1 SCOPE

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.

a. This specification establishes requirements for 250F (121C) curing epoxy resin-impregnated BMS9-8 Type I carbon fiber unidirectional tape and woven fabric forms.

b. This specification requires qualified products.

1.1 CONTENTS

1.1 CONTENTS (Continued)

1.1 CONTENTS (Continued)

LIST OF FIGURES

1.1 CONTENTS (Continued)

LIST OF TABLES

2 CLASSIFICATION

This specification consists of the following Types, Classes, and Grades or Styles.

2.1 TYPES

Type shall specify resin system.

Type I - Nonadhesive resin system

Type II - Self adhesive resin system

Type III - Self adhesive resin system meeting flammability requirements

2.2 CLASSES

Class shall specify carbon fiber reinforcement configuration.

Class 1 - Unidirectional prepreg tape

Class 2 - Woven fabric prepreg

2.3 CLASS 1 GRADES

Grade shall specify the nominal areal weight of unidirectional tape.

Grade 95 - 95 g/m^2 carbon fiber nominal areal weight

Grade 145 - 145 g/m^2 carbon fiber nominal areal weight

Grade 190 - 190 g/m^2 carbon fiber nominal areal weight

2.4 CLASS 2 STYLES (BMS9-8)

Style shall specify weave characteristic.

3K-70-PW - 3K yarn, 7-mil plain weave, nonporous

3K-135-8H - 3K yarn, 13.5-mil, 8-harness satin weave

3 REFERENCES

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

AMS-STD-401 - Sandwich Construction and Core Materials: General Test Methods
ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM E4 - Standard Practices for Force Verification of Testing Machines
BMS9-8 - Graphite Reinforcements, Yarn and Fabric
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 - Flammability Properties of Aircraft Materials, Determination of
BSS7260 - Advanced Composite Compression Tests
BSS7276 - Gel Time, Prepreg, Test Method for Determination of
BSS7286 - Statistical Process Control of Designated Engineering Characteristics
BSS7305 - High Performance Liquid Chromatography - Reverse Phase Method
BSS7320 - Tensile Testing of Composites
BSS7335 - Resin Flow of Prepreg Fabric and Tape, Test Method for
BSS7336 - Resin Content and Fiber Areal Weight of Prepreg Fabric and Tape, Test Method for
BSS7337 - Volatile Content of Prepreg Fabric and Tape, Test Method for
OSHA 1910.1210 - Hazard Communication Program

4 DEFINITIONS

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

Bag Side - That side of the panel that is cured against the vacuum bag.

Bleeder - Porous material used as a vacuum contact and to absorb excess resin from prepreg during cure.

4 DEFINITIONS (Continued)

Breather	-	A porous material (such as glass fabric or nylon) used during cure to provide a continuous vacuum path for a part but is not allowed to directly contact any prepreg.
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	-	Date on which the prepreg batch is initially impregnated.
Fabric Batch	-	Fabric woven from one warp loom setup with warp and fill yarns meeting the requirements of BMS9-8 with traceability to individual yarn lots.
Fabric Prepreg Batch	-	Prepreg containing fabric traceable by fabric batch (as defined in BMS9-8) meeting the requirements of BMS9-8 impregnated with one batch of resin in one continuous operation.
Fill	-	The crosswise yarns running at 90 degrees to the warp of the fabric reinforcements.
Fill Face	-	The side of the fabric where the greatest number of the yarns are perpendicular to the selvage.
Fold	-	A condition in which the fabric is laid back over itself.
Fuzz Balls	-	These occur when individual filaments are abraded or broken during the manufacture of the impregnated material. The broken filaments and/or abraded particles collect as loose filament bundles or balls which are occasionally incorporated into the impregnated material.
Out-time	-	The maximum (cumulative) time that a prepreg may be kept at amibient condition and still retain properties within the limits of this specification.
Prepreg Lot	-	Prepreg from one batch submitted for acceptance at one time.
Puckers	-	Areas on prepreg materials where the material has locally blistered or puckered from the separator film or release paper.
Resin Batch	-	Resin mixed in one mixer in one operation or blended together in one homogeneous mix with traceability to individual component lots.
Selvage	-	The woven edge portion of a fabric parallel to the warp; usually has an increased number of ends/inch.
Tape Prepreg Batch	-	Prepreg containing reinforcement meeting the requirements of BMS9-8 impregnated with one batch of resin in one continuous operation, with traceability to individual fiber lots.
Tool Side	-	That side of the panel that is cured against the tool surface.
Warp	-	The yarns running lengthwise in woven fabric.

4 DEFINITIONS (Continued)

Warp Face - That side of the fabric where the greatest number of the yarns are parallel to the selvage.

Yarn Lot - In general, a quantity of material formed during a unit of production having the same process and identical characteristics throughout.

5 MATERIAL REQUIREMENTS

Reinforcement used in the manufacture of prepreg to this specification shall meet the requirements of BMS9-8 with traceability to original yarn lots.

5.1 PREPREG PROPERTIES

5.1.1 PHYSICAL PROPERTIES

The prepreg shall conform to the requirements of Table I when tested in accordance with the designated methods.

TABLE I - PREPREG PHYSICAL PROPERTIES

PROPERTY	AVERAGE REQUIREMENT				TEST METHOD SECTION	INDIVIDUAL REQUIREMENT			
	TYPE I	TYPE II		TYPE III		TYPE I	TYPE II		TYPE III
	CLASS 1 AND 2	CLASS 1	CLASS 2	CLASS 2		CLASS 1 AND 2	CLASS 1	CLASS 2	CLASS 2
Resin Content, percent wt. FL 1 FL 2 FL 3	35.0 ± 2.0	40.0 ± 2.0	42.0 ± 2.0	42.0 ± 2.0	8.1.1	35.0 ± 2.5	40.0 ± 3.0	42.0 ± 3.0	42.0 ± 3.0
Volatiles Content, percent wt. FL 1	2.0 max.	2.0 max.	2.0 max.	2.0 max.	8.1.2	2.0 max.	2.0 max.	2.0 max.	2.0 max.
Flow, percent wt. FL 1	QPL	QPL	QPL	QPL	8.1.3	QPL	QPL	QPL	QPL
Gel Time, minutes FL 1	QPL	QPL	QPL	QPL	8.1.4	QPL	QPL	QPL	QPL
Areal Weight Carbon Fiber Only FL 1	gm/m^2	oz/yd^2			8.1.1	gm/m^2	oz/yd^2		
Grade 95	95 ± 5	2.80 ± 0.15				95 ± 6	2.80 ± 0.18		
Grade 145	145 ± 5	4.30 ± 0.15				145 ± 6	4.30 ± 0.18		
Grade 190	190 ± 5	5.60 ± 0.15				190 ± 9	5.60 ± 0.27		
Style 3K-70-PW	193 ± 8	5.7 ± 0.25				193 ± 9	5.7 ± 0.27		
Style 3K-135-8H	364 ± 14	10.7 ± 0.40				364 ± 15	10.7 ± 0.44		

FL 1 Minimum tests required for supplier and purchaser quality control testing.

FL 2 Supplier Test: For Grade 95 tape, any roll of any prepreg lot may be within ±3 wt. percent of nominal. For all other Grades and Styles, a maximum of 20 percent or one roll of any prepreg lot may be within ±3 wt. percent of nominal.
Purchaser Test: For all Grades and Styles all sampled rolls of any prepreg lot may be within ±3 wt. percent of nominal.

FL 3 Supplier Key Characteristic in accordance with BSS7286.

5.1.2 CHEMICAL PROPERTIES

The prepreg resin shall conform to the requirements of Table II when tested in accordance with the designated method.

TABLE II - PREPREG CHEMICAL PROPERTIES

PROPERTY	REQUIREMENT	TEST METHOD SECTION
Uncured Resin Chemical Structure	Report IR Spectrum	8.4.1
Uncured Resin Component Analysis FL 1 (High Performance Liquid Chromotography - LC)	QPL	8.4.2

FL 1 Supplier Key Characteristic in accordance with BSS7286.

5.1.3 DEFECT LIMITATIONS AND DIMENSIONAL REQUIREMENTS - CLASS 1 (TAPES)

a. The preimpregnated material shall be uniform in quality and condition and shall not exhibit characteristics detrimental to handling, layup or structural properties.

b. The material shall be free from crimped or misaligned fibers, cured resin particles, foreign material, twists, unwetted fibers, dry or boardy areas, puckers and moisture.

c. The edge of the prepreg tape shall not deviate from a straight line by more than 0.025 inch per foot of length and shall be flush with the separator paper.

d. Fuzz balls which do not cause a sudden discernable change in the prepreg thickness shall be acceptable, provided the overall thickness change is no more than 100 percent of the nominal thickness for Grade 95 material, and no more than 50 percent of the nominal thickness for all other grades.

e. Fuzz balls within the above criteria shall be acceptable provided no apparent fiber distortion is caused by the fuzz ball, and the accumulated area of such fuzz balls does not exceed 3 square inches in any square foot of prepreg material.

f. In determining if there is any apparent fiber distortion caused by a fuzz ball, it shall not be necessary to remove the fuzz ball from the prepreg.

g. The length of open spaces between fibers shall not exceed 10 inches. The width of open spaces between fibers shall not exceed 0.030 inches. One open space 0.010 to 0.030 inches wide and not exceeding 10 inches long is acceptable in each 10 sq. ft. of prepreg. Open spaces less than 0.010 inches wide and not exceeding 10 inches long are acceptable.

h. The orientation of the yarn within the prepreg shall not deviate from a straight line parallel to the centerline of the prepreg by more than 0.032 inch in 1 foot of length.

i. Tolerances on width of the material shall be ± 0.050 inch.

j. Yarn splice locations shall be clearly indicated on the prepreg or separator film (backing paper).

5.1.4 DEFECT LIMITATIONS AND DIMENSIONAL REQUIREMENTS - CLASS 2 (FABRICS)

a. The preimpregnated material shall be uniform in quality and condition and shall not exhibit characteristics detrimental to handling, layup or structural properties.

