sides.
- FL 2** Panel dimensions shall be such as to allow machining of the number and kinds of test coupons specified in Section 8.4d. and Table V or Table VI as applicable.
- FL 3** No splices allowed in test panel core.
- FL 4** All test panel cores shall be chamfered  $25 \pm 10$  degrees.

**NOTE:** Square edge is optional to chamfer edge.

### 8.3.3 TEST PANEL PROCESSING

- a. Edge bleed only. The bleeder material may overlap the layup a maximum of 0.5 inch.
- b. Apply nonbondable Tedlar, FEP, or TFE release film between layup and bag (do not use bondable Tedlar).
- c. Vacuum bag each test panel. Draw full vacuum and test each assembly for leaks – when vacuum line is disconnected, vacuum shall not drop more than 5 inches of mercury in 5 minutes.
- d. For qualification, cure one set of test panels at a heat-up rate of  $2 + 1.5/- 0.5$  degrees F/minute and cure a duplicate set at a heat-up rate of  $8 + 0/- 2$  degrees F/minute. For Quality Assurance, cure panels, as needed, using a heat-up rate between 2 and 8 degrees F/minute.
  - (1) Place test panels while under vacuum into autoclave and apply  $45 \pm 5$  psi positive pressure. When autoclave pressure reaches 15 psi, vent assemblies to atmosphere.
  - (2) Heat to  $260 \pm 10$  F at designated heat-up rate. Hold at temperature for  $90 + 15/- 0$  minutes. Cool to or below 160 F before releasing autoclave pressure.

### 8.4 SPECIMEN PREPARATION AND TEST

General Requirements for both laminate and sandwich specimens.

- a. Machine all mechanical test specimens at  $0 \pm 1$  degree to warp (parallel to warp).
- b. Heat soak all elevated temperature specimens for a minimum of 30 minutes at specified temperature just prior to test.
- c. Report individual and average values.
- d. Use test machines conforming to ASTM E 4.
- e. Test 5 specimens at each temperature for laminate mechanical properties and 4 specimens at each temperature for sandwich mechanical properties unless otherwise stated in the property test method.
- f. Compression Ultimate and Modulus – ASTM D 695
  - (1) Machine and test a minimum of five specimens in accordance with ASTM D695, from each test panel at each temperature. Cut specimens randomly to make them representative of the panel. Use specimen cross section area based on nominal thickness to calculate test results. Use the ply thickness listed in Table VII to determine nominal specimen thickness.
  - (2) Use a compressometer to obtain the load-strain curve – do not use a deflectometer.
  - (3) Compression ultimate and modulus test averages shall meet requirements of Table II or Table IV as applicable.

8.4.1

LAMINATE TEST SPECIMENS

a. Tensile Ultimate and Modulus – ASTM D 638

- (1) Machine and test a minimum of five Type II configuration specimens in accordance with ASTM D638, from each set at each temperature. Cut specimens randomly to make them representative of panel. Use specimen cross section area based on nominal thickness to calculate test results. Use the ply thickness listed in Table VII to determine nominal specimen thickness.
- (2) When testing each specimen, use a crosshead rate of travel of 0.05 inch/minute until the initial straight line portion of the stress/strain curve is obtained for modulus calculation. Rate may then be increased to 0.20 to 0.25 inch/minute until failure occurs.
- (3) Tensile ultimate and modulus averages shall meet Table II or Table IV requirements as applicable.

b. Interlaminar Shear

- (1) Each test specimen shall be in accordance with ASTM D 3846, except that distance between the notches is to be 0.375 inch  $\pm$  0.015 inch.
- (2) Machine and test a minimum of five specimens from each test panel at each temperature (15 specimens/panel). Cut specimens randomly to make them representative of the entire panel.
- (3) Interlaminar shear test averages shall meet Table II or Table IV requirements as applicable.

c. Dielectric Constant and Loss Tangent

- (1) Each test specimen shall be in accordance with D6–40201–1.
- (2) Machine and test a minimum of two specimens from each test panel.
- (3) Use a frequency of 9.3 gigahertz. Test one specimen as received (dry) at  $70 \pm 5$  F. Immerse second specimen in distilled water at  $70 \pm 5$  F for 24 hours, wipe dry, and test immediately at  $70 \pm 5$  F.
- (4) Dielectric constant and loss tangent test values shall meet Table III requirements.

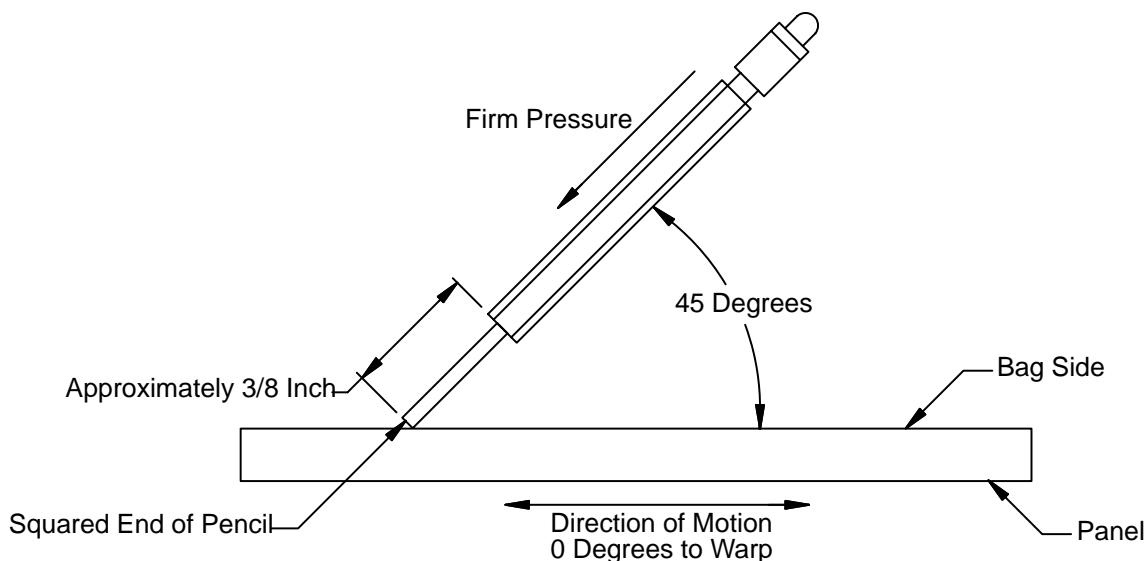
d. Hydraulic Fluid Resistance

- (1) Each test specimen shall be approximately 1 inch wide by 3 inches long.
- (2) Cut two specimens from excess of mechanical test or interlaminar shear test panels, one from each test panel if excess permits.
- (3) Obtain drawing pencils ranging in hardness from 4H through 9H and square the tips (see Figure 4). This may be done by holding the pencil in a vertical position and moving the lead back and forth over 400-grit or finer abrasive paper. Resquare tips after each hardness test.

8.4.1

LAMINATE TEST SPECIMENS (Continued)

- (4) Place specimen in a horizontal position vacuum bag side up. Hold pencil at a 45-degree angle and push it across the specimen using firm, steady pressure (see Figure 4). Continue testing with the various hardness pencils until one is found that will just cut or scratch the panel. Make these tests at  $80 \pm 10$  F. The minimum pencil hardness shall be 6H.
- (5) Immerse each specimen in Monsanto Low Density Aviation Hydraulic Test Fluid or BMS3-11, Type IV, Class 1 heated to  $160 \pm 5$  F and hold immersed and at temperature for 48 hours minimum.
- (6) Remove specimens from bath, cool to  $80 \pm 10$  F and remove excess oil from panels using clean, dry gauze.
- (7) Immediately retest hardness. Surface hardness of the exposed panel shall not decrease more than two pencil lead hardnesses.
- (8) Examine exposed panel edges. There shall be no evidence of delamination due to exposure.



**FIGURE 4 HYDRAULIC FLUID RESISTANCE TEST CONFIGURATION**

e. Flammability Properties

- (1) The 60-second vertical test specimens shall be 3.0 inches  $\pm$  0.1 inches wide and 13.0 inches  $\pm$  0.1 inches long (warp) and the 45-degree specimens shall be 10.0 inches by 10.0 inches  $\pm$  0.1 inches.
- (2) Cut three specimens for each test from each set of panels and test to the procedures listed in BSS7230.
- (3) Flammability properties shall meet requirements listed in Table III.

## 8.4.2 SANDWICH TEST SPECIMENS

Cut test specimens from each test panel and test as follows:

### a. Sandwich Peel Test

- (1) Each test specimen shall be  $3.00 \pm 0.03$  by  $12.0 \pm 0.1$  inches with the 12-inch dimension 0 degree (parallel) to the warp direction.
- (2) Cut and test a minimum of two specimens for each face of each panel. Use the climbing drum peel apparatus (see ASTM D 1781). Use a head speed of  $1.00 \text{ inch} \pm 0.10 \text{ inch per minute}$ . Determine peel curve average.
- (3) Rewind drum using a loose material such as Osnaburg cloth and determine rewind curve average. Determine rewind value at least once each day peel testing is being conducted. This average rewind value shall be subtracted from the average peel value.
- (4) Determine average peel strength for bag face skins and average peel strength for tool face skins.

Peel Strength = (Avg. Peel – Drum Rewind) (Torque Arm) = lb-in./3-in. width

Torque Arm = Radius of Flange minus Radius of Drum = 0.5 inch

Peel strength averages shall meet Table V or Table VI requirements as applicable.