5.1.4 DEFECT LIMITATIONS AND DIMENSIONAL REQUIREMENTS - CLASS 2 (FABRICS) (Continued)

b. Visible indications of impurities, dry areas, areas of nonconformity, incomplete impregnation, cured resin, hard spots, or localized color differences in the impregnated fabric supplied shall be marked by tags as nonconforming areas (see Section 5.1.5).

c. Impregnated fabric shall be free from curled or folded selvages that overlap nonselvage areas, wrinkles or resin rich areas.

d. Selvage width on each side of the fabric shall not exceed 1.5 inches.

e. The warp and fill yarns shall be perpendicular to each other and parallel to the warp and fill directions of the impregnated cloth within 2.0 inches over the full cloth width (exclusive of selvage) and within 1.0 inch in any 21.0 inches of cloth width or length.

f. Width of the material shall be within ± 1 inch. Width shall not include selvages.

g. For both warp and fill yarns the ratio (L/D) between maximum yarn deviation (D) from a straight line and the distance along the yarn (L) over which the deviation takes place shall not be less than 10. When the deviation (D) is less than 1/4 inch, the L/D requirement is waived.

5.1.5 NONCONFORMING MATERIAL (TAPES AND FABRIC)

a. Areas of material not conforming to Section 5.1.3 or Section 5.1.4 shall be identified along the edge of the prepreg roll by markers. Markers shall be 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. For continuous defective areas, markers shall be placed at the beginning, at 2 feet (maximum) intervals and at the end of the continuous defect.

d. For Class 2 woven fabric defects, each crease, cut tear, smash, fabric splice and weave separation shall be marked. Fabric weaving defects shall be remarked after impregnation only if the fabric quality requirements of BMS9-8 are not met.

e. Prepreg may be cut to remove defects. Prepreg splicing procedures 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 by weight. Defect weight limit shall be based on the full-width weight.

g. Ninety percent of the supplied prepreg shall be in lengths of not less than 50 feet and the remaining ten percent shall be in lengths not less than 15 feet.

h. The type, location, and length (for continuous defect) 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 to within 3 feet relative to the outside end of the prepreg roll.

i. Defective areas shall not be counted toward the amount purchased.

5.1.6 STORAGE LIFE AND OUTTIME

a. Storage Life - 300 days from date of manufacture, stored at 10F or below in a sealed moisture-proof container.

b. Out-time exposure units shall be calculated, recorded and reported in accordance with Table III and as follows:

(1) One unit accumulates for each hour at temperatures between 11F and 80F,

(2) Three units accumulate for each hour at exposed temperatures between 81F and 100F,

(3) Materials exposed to temperatures above 100F shall be rejected.

TABLE III - STORAGE LIFE AND NONREFRIGERATION TIME (OUT TIME)

MATERIAL	REQUIREMENTS (MAXIMUM)	
	STORAGE LIFE (< 10F)	OUT TIME (EXPOSURE UNITS) FL 1
Type I	300 days from date of manufacture	240
Type II		200
Type III		200

FL 1 Calculate total out-time exposure units in accordance with Section 5.1.6.b.

c. Materials shall be rejected that have been exposed to temperatures above 100F or have exceeded the maximum storage life or out time exposure units, described in Table III.

d. The supplier shall assure that the material qualified and supplied to this specification will retain the qualities defined in the requirements section of this specification under the following conditions:

(1) At the end of the storage life of this prepreg, when maintained at or below 10F; a minimum of 300 days from the date of manufacture.

(2) At the end of the storage life of this prepreg as defined in Section 5.1.6.d.(1). plus a minimum accumulated total of out-time of 240 or 200 out-time exposure units, as defined in Table III.

e. The supplier is allowed a maximum out-time of 72 hours at room temperature.

f. Unless specified on the purchase contract, there shall be a minimum of 210 days of storage life remaining from the date of receipt at the purchasers facility.

5.2 LAMINATE AND SANDWICH PROPERTIES

a. Individual and average property values shall be reported for all tests.

b. Properties of cured laminate and sandwich materials, when fabricated and tested in accordance with Section 8.2 and Section 8.3, respectively, shall meet the requirements of Table IV (Physical Properties) and Table VI, Table VII, Table X, or Table XI (Mechanical Properties), as appropriate for each Type, Class and Grade/Style.

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

TABLE IV - LAMINATE PHYSICAL PROPERTIES

PROPERTY	GRADE/STYLE	REQUIREMENTS			TEST METHOD SECTION
		TYPE I	TYPE II	TYPE III	
Ply Thickness, mils FL 1 FL 5	95	3.2 - 3.9	3.7 - 4.5		8.1.5
	145	5.0 - 5.9	5.6 - 6.8		
	190	6.5 - 7.6	7.5 - 8.8		
	3K-70-PW	6.9 - 8.2	7.5 - 9.1	7.5 - 9.1	
	3K-135-8H	13.2 - 15.8	14.4 - 17.4	14.4 - 17.4	
Void Content FL 5	All	2 percent maximum	2 percent maximum	2 percent maximum	8.1.6
Porosity FL 5	3K-70-PW	Pass	Pass	Pass	8.1.7
Flammability FL 4 FL 6	All	Not Required	Not Required	FL 2	8.1.8
(BMS3-11, Hydraulic Fluid, Resistance Type IV, Class 1) FL 6	All Nonhybrid	FL 3	FL 3	FL 3	8.1.9

FL 1 Minimum tests required for supplier and purchaser quality control testing. Supplier Key Characteristic in accordance with BSS7286.

FL 2 60-second vertical - material shall be self extinguishing with 8 seconds of flame removal, shall burn no more than 4 inches, and resin drips shall extinguish within 1 second.
30-second 45-degree - material shall be self extinguishing with 8 seconds of flame removal, afterglow shall cease to be visible within 3 seconds of flame removal, and there shall be no complete penetration of the material by flame.

FL 3 Surface hardness of the exposed panel shall not decrease more than 2 pencil lead hardnesses nor shall more than one original panel hardness fall below 6H nor shall any test value fall below 4H.

FL 4 Minimum tests required for purchaser quality control testing.

FL 5 Determine pass/fail based on average values.

FL 6 Determine pass/fail based on individual test results.

TABLE V - LAMINATE NOMINAL PER-PLY THICKNESS

GRADE/STYLE	NOMINAL THICKNESS, INCH		
	TYPE I	TYPE II	TYPE III
95	0.0035	0.0041	NR
145	0.0054	0.0062	NR
190	0.0071	0.0082	NR
3K-70-PW	0.0075	0.0086	0.0086
3K-135-8H	0.0144	0.0164	0.0164

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

TABLE VI - LAMINATE MECHANICAL PROPERTIES (TYPE I - CLASS 1 - TAPES)

TEST	TEST TEMPERATURE	REQUIREMENT FL 1		TEST METHOD SECTION
		MIN. AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Strength Ultimate, ksi, 0 degrees	-65F (-54C)	175	155	
	RT FL 3	185	160	
	160F (71C)	185	160	
Tensile Modulus msi, 0 degrees	-65F (-54C)	19.5 - 22.5	18.5 - 23.5	
	RT FL 3	19.5 - 22.5	18.5 - 23.5	8.3.1.1
	160F (71C)	19.0 - 22.0	18.0 - 23.0	
Tensile Strain Ultimate, µ-in./in., 0 degrees	-65F (-54C)	7,500	6,500	
	RT FL 3	9,500	7,500	
	160F (71C)	9,500	7,500	
Compression Strength Ultimate, ksi, 0 degrees	-65F (-54C)	175	150	
	RT	175	150	
	160F (71C) FL 3	155	130	
Compression Strength Ultimate, ksi, 0 degrees	RT Wet FL 2	165	150	
	160F (71C) Wet FL 2	130	90	
Compression Modulus, msi, 0 degrees	-65F (-54C)	18.0 - 21.5	16.0 - 23.0	8.3.1.2
	RT	18.5 - 21.5	16.0 - 23.0	
	160F (71C)	18.0 - 21.5	16.0 - 23.0	
Compression Strain Ultimate, µ-in./in., 0 degrees	-65F (-54C)	8,100	No reqt.	
	RT	8,100	No reqt.	
	160F (71C)	7,200	No reqt.	

FL 1 Record the actual number of plies used in each specimen configuration. Calculate laminate mechanical properties using nominal per ply thickness as specified in Table V.

FL 2 Tested after immersion in water at 160 ± 10F (71 ± 5C) for 14 days.

FL 3 Minimum tests required for supplier and purchaser quality control testing. Supplier Key Characteristic in accordance with BSS7286.

TABLE VII - CARBON FIBER/EPOXY MECHANICAL PROPERTIES (TYPE II - CLASS 1 - TAPES) LAMINATE AND SANDWICH

TEST	TEST TEMPERATURE	REQUIREMENT FL 1		TEST METHOD SECTION
		MIN. AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Strength Ultimate, ksi, 0 degrees	-65F (-54C)	170	150	
	RT FL 3 FL 4	170	150	8.3.1.1
	160F (71C)	155	140	

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

TABLE VII - CARBON FIBER/EPOXY MECHANICAL PROPERTIES (TYPE II - CLASS 1 - TAPES) LAMINATE AND SANDWICH (Continued)

TEST	TEST TEMPERATURE	REQUIREMENT FL 1		TEST METHOD SECTION
		MIN. AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Modulus msi, 0 degrees	-65F (-54C) RT FL 3 160F (71C)	16.0 - 19.0 16.0 - 19.0 16.0 - 19.0	15.0 - 20.0 15.0 - 20.0 15.0 - 20.0	8.3.1.1
Tensile Strain Ultimate, µ-in./in., 0 degrees	-65F (-54C) RT FL 3 160F (71C)	8,800 8,200 7,600	No reqt. No reqt. No reqt.	
Compression Strength Ultimate, ksi, 0 degrees	-65F (-54C) RT RT Wet FL 2 160F (71C) FL 3 FL 4	160 150 80 120	140 130 60 100	
Compression Modulus, msi, 0 degrees	-65F (-54C) RT 160F (71C)	14.5 - 19.0 14.5 - 19.0 14.5 - 19.0	14.5 - 20.0 14.5 - 20.0 14,5 - 20.0	8.3.1.2
Compression Strain Ultimate, µ-in./in., 0 degrees	-65F (-54C) RT 160F (71C)	8,300 8,100 6,100	No reqt. No reqt. No reqt.	
Flatwise Tension, psi	-65F (-54C) RT FL 3 FL 4 160F (71C)	425 450 425	No reqt. No reqt. No reqt.	8.3.2.2
Long Beam Flexure, Ultimate Load, lb. FL 5 P/Y, lb/in.	-65F (-54C) RT 160F (71C) -65F (-54C) RT 160F (71C)	Report only	N.A.	8.3.2.1

FL 1 Record the actual number of plies used in each specimen configuration. Calculate laminate mechanical properties using nominal per ply thickness as specified in Table V.

FL 2 Tested after immersion in water at 160 ± 10F (71 ± 5C) for 14 days.

FL 3 Minimum tests required for supplier and purchaser quality control testing. Supplier key characteristic in accordance with BSS7286.

FL 4 Values in Table VII are for qualification purposes only. See the QPL for supplier and purchaser specific quality assurance batch acceptance test requirements. If no values are listed on the QPL the requirements of Table VII apply.

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

FL 5 Layup to Figure 6.

TABLE VIII - ARAMID FABRIC/EPOXY-TYPE I GRAPHITE/EPOXY HYBRID MECHANICAL SANDWICH PROPERTIES FL 3

TEST	MINIMUM AVERAGE REQUIREMENT	
	BMS8-168 TYPE I CLASS 1 GRADE 145	BMS8-168 TYPE I CLASS 2 3K-70-PW
	BMS8-219 STYLE 285	BMS8-219 STYLE 285
Longbeam Flexure (Section 8.3.2.1)		
Ultimate Load, lb		
-65F (-54C)	330	FL 2
RT	250	250
160F (71C)	200	FL 2
P/Y, lb/in. FL 1		
-65F (-54C)	200	FL 2
RT	260	215
160F (71C)	250	FL 2
Flatwise Tension, psi (Section 8.3.2.2)		
-65F (-54C)	FL 2	FL 2
RT	600	600
160F (71C)	FL 2	FL 2

FL 1 P/Y is the slope of the tangent drawn through the initial portion of the load deflection (stress strain) curve

FL 2 Requirement to be determined.

FL 3 See Figure 7 for panel lay up.

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

TABLE IX - ARAMID FABRIC/EPOXY-TYPE II/III GRAPHITE/EPOXY HYBRID MECHANICAL SANDWICH PROPERTIES FL 2

TEST	MINIMUM AVERAGE REQUIREMENT	
	BMS8-168 TYPE I CLASS 1 GRADE 145	BMS8-168 TYPE I CLASS 2 3K-70-PW
	BMS8-219 STYLE 285	BMS8-219 STYLE 285
Longbeam Flexure (Section 8.3.2.1)		
Ultimate Load, lb		
-65F (-54C)	240	200
RT	185	170
160F (71C)	135	140
P/Y, lb/in. FL 1		
-65F (-54C)	225	175
RT	200	150
160F (71C)	175	150
Flatwise Tension, psi (Section 8.3.2.2)		
-65F (-54C)	600	600
RT	650	650
160F (71C)	600	600

FL 1 P/Y is the slope of the tangent drawn through the initial portion of the load deflection (stress strain) curve.

FL 2 See Figure 8 for panel layup.

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

TABLE X - LAMINATE MECHANICAL PROPERTIES (TYPE I - CLASS 2 - FABRICS)

TEST	TEST TEMPERATURE	REQUIREMENT FL 1		TEST METHOD SECTION
		MIN. AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Strength Ultimate, ksi, Warp and Fill	-65F (-54C)	70	60	
	RT FL 3	75	65	
	160F (71C)	75	65	
Tensile Modulus msi, Warp and Fill	-65F (-54C)	9.0 - 11.5	8.0 - 12.5	
	RT FL 3	8.0 - 10.0	7.5 - 11.5	8.3.1.1
	160F (71C)	8.0 - 10.0	7.5 - 11.0	
Tensile Strain Ultimate, µ-in./in., Warp and Fill	-65F (-54C)	6,500	No reqt.	
	RT FL 3	8,500	No reqt.	
	160F (71C)	8,000	No reqt.	
Compression Strength Ultimate, ksi, Warp and Fill	-65F (-54C)	75	60	
	RT	80	70	
	160F (71C) FL 3	75	60	
	RT Wet FL 2	70	60	
	160F Wet FL 2	45	35	
Compression Modulus, msi, Warp and Fill	-65F (-54C)	8.0 - 10.5	7.0 - 11.5	8.3.1.2
	RT	7.5 - 10.0	6.5 - 11.0	
	160F (71C)	7.5 - 10.0	6.5 - 11.0	
Compression Strain Ultimate, µ-in./in., Warp and Fill	-65F (-54C)	7,100	No reqt.	
	RT	8,000	No reqt.	
	160F (71C)	7,500	No reqt.	

FL 1 Record the actual number of plies used in each specimen configuration. Calculate laminate mechanical properties using nominal per ply thickness as specified in Table V.

FL 2 Tested after immersion in water at 160 ± 10F (71 ± 5C) for 14 days.

FL 3 Minimum tests required for supplier and purchaser quality control. Test in fill direction only. Supplier key characteristic in accordance with BSS7286.

5.2 LAMINATE AND SANDWICH PROPERTIES (Continued)

TABLE XI - LAMINATE AND SANDWICH MECHANICAL PROPERTIES (TYPE II AND III - CLASS 2 - FABRICS)

TEST	TEST TEMPERATURE	REQUIREMENT FL 1		TEST METHOD SECTION
		MIN. AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Strength Ultimate, ksi, Warp and Fill	-65F (-54C) RT FL 3 160F (71C)	75 75 70	65 65 60	
Tensile Modulus msi, Warp and Fill	-65F (-54C) RT FL 3 160F (71C)	7.0 - 9.5 7.0 - 9.5 7.0 - 9.5	6.0 - 10.5 6.0 - 10.5 6.0 - 10.5	8.3.1.1
Tensile Strain Ultimate, µ-in./in., Warp and Fill	-65F (-54C) RT FL 3 160F (71C)	9,000 7,500 7,500	No reqt. No reqt. No reqt.	
Compression Strength Ultimate, ksi, Warp and Fill	-65F (-54C) RT 160F (71C) FL 3 RT Wet FL 2	75 75 60 50	65 65 50 40	8.3.1.2
Compression Modulus, msi, Warp and Fill	-65F (-54C) RT 160F (71C)	7.0 - 9.5 7.0 - 9.5 7.0 - 9.5	6.0 - 10.5 6.0 - 10.5 6.0 - 10.5	8.3.1.2
Compression Strain Ultimate, µ-in./in., Warp and Fill	-65F (-54C) RT 160F (71C)	7,900 7,900 6,300	No reqt. No reqt. No reqt.	
Flatwise Tension, psi	-65F (-54C) RT FL 3 160F (71C)	500 575 500	No reqt. No reqt. No reqt.	8.3.2.2
Long Beam Flexure, Ultimate Load, lb. FL 4	-65F (-54C) RT 160F (71C)	Report Only	N.A.	8.3.2.1
P/Y, lb/in.	-65F (-54C) RT 160F (71C)			

FL 1 Record the actual number of plies used in each specimen configuration. Calculate laminate mechanical properties using nominal per ply thickness as specified in Table V.

FL 2 Tested after immersion in water at 160 ± 10F (71 ± 5C) for 14 days.

FL 3 Minimum tests required for supplier and purchaser quality control. Test in fill direction only. Supplier key characteristic in accordance with BSS7286.

FL 4 Layup to Figure 6.

6 QUALIFICATION

a. Suppliers seeking qualification to this specification shall comply with the requirements in this section.

b. Prior to submitting a material for qualification to this specification, the material supplier shall provide a MSDS and 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 SHEA organization to perform a health hazard evaluation. Determine whether it is adequate or whether additional information is necessary, and identify and document appropriate precautions for the material use.

c. Production materials shall be capable of meeting all qualification requirements.

6.1 REQUEST FOR QUALIFICATION

All requests for qualification shall be directed to a Supply Management (SM) organization of The Boeing Company. SM will forward the request to the appropriate Boeing Engineering department for evaluation. After receiving written authorization from SM, the manufacturer shall submit the data and samples required for qualification purposes.

The following information shall be supplied in the request for qualification:

a. The name of the supplier company, plant location

b. Supplier product designation for the resin, carbon fiber, fiber sizing and candidate preimpregnated material

c. BMS8-168 Classification (Type, Class, Grade or Style as applicable) in accordance with the latest revision of this specification.

d. Identification of the test facility (supplier or test laboratory) including locations, test apparatus, and designated company official(s) or representative(s) responsible for the qualification program.

e. For new material system, a certified test report that demonstrates the ability of the candidate prepreg to meet the requirements of this specification, both before and after exposure to the conditions required in Section 5.2. Specific test requirements should be coordinated with Boeing Engineering.

f. Description of facilities and equipment to be used to produce materials in accordance with this specification.

6.2 PREQUALIFICATION TESTING

As deemed necessary by The Boeing Company, the supplier shall submit production batch (es) of the candidate material for preliminary evaluation of material performance and part producibility to verify supplier-submitted test reports and to grant approval for full qualification testing.

6.3 PROCESS CONTROL DOCUMENT (PCD)

a. Supplier shall submit a Process Control Document (PCD) for Boeing review prior to qualification audits of production material.

6.3 PROCESS CONTROL DOCUMENT (PCD) (Continued)

b. The PCD shall identify baseline chemical constituents, in-process test procedures and requirements, and manufacturing procedures in accordance with BSS7101. Rationale for the formulation and process parameters shall be supported by historical data and by statistically designed or other types of experimentation.