- (5) Report individual and average values.

### b. Flatwise Tensile

- (1) Each test specimen shall be  $2.00 \pm 0.01$  inches by  $2.00 \pm 0.01$  inches square.
- (2) Cut, bond, and test a minimum of 12 specimens from each test panel (four specimens each at each temperature as listed in Table V or Table VI as applicable) in accordance with SAE-AMS-STD-401.
- (3) Average flatwise tensile strength shall meet Table V or Table VI requirements as applicable.
- (4) Report individual and average values.

## 8.4.2 SANDWICH TEST SPECIMENS (Continued)

### c. Long Beam Flexure

- (1) Each test specimen shall be  $3.00 \pm 0.03$  inches by  $24.0 \pm 0.1$  inches with the 24-inch dimension in the warp direction. Exception: Elevated temperature specimens may be reduced in length if required to fit equipment used, provided an 18-inch span is maintained.
- (2) Cut and test a minimum of 12 specimens from each panel, four each at each temperature listed in Table V or Table VI as applicable, in accordance with SAE-AMS-STD-401, except test shall be single point loading on an 18-inch span. Use a 1-inch wide by 3-inch long steel block with a 60D (durometer) rubber pad 1/8-inch thick at the center load point. Test all specimens bag side up.
- (3) Report ultimate load and P/Y for each specimen. Average long beam flexure strength shall meet Table V or Table VI as applicable requirements. P/Y is the slope of the tangent to the initial portion of the load-deflection curve.

## 9 MATERIAL IDENTIFICATION

Legibly identify each roll by means of a tag or label, pressure sensitive labels preferred, inside the prepreg core or transferable to inside the core from the exterior of the sealed noncontaminating bag. The label shall contain the following information:

- a. Glass fabric impregnated with epoxy resin.
- b. Manufacturer's name and product designation
- c. BMS8-79, including revision letter, Class and Style of prepreg
- d. Date of impregnation
- e. Batch number, roll number and roll length in linear yards
- f. Width of prepreg not including selvage
- g. Number of preplied plies in roll, if applicable

## 10 PACKAGING AND MARKING

### 10.1 CARRIER

- a. All prepreg shall be interleaved with noncontaminating carrier material.
- b. If the carrier or interleaf material has a release coating, the coating shall be fully cured and nontransferring. The carrier width shall be not less than the prepreg including selvages. The carrier material shall contain a nontransferring or noninhibiting color. The carrier material shall have a diamond embossed pattern, and shall be placed on the warp face of the prepreg surface with the pattern long dimension parallel to the fabric warp direction and be easily removable from the prepreg at shop temperatures.

10.2 ROLL SIZE

Rolls of prepreg material shall be supplied in the width stated in the purchase order. The total linear yardage received shall be within the limits authorized in the purchase order.

10.3 CORE CONFIGURATION

- a. Rolls of prepreg shall be supported by a core that is not deformed by the material weight.
- b. The inside diameter of the core shall be 3 inches minimum.
- c. The core shall extend 2 inches to 3 inches nominal (50 to 75 mm) beyond the carrier width at each end.

10.4 COLOR CODING

Each prepreg roll shall be color coded as follows:

CLASS III STYLE DESIGNATIONS	CARRIER COLOR	CLASS IV STYLE DESIGNATIONS	CARRIER COLOR
120 and 220	Red	220	Black
1581 and 7781	Red	7781	Black
1582	Purple		
1584	Green		
1543	Yellow		

10.5 CONTAINER

- a. Packaging shall be accomplished in such a manner as to assure delivery of material capable of meeting the requirements of this specification.
- b. Seal each roll in a clean, defect free bag. Defects are considered to be visually detectable discontinuities such as holes, cuts, or tears, which allow free passage of moisture or other contaminants. Bags shall be either a 0.006 inch polyethylene or a Boeing approved alternate as listed in the Boeing approved PCD. A suitable desiccant shall be placed in bags prior to sealing.
- c. The core when within the container, shall be supported in such a way that the material will not be damaged or degraded from its own weight.
- d. Labeling shall conform to OSHA 1910.1200.



10.6

MARKING

- a. Each container of prepreg shall be permanently and legibly marked to give the information in Section 9 and the following:
  - (1) Purchase order number
  - (2) Date of shipment
- b. In addition, containers will be labeled on two sides in red letters at least 2 inches high with the following or equivalent statement:
  - (1) "Ship and store at 10 F or below"
  - (2) "Do not stand on end"

10.7

SHIPPING

- a. Ship material at 10 F or below.
- b. Include sufficient temperature recorders with each lot shipped to assure that all temperature excursions above 10 F are recorded.
- c. The use and placement of temperature recorders shall be in accordance with BSS7061.
  - (1) The use of a freezer truck is acceptable with the use and placement of two thermocouples in accordance with BSS7061.