6.4 QUALIFICATION AUDIT

a. Supplier shall submit to an audit of their product manufacturing operations, Quality Assurance system, raw material traceability, process records, test procedures, test results, and quality assurance records.

b. Qualification audits shall be conducted during the manufacture of the qualification batches in accordance with BSS7101.

c. The Boeing Company reserves the right to perform an on-site audit of the manufacturing of any prepreg production order subsequent to qualification.

6.5 QUALIFICATION TESTING

6.5.1 MATERIAL QUANTITY

A minimum of three different batches of each candidate prepreg material (for each Type, Class, Grade or Style) shall be tested. The three batches shall contain at least two different resin batches and at least two different yarn lots of carbon fiber. For Class 2 materials, the two different yarn lots of carbon fiber apply to the fill yarn only.

6.5.2 TEST MATRIX

Testing of the qualification batches shall consist of the following:

a. Physical, mechanical and chemical property testing in accordance with Section 8.1, Section 8.3, and Section 8.4.

b. Part producibility evaluations.

c. When deemed necessary by The Boeing Company, additional tests, such as morphology, degree of impregnation, porosity, cure and processing study, design related tests and the evaluation of outtime-related handling characteristics may be required.

d. Materials submitted for qualification shall be tested against the requirements of this specification both as-received and after exposure to the maximum storage and mechanical life periods and shall also be evaluated for manufacturing suitability.

6.5.3 RESPONSIBILITY FOR TESTING

a. Physical, mechanical and chemical property tests shall be performed both by the supplier and The Boeing Company.

b. Part producibililty evaluations shall be performed by The Boeing Company.

c. At the discretion of The Boeing Company, any required additional tests may be performed jointly by The Company and by the supplier.

6.5.4 TESTING LABORATORY

The supplier shall have facilities capable of testing in accordance with this specification, or the supplier shall identify a laboratory capable of testing in accordance with this specification. Boeing Quality Assurance and Engineering organizations shall approve the laboratory and test procedures. The laboratory and test procedure shall be listed in the Supplier Process Control Document.

6.5.5 TEST DATA AND REPORTS

a. When requested by The Boeing Company, SM Organization, the supplier shall submit two copies of test data including individual specimen values, showing that the candidate material meets all the requirements of this specification for the Type, Class, Grade, or Style.

b. All qualification tests may be repeated at any time by The Boeing Company and the material shall be capable of meeting all qualification requirements.

6.6 QUALIFICATION APPROVAL

a. Qualification approval of the candidate material shall be granted subject to the requirements of Section 6.6.1 and Section 6.6.2.

b. Qualified material shall be listed in the QPL, identifying the following:

(1) Classification of the material

(2) Supplier name and manufacturing plant address

(3) Supplier product designation

(4) Reduced testing plan approval status

(5) Qualifying Boeing Division

(6) Product approval date

(7) Material properties specific to the approved product as identified in the tables.

c. No changes in approved product formulation, raw materials, basic methods of manufacture, or plant site shall be made without notification and prior approval in writing. Requalification of the revised material may be required and a revised supplier designation may be requested.

6.6.1 PRODUCT APPROVAL

a. After review of the Supplier data and completion of the Boeing tests, the supplier will be advised of qualification status in writing. Product approval requires successful completion of all qualification tests required in Section 6.5.

b. Product approval shall be for the candidate prepreg and the specific manufacturing process associated with the manufacture of the prepreg which shall include raw materials, equipment, facilities, and procedures used as documented in the supplier PCD.

6.6.2 PROCESS CONTROL DOCUMENT (PCD) APPROVAL

a. The PCD shall be approved in writing by The Boeing Company after successful resolution of all comments.

b. The PCD shall be approved concurrently with the approval of the candidate material.

c. The supplier shall maintain the Boeing approved PCD to the current specification revision.

d. No major changes such as product formulation, critical raw materials or suppliers, basic methods of manufacture, testing, or geographic location shall be made to the PCD without notification and approval by Boeing in writing prior to implementation.

7 QUALITY CONTROL

7.1 SUPPLIER QUALITY CONTROL

a. Verify that the material has been manufactured in accordance with the approved PCD.

b. Manufacture and test each batch of material prior to shipment.

(1) Test every roll of material to verify compliance with the resin content and fiber areal weight requirements of Table I, Prepreg Physical Properties. Test two rolls of each prepreg batch to verify compliance with the volatile content, flow and gel time of requirements of Table I.

(2) Test each prepreg batch to the requirements of Table II, Chemical Properties. If the supplier cannot perform the tests of Table II, then the tests shall be conducted by a Boeing approved laboratory listed in the PCD. Test one roll of the prepreg batch for Uncured Resin Chemical Structure (IR). Test the first and last rolls of the prepreg batch for Uncured Resin Component Analysis (LC).

(3) Test the laminate and sandwich physical and mechanical properties required by Table IV, Table VI, Table VII, Table VII, Table VIII, Table IX, Table X, and Table XI as follows for each prepreg batch.

NUMBER OF POUNDS IN PREPREG BATCH		NUMBER OF ROLLS TO TEST FROM EACH BATCH
CLASS 1	CLASS 2	
1 to 250	1 to 300	1
251 to 500	301 to 750	2
501 +	750 +	2 rolls plus 1 roll for each additional 500 pounds for Class 1, or 1,500 pounds for Class 2, or part thereof

c. Furnish actual test data comprised of individual and average values showing conformance with the above requirements for each prepreg batch and 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. Peak tables shall accompany material shipment.

d. The acceptance tests in Section 5.2 may be performed on a ship-lot basis for each vendor and class in accordance with a suitably documented plan having an AQL of at least 10 percent. This paragraph is not applicable to flammability testing.

7.1 SUPPLIER QUALITY CONTROL (Continued)

e. Maintain, for a period of 7 years, all records pertaining to raw material receiving inspection and certification, in progress records, storage temperature 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 (SM) 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 must 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 7.1, a supplier may request reduced testing. Reduced inspection is allowed in accordance with a documented plan approved by the Boeing Materials 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 (include revision control and Supplier Quality Control approval), as well as any other relevant information (for example, studies identifying key process parameters).

h. If reduced testing is in place so that the reporting of test results is affected, the supplier shall submit a certified test report which states the authorization for reduced testing (for example, specification provision 'Section 7.1.X' or 'PCD provision . . .'). The report shall be easily understood and certify that the material meets the requirements of the BMS.

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 IV, Table VI, Table VII, Table VIII, Table IX, Table X, and Table XI.

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 KPPs 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 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.

7.1.1.2 Analysis and Review (Continued)

b. The procedure 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 Type, 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. Verify the material was manufactured and tested prior to shipping.

b. Purchaser Quality Assurance shall review all supplier test data submitted with each shipment and perform any additional inspection or testing necessary to assure that the production material meets all the requirements specified herein.

c. Perform flammability testing in accordance with Table IV on Type III material. Test one roll per prepreg lot.

d. For flammability testing, when consistent conformance to specification acceptance (receiving) requirements has been demonstrated, Quality Assurance may implement reduced testing in accordance with a suitable sampling plan. Authorization of a reduced sampling plan shall be on a Boeing Company basis and shall be documented on Boeing Company documentation (e.g. Receiving Inspection Plan, Block memo, etc.).

e. Perform quality control test on each lot of material in accordance with Section 7.2.e.(1) or Section 7.2.e.(2) unless Purchaser testing requirements have been removed for that product in accordance with Section 7.2.f.

(1) Test each lot of material in accordance with Table XII at the frequency listed in Table XIII.

TABLE XII - PURCHASER QUALITY CONTROL TESTS

TEST	TEMPERATURE	TABLE	SECTION
Resin Content FL 1	- - -	I	8.1.1
Areal Weight	- - -	I	8.1.1
Volatile Content	- - -	I	8.1.2
Flow	- - -	I	8.1.3
Gel Time	- - -	I	8.1.4
Ply Thickness	- - -	IV	8.1.5
Flammability	- - -	IV	8.1.8
Tensile Strength, Modulus, Strain	RT dry	VI, VII, X, or XI	8.3.1.1
Compression Strength	160F dry	VI, VII, X, or XI	8.3.1.2
Flatwise Tension	RT dry	X or XI	8.3.2.2

7.2 PURCHASER QUALITY CONTROL (Continued)

FL 1 For all Grades and Styles, all sampled rolls of any prepreg lot may be within ±3 percent of nominal

TABLE XIII - PURCHASER TEST FREQUENCY

NO. OF ROLLS IN LOT	NO. OF ROLLS TO TEST
1 to 10	1
11 to 30	2
31 to 60	3
61 to 90	4
91+	1 additional roll for each additional 40 rolls in the lot

(2) The Table XII Mechanical Acceptance Tests (ply thickness, tensile, compression, and flatwise) are not required if the purchaser has implemented chemical characterization capablility, and performs the tests of Section 5.1.2 on each prepreg lot to the requirements of Table II.

f. 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.

g. Verify that each lot of prepreg meets the storage requirements in Section 5.1.6 and Section 10.7 of this specification during shipping.

(1) The purchaser shall document the procedure used to verify temperature exposure.

(2) If the time and temperature exposure exceeds the maximum storage life conditions, reject the material. Temperature excursions during shipment of up to + 10 F above the maximum storage temperature are allowed without outtime deduction as long as the total time of the excursions does not exceed 60 minutes.

h. All test data and records shall be kept on file for a minimum of 7 years and 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.

8 MATERIAL TEST METHODS (Continued)

a. The test methods described below shall be used. Requests for use of an equivalent test method shall be directed to a SM 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 shall be referenced in the PCD and shall be approved by the responsible Boeing Engineering Group(s).

b. Rolls of material which have been stored at lower than room temperature shall not be exposed to ambient atmospheric conditions unless contained in a sealed moisture resistant bag. Sealed bags shall not be opened until the contents have attained ambient temperature (for example, moisture shall not be visible or condense on the exterior surface of the bag).

8.1 PHYSICAL PROPERTY TESTS

a. Except as otherwise noted in the test method, test three samples equally spaced across the width of the prepreg for each physical property. Do not cut any specimens within 2 inches of the selvage.

b. Report the individual and average values.

8.1.1 RESIN CONTENT/CARBON FIBER AREAL WEIGHT - UNCURED PREPREG

a. Cut three samples, each 10 cm x 10 cm minimum, equally spaced across the width of the prepreg, and for Class 2 at least 2.5 cm from the edge of the prepreg. Cut the samples so that the edges are parallel and perpendicular to the carbon fiber.

b. Determine the resin content and carbon fiber areal weight by extracting samples in methyl ethyl ketone, methylene dichloride, or acetone in accordance with BSS7336, Method II, Type I, Beaker Extraction.

c. Report the individual and average values for resin content and carbon fiber areal weight.

8.1.2 VOLATILE CONTENT

a. Determine the volatile content in an air circulating oven at 275 ± 10F (135 ± 5C) in accordance with BSS7337, Method II, (Pan Method).

b. Report the individual and average of three tests.

8.1.3 FLOW

a. In accordance with BSS7335, Method II, Bleeder Method, determine the resin flow in a platen press at 275 ± 5F (135 ± 3C), 50 psi ± 5 psi, for 5 minutes plus the average gel time listed on the QPL.

b. The test shall be repeated if the three flow measurements vary more than 3 flow percent.

c. Report the individual and average values of three tests.

8.1.4 GEL TIME

a. Determine the gel time at 275 ± 5F (135 ± 3C) in accordance with BSS7276, Method II, Temperature Controlled Hot Plate Method.

b. Repeat the procedure for three specimens.

c. Report the individual and average values.

8.1.5 PLY THICKNESS - CURED LAMINATE

a. Measure the cured laminates prepared for mechanical testing using a single 1/4-inch diameter flatface anvil micrometer. Do not measure thickness across the laminate edge area where edge bleeding or edge damming will affect laminate thickness.

b. Report the per ply thickness as the average of at least 10 determinations uniformly dispersed over the laminate surface.

8.1.6 VOID CONTENT (LAMINATE)

a. Cut three specimens from each panel made for Laminate Mechanical Properties. Weigh each specimen (W_c).

b. Perform density measurements in accordance with ASTM D792 Method A.

c. Digest and separate fibers as follows:

(1) Place each sample in a beaker containing 50 ml minimum of concentrated nitric acid.

Option - Sulfuric acid may be used in place of nitric acid.

(2) Heat the acid to boiling and hold for 60 to 90 minutes.

(3) After heating, separate the fibers by filtering with Coors Porcelain Co. No. 27007-4 filter. Rinse the remaining fibers with water, then acetone, filtering each time. Discard filtered acid and water before filtering acetone. Transfer the fibers to the filter and wash fibers with acetone.

d. Dry the fibers for 30 minutes minimum at 220 ± 10F (105 ± 5C), then allow to cool at room temperature in a desiccator.

e. Weigh the fibers to the nearest milligram (W_f) .

f. Calculate Fiber Volume (V_f) from the formula

$$\frac{W_f \times \rho_c}{\rho_f \times W_c} \times 100$$

Calculate Resin Volume (V_r) from the formula

8.1.6 VOID CONTENT (LAMINATE) (Continued)

$$\frac{W_t \times \rho_c}{\rho_t \times W_c} \times 100$$

Calculate Void Content (V_v) from the formula

$$100 - (V_f + V_r)$$

where:

W_c - weight of original sample, measured to nearest 0.0001 gram

W_f - weight of fiber, measured to nearest 0.0001 gram

$W_r = W_c - W_f$ - weight of resin, to nearest 0.0001 gram

ρ_f - density of carbon (from supplier), g/cm^3

ρ_r - density of resin (from supplier), g/cm^3

ρ_c - density of composite in accordance with ASTM D792, gm/cm^3

g. Report the average Fiber Volume and Void Content of three specimens to nearest 0.1 percent.

8.1.7 LAMINATE POROSITY

a. Fabricate a 12 inch x 12 inch two ply laminate (0/45-degree orientation) and cure in accordance with Section 8.2.

b. Calibrate test apparatus (Figure 1) as follows:

(1) Use a metal plate, nominally 0.062 inch thick, with a 0.0156 ± 0.0010 inch diameter hole drilled through the plate.

(2) Position the plate under the test apparatus such that the hole is at the approximate center.

(3) Adjust the valve until a steady reading of 20.5 ± 0.5 inches Hg vacuum is obtained.

(4) Record the average of three indicated flow readings. This is the calibration reading.

c. Place a test laminate under the apparatus.

(1) Adjust valve to maintain 20.5 ± 0.5 inches Hg vacuum.

(2) Record the average of three indicated flow readings across the panel.

8.1.7 LAMINATE POROSITY (Continued)

(3) The average flow reading must be equal to or less than the average flow reading obtained in calibration.

d. Report pass or fail for panel.

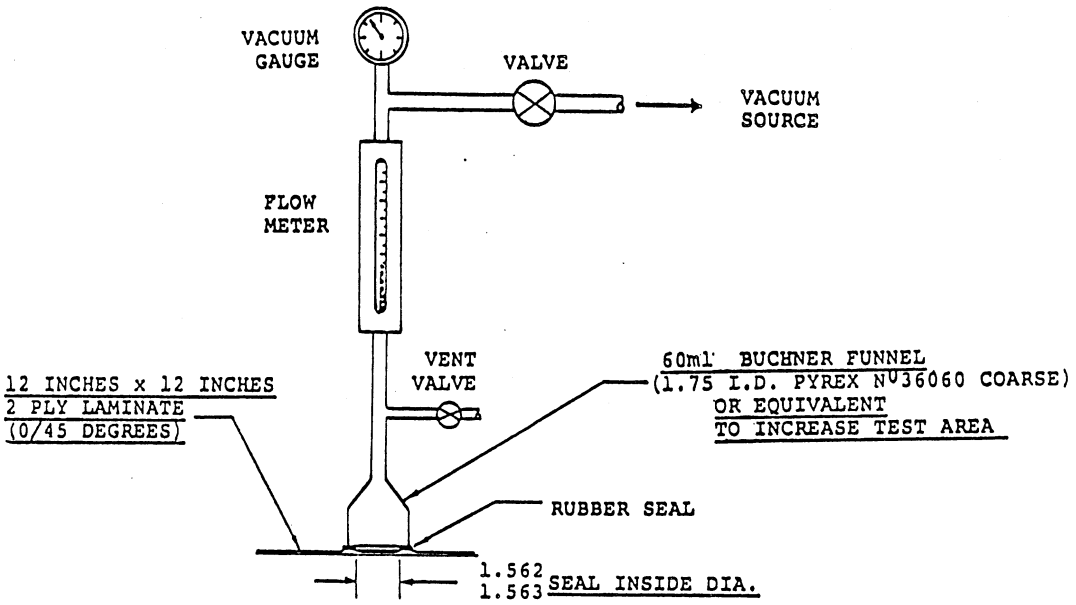


FIGURE 1 - LAMINATE POROSITY TEST

8.1.8 FLAMMABILITY (TYPE III MATERIALS)

a. Fabricate in accordance with Section 8.2 a 0.06 inch thick laminate, or 0.06 inch thick laminates such that three specimens 12 inches x 3 inches, and three specimens 10 inches x 10 inches can be cut. Orientation shall be 0-degree or warp in the 12 inch direction. All dimensions are nominal.

b. Test the 12 inch x 3 inch specimens to the 60 second vertical test procedure, Method F1 in BSS7230.

c. Test the 10 inch x 10 inch specimens to the 30 second 45 degree test procedure, Method F5 in BSS7230.

8.1.9 HYDRAULIC FLUID RESISTANCE

a. Each test specimen shall be 1 inch wide by 3 inches long (typical). The 3 inch direction is parallel to the warp or 0 degree direction.

b. Cut two specimens from the excess of laminate mechanical test panels (one from each test panel if excess permits).

c. Obtain drawing pencils ranging in hardness from 4H through 9H and square the tips (see Figure 2). 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.

8.1.9 HYDRAULIC FLUID RESISTANCE (Continued)

d. Place the specimen bag side up in a horizontal position. Hold the pencil at approximately a 45-degree angle and push it across the specimen using firm steady pressure (see Figure 2). Test with the various hardness pencils until one is found that will just cut or scratch the panel. Make these tests at 80 ± 10F. Report pencil hardness as the softest pencil lead that will just cut or scratch the panel.

e. Immerse each specimen in BMS3-11, Type IV, Class 1 hydraulic test fluid heated to 160 ± 5F and hold immersed and at temperature for 48 hours minimum.

f. Remove specimens from bath, cool to 80 ± 10F and remove excess oil from the specimens using clean, dry gauze.

g. Immediately retest hardness.

h. Examine exposed panel edges for delamination.

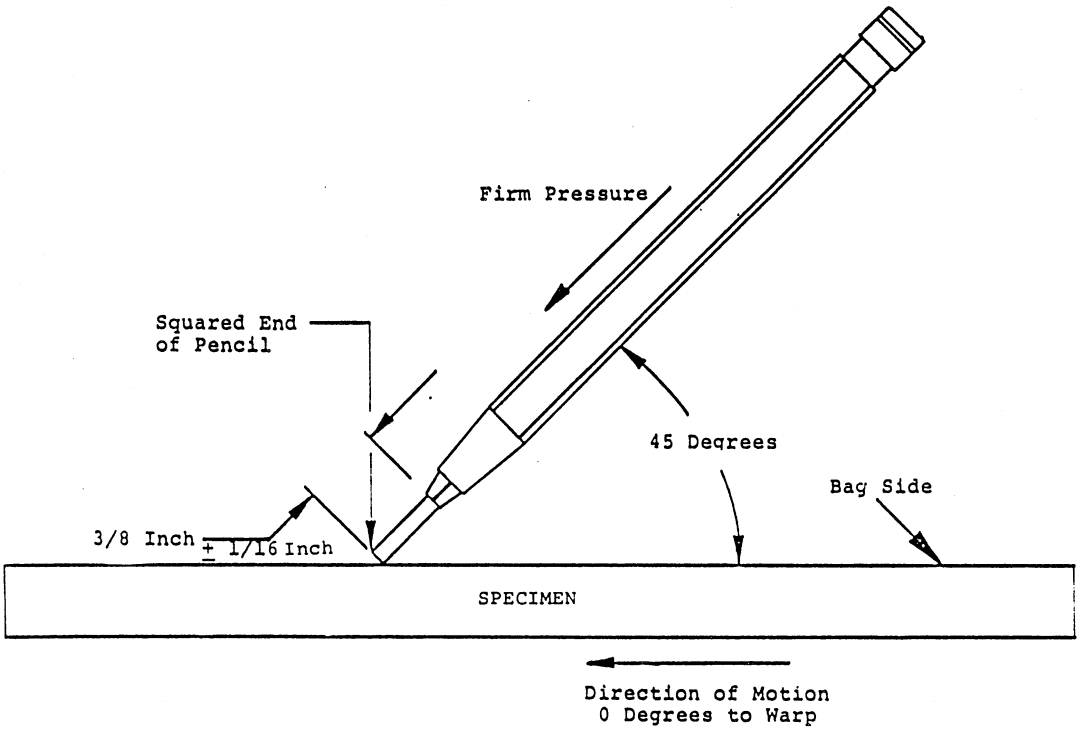


FIGURE 2 - HYDRAULIC FLUID RESISTANCE TEST CONFIGURATION

8.2 TEST PANEL PREPARATION

NOTE: For all layups, carefully align tape fibers. For fabrics, align warp yarns in layup.

a. Laminate specimens shall be laid up in accordance with Table XIV.

TABLE XIV - LAMINATE PLY REQUIREMENTS

GRADE/STYLE	ORIENTATION	NUMBER OF PLIES
3K-70-PW	Warp and Fill	14

8.2 TEST PANEL PREPARATION (Continued)

TABLE XIV - LAMINATE PLY REQUIREMENTS (Continued)

GRADE/STYLE	ORIENTATION	NUMBER OF PLIES
3K-135-8H	Warp and Fill	8 FL 1
95	0 degrees	12
145	0 degrees	8
190	0 degrees	6

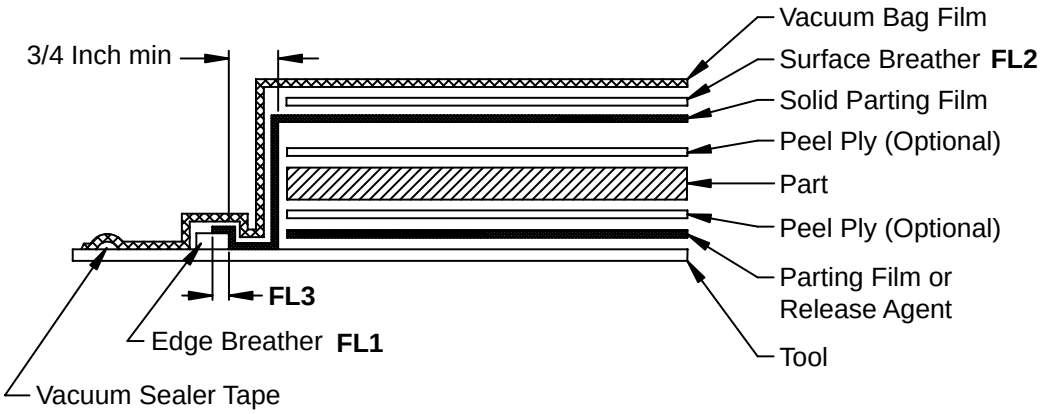
FL 1 Lay up 4 plies warp face down against the tool, followed by 4 plies warp face up.

b. For Type I, use the vacuum bagging procedure shown in Figure 3 for laminate and sandwich test panels.

c. For Types II and III, use the vacuum bagging procedure shown in Figure 4.

d. Leak check each vacuum bag layup prior to cure. Draw 22 inches Hg vacuum minimum in the bag. Close off the vacuum line and measure the leakage rate using a gage on the assembly. The vacuum under each bag must not fall more than 5 inches Hg in 5 minutes.

e. Cure test panels in an autoclave using the cure cycle shown in Figure 5.



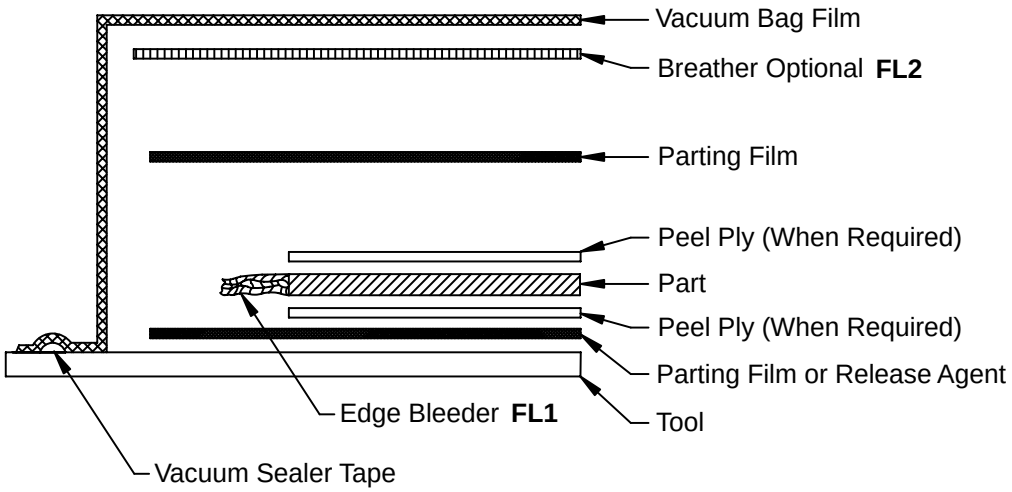
FL 1 1-inch minimum width with connection to vacuum source. At one corner of the layup, place a single fiberglass yarn or equivalent between the edge of the layup and the edge breather, to allow evacuation of air from the layup. Additional yarns may be required on larger parts to provide adequate removal of trapped air.

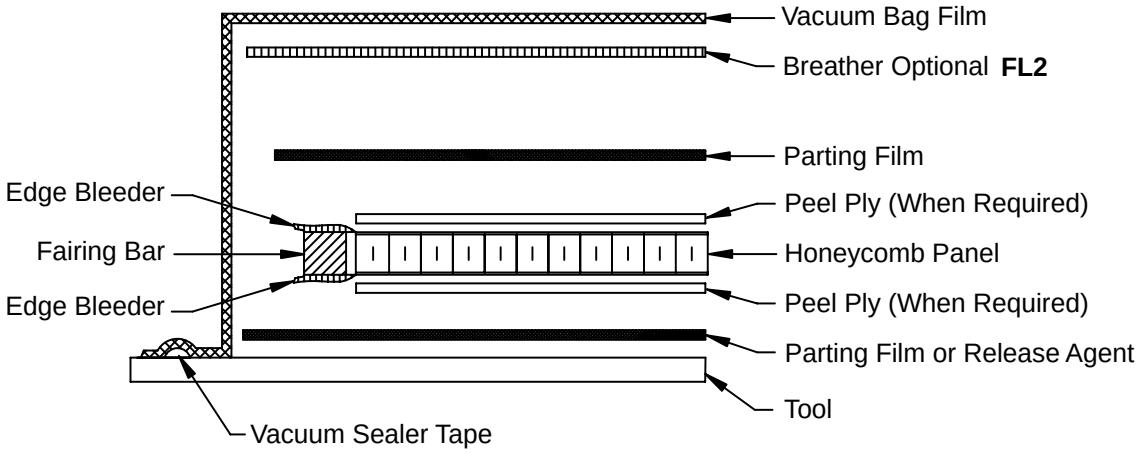
FL 2 If fiberglass is used for surface breathers, it shall be net trimmed to edge of layup and at one position connect the surface breather to the edge breather using a single fiberglass yarn - if a flexible breather material is used for surface breathers, it may extend to connect with the edge breather.

FL 3 Parting film extends to centerline of edge breather.

FIGURE 3 - TYPICAL VACUUM BAG ASSEMBLY FOR TYPE I CARBON FIBER/EPOXY LAMINATE AND SANDWICH PANELS

8.2 TEST PANEL PREPARATION (Continued)



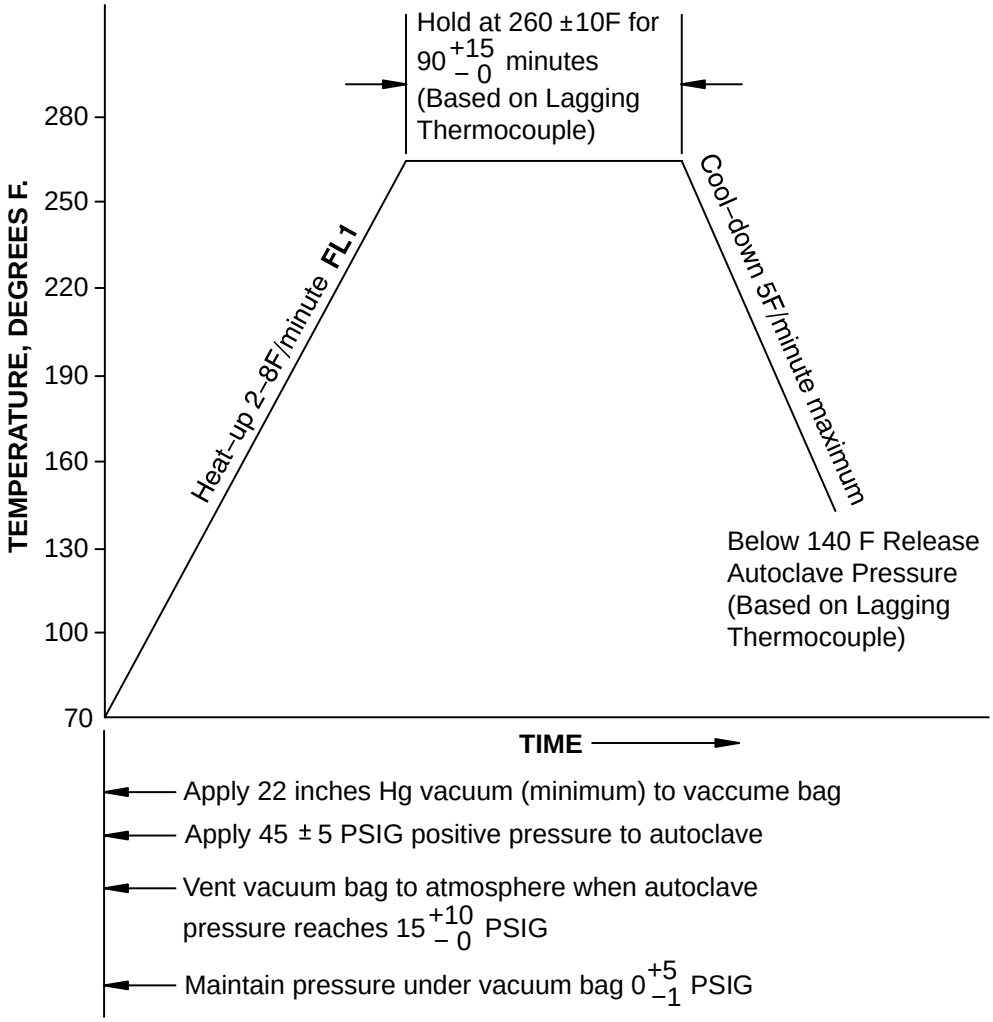


FL 1 Use a 1-inch minimum width edge bleeder with connection to vacuum source. At one corner of the layup, place a single fiberglass yarn or equivalent between the edge of the layup and the edge breather to allow evacuation of air from the layup. Additional yarns may be required on larger parts to provide adequate removal of trapped air.

FL 2 If fiberglass is used for surface breathers, it shall be net trimmed to the edge of layup. At one position, connect the surface breather to the edge breather using a single fiberglass yarn or equivalent. If a flexible breather material is used for surface breathers, it may extend to connect with the edge breather.

FIGURE 4 - TYPICAL VACUUM BAG ASSEMBLIES FOR TYPE II/III CARBON FIBER/EPOXY LAMINATE AND SANDWICH PANELS

8.2 TEST PANEL PREPARATION (Continued)



FL 1 One panel to be cured at each of the following heat up rates for initial qualification testing:

a) $2\ ^{+1.5}_{-0}$ F/minute

b) $8\ ^{+0}_{-2}$ F/minute

FIGURE 5 - CURE CYCLE

8.3 MECHANICAL PROPERTIES TESTS

a. Specimens tested at room temperature shall be conditioned and tested at 75 ± 10F.

b. Specimens tested at -65 ± 10F or 160 ± 10F shall be conditioned prior to initiating test load according to Table XV.

8.3 MECHANICAL PROPERTIES TESTS (Continued)

TABLE XV - SPECIMEN CONDITIONING TIME

TEST	TIME AT TEST TEMPERATURE (MINUTES)
All dry tests except flatwise tension	10 ± 3
Flatwise tension	30^{+5}_{-0}
All wet tests	2 ± 1

c. Perform all mechanical property testing using test machines complying with ASTM E4 requirements.

d. Machine specimens to ± 1 degree of the fiber test direction.

e. Report individual and average values.

8.3.1 LAMINATE MECHANICAL PROPERTIES

a. Measure and record the width and thickness of specimens with a flatface anvil micrometer.

b. Test a minimum of 5 specimens per test per condition, unless otherwise indicated.

8.3.1.1 Tensile Tests

a. Prepare and test tensile specimens in accordance with BSS7320 from laminates fabricated in accordance with Section 8.2.

b. The individual and average values shall meet the requirements listed in Table VI, Table VII, Table X, or Table XI as applicable for each Grade/Style, and shall be reported.

8.3.1.2 Compressive Strength and Modulus

a. Fabricate laminate panels in accordance with Section 8.2.

b. In accordance with BSS7260, Type III, fabricate tabs from BMS8-168, with the 0-degree direction in the longitudinal directions of the specimens. Tabs shall be made of 14 plies grade 95, nine plies of grade 145, or seven plies of grade 190 or style 3K-70-PW, and cured in accordance with Section 8.2.e.

c. Bond tabs with BMS5-129, Type 2 or 4, Grade 10, or BMS5-101, Type 2, Grade 10.

OPTION: 2 plies of Grade 5 material may be used in place of Grade 10 material.

d. Tab, machine, and test specimens in accordance with BSS7260, Type III, for compression ultimate, and Type IV for compression modulus.

e. Report the individual and average values.

8.3.2 SANDWICH MECHANICAL PROPERTIES

Fabricate test panel as shown in Figure 6, Figure 7, and Figure 8 and cure in accordance with Section 8.2.

8.3.2.1 Longbeam Flexure

a. Machine longbeam flexure specimens 3.00 ± 0.03 inches wide and 24 inches long, with ribbon direction parallel to the long dimension.

b. Test a minimum of three specimens. Test bag side up, apply load in accordance with Figure 9. Distribute the load using 1 inch nominal wide steel blocks. Rubber pads (1 x 3 x 1/8 inches, Shore "A" durometer 60) may be used to prevent crushing under load and reaction blocks. Measure deflection at the center of the span. Except for the deflection, test in accordance with SAE AMS-STD-401.

c. Report the ultimate load (lb) and the P/Y value (lb/in.), where P/Y is the slope of the tangent drawn through the initial portion of the load-deflection (stress-strain) curve. See Figure 10.

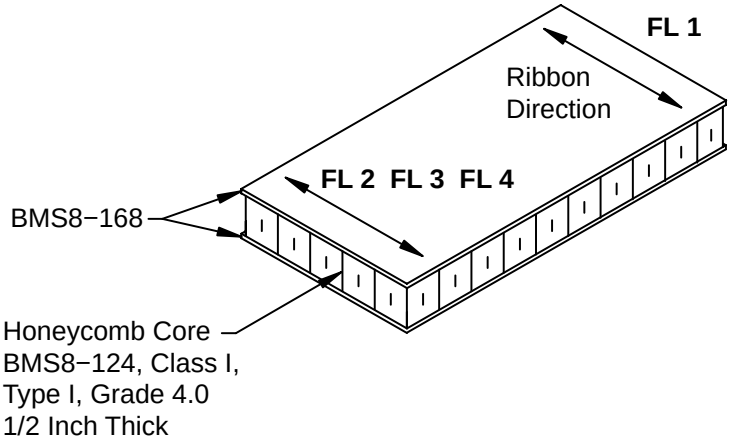
8.3.2.2 Flatwise Tension

a. Machine a minimum of four flatwise tension specimens, each 2 x 2 inches.

b. Test in accordance with SAE AMS-STD-401. Load at a rate so that failure occurs in no less than 3 minutes and no more than 6 minutes.

c. Report the ultimate load in pounds per square inch.

8.3.2.2 Flatwise Tension (Continued)



NUMBER OF FACE PLIES AND ORIENTATION		
CLASS	**GRADE/STYLE**	**LONG BEAM FLEXURE AND FLATWISE TENSION**
1	95	5 plies, 0-degree direction
1	145	3 plies, 0-degree direction
1	190	3 plies, 0-degree direction
2	3K-70-PW	2 fill plies
2	3K-135-8H	2 fill plies

FL 1 Panel dimensions shall be such as to allow machining of the number and kinds of test specimens specified in Table VII or Table XI, as applicable.

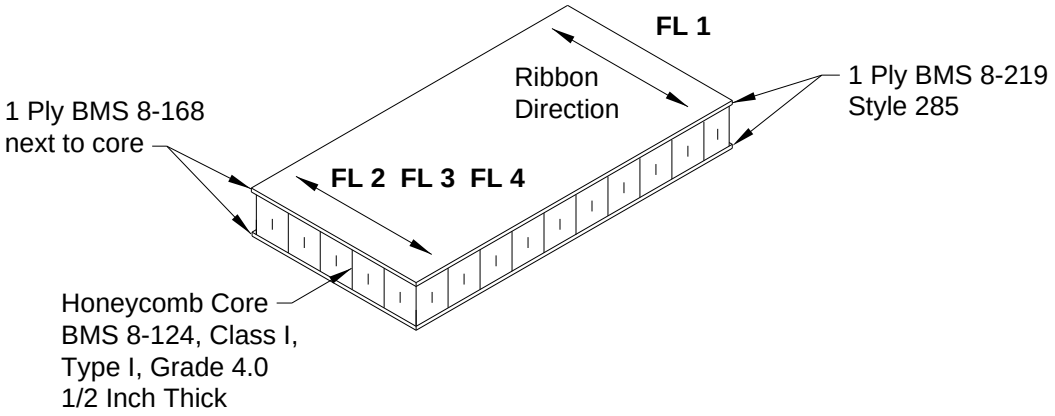
FL 2 Tape 0-degree of fabric fill direction. Place the fabric warp face against the core.

FL 3 No splices allowed.

FL 4 Use peel ply or hand sand surface for flatwise tensile specimens. Do not use peel ply on long beam flexure specimens.

FIGURE 6 - TYPE II AND III CARBON FIBER/EPOXY SANDWICH PANEL

8.3.2.2 Flatwise Tension (Continued)



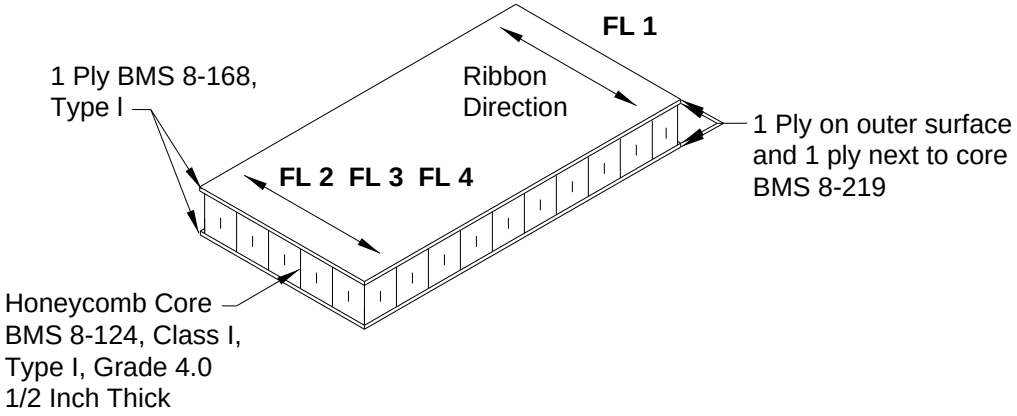
FL 1 Panel dimensions shall be such as to allow machining of the number and kinds of test specimens specified in Table XII.

FL 2 Tape 0–degree or fabric fill direction. Place fabric warp face against the core (if applicable).

FL 3 Use peel ply or hand sand surface for flatwise tensile specimens. Do not use peel ply on long beam fixture specimens.

FL 4 No splices allowed.

FIGURE 7 - ARAMID FABRIC/EPOXY-TYPE I GRAPHITE/EPOXY HYBRID SANDWICH PANEL



FL 1 Panel dimensions shall be such as to allow maching of the number and kinds of test specimens specified in Table XI.

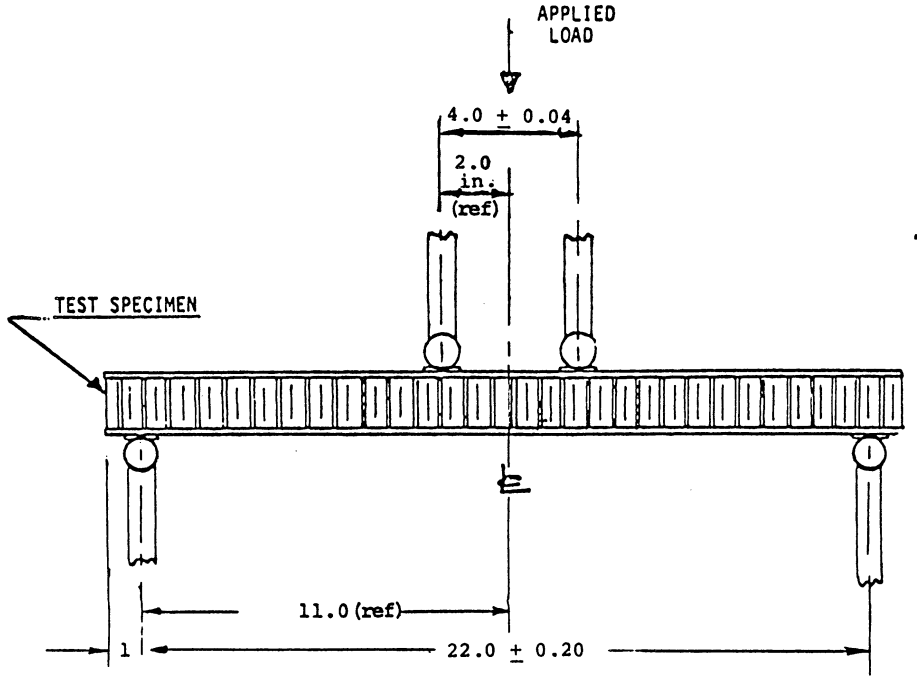
FL 2 Tape 0-degree or fabric fill direction. Place fabric warp face against the core (if applicable).

FL 3 Use peel ply or hand surface for flatwise tensile specimens. Do not use peel ply on long beam fixture specimens.

FL 4 No splices allowed.

FIGURE 8 - ARAMID FABRIC/EPOXY - TYPE II AND III GRAPHITE/EPOXY HYBRID SANDWICH PANEL

8.3.2.2 Flatwise Tension (Continued)



All dimensions are in inches.

FIGURE 9 - LONG BEAM FLEXURE TEST

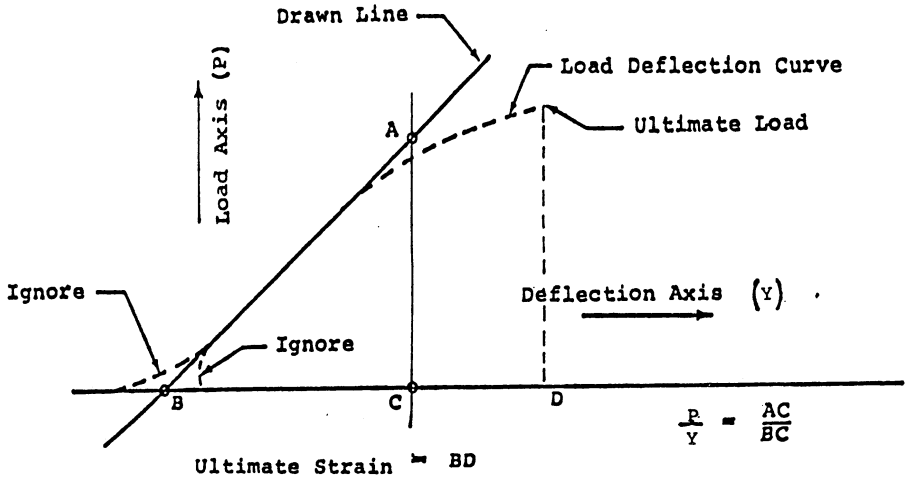


FIGURE 10 - TYPICAL LOAD DEFLECTION CURVE

8.4 CHEMICAL CHARACTERIZATION TESTS

8.4.1 INFRARED SPECTROSCOPY (IR) (TYPES II AND III ONLY)

a. Sample Preparation - Extract a sample of prepreg with reagent grade acetone at room temperature. Make sure all the resin is extracted by manipulating the fibers with a probe. Place a few drops of this solution on a salt block. Allow the acetone to evaporate. The resin film should be of such thickness as to give transmittance of 10 to 30 percent with the strongest absorbing peak.

b. Analysis - The spectrum shall be compared manually or computer aided with a standard spectrum to detect contaminants or gross change in formulation. The standard shall be furnished to supplier by Boeing.

c. Report the IR analysis results as pass/fail and submit spectrum.

8.4.2 LIQUID CHROMATOGRAPHY (LC) (TYPES II AND III ONLY)

Perform Liquid Chromatography (LC) in accordance with BSS7305, Method IIA.

a. Calibrate column in accordance with BSS7305.

b. Test prepreg in accordance with BSS7305. The standard chromatogram together with a description of baseline and peaks to be ratioed are identified in the applicable D6-document listed in the QPL.

c. Report the LC ratios.

9 MATERIAL IDENTIFICATION

Place the following information on a label inside the core of each roll of prepreg.

a. Batch number, roll number, and roll length

b. BMS8-168 (including latest revision letter), Type, Class, and Grade/Style

c. Quantity by weight and width

d. Manufacturer and material designation

e. Date of impregnation

f. Fiber identification (BMS9-8 Grade) and manufacturer's designation

10 PACKAGING AND MARKING

10.1 CARRIER

a. All prepreg shall be interleaved with noncontaminating carrier material, approved by Boeing.

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 width including selvages. The carrier material shall contain a nontransferring or noninhibiting color and be easily removable from the prepreg at ambient temperatures by manufacturing personnel after normal handling during fabrication.

10.1 CARRIER (Continued)

c. For Class 2 prepregs, the carrier material shall have a diamond embossed pattern, and shall be placed on the warp surface of the prepreg surface with the long dimension parallel to the fabric warp direction.

10.2 ROLL SIZE

Individual rolls shall be between 20 pounds (9 kg) and 70 pounds (32 kg) of net conforming material weight. Unless otherwise specified on the purchase order, only one roll of each batch may be below minimum weight.

10.3 CORE CONFIGURATION

a. Rolls of prepreg shall be supported by a core that is not deformed by the material weight. The core itself should be supported at all times within the shipping container during shipping and storage in such a way that the material will not be damaged from its own weight.

b. Core inside diameter shall be 8 inches minimum for Class 1 prepregs, and 3 inches minimum for Class 2 prepregs.

c. Core length shall be 2 to 6 inches longer than the carrier width for Class 2 materials.

d. Cores shall be longer than the release paper, by 2 ± 1 inch on either side, for Class 1 materials.

10.4 COLOR CODE

Each prepreg roll shall be color coded either by colored carrier or by color marking of the roll core end or center. The color code is as follows:

GRADE/STYLE	**CARRIER/ROLL CORE COLOR**
95	White
145	Yellow
190	Natural
3K-70-PW	Red
3K-135-8H	Red

10.5 PACKAGING

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 an airtight, noncontaininating bag. Bags shall be either a 0.006 inch polyethylene bag or a Boeing approved alternate. Desiccant shall be placed in bags prior to sealing.

c. Rolls of material which have been stored at lower than room temperature shall not be exposed to ambient atmospheric conditions unless contained in a sealed moisture proof bag. Sealed bags shall not be opened until the contents have attained ambient temperature and no moisture shall be visible on the surface of the bags.

10.6 MARKING

a. Each container of prepreg shall be permanently and legibly marked with the information specified in Section 9.

b. Letter on each container in letters at least 3/4 inch high:

"SHIP AND STORE AT 10F OR BELOW"

"DO NOT STAND ON END"

c. Each container shall have the date of shipment and the purchase order number printed on the package.

d. All labeling shall conform to OSHA 1910.1200.

10.7 SHIPPING

a. Ship and store materials at 10F or below.

b. Include sufficient temperature recorders with each lot shipped to assure all temperature excursions above 10F are recorded.

c. The use and placement of temperature recorders shall be in accordance with BSS7061.