INACTIVE FOR NEW DESIGN

1 SCOPE

a. This specification establishes requirements for 350 F epoxy resin impregnated BMS9–8, Type I carbon fiber unidirectional tape and woven fabric forms.

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.

1.1 CONTENTS

1.1 CONTENTS (Continued)

1.1 CONTENTS (Continued)

LIST OF FIGURES

1.1 CONTENTS (Continued)

LIST OF TABLES

2 CLASSIFICATION

Preimpregnated materials shall be the following Types, Classes, and Grades or Styles.

2.1 TYPES

Type shall specify prepreg resin nominal content.

Type I	–	Nominal resin content 42 percent by weight
Type II	–	Nominal resin content 35 percent by weight
Type III	–	Nominal resin content 37 percent by weight
Type IV	–	Nominal resin content 40 percent by weight

2.2 CLASSES

Class shall specify prepreg form.

Class 1	–	Unidirectional prepreg tape for manual layup
Class 2	–	Woven fabric prepreg
Class 3	–	Unidirectional prepreg tape for use with automated tape laying equipment or manual layup

2.3 GRADES

Grade shall specify nominal carbon fiber 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 STYLES

Style shall specify weave style of the carbon fiber fabric.

3K–70–PW	–	plain weave, nonporous
3K–135–8H	–	8–harness satin weave

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 indicated herein.

ANSI B–46.1	–	Surface Texture, Surface Roughness, Waviness, and Lay
ASTM E–4	–	Load Verification of Testing Machines
BAC5317	–	Fiber Reinforced Composite Parts
BAC5317–1	–	Carbon and Aramid Fiber Reinforced Composite Parts, 350 F (177 C) Cure
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 Documents (PCD) System for Suppliers of Raw Material Specifications
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
BSS7309	–	Moisture Determinations in Resin–Fabric Composite Materials
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
D6–54717	–	Chemical Characterization Documentation and Operational Procedures.
OSHA 1910.1200	–	Hazard Communication Standard
RE–ADD–030	–	Hazard Communication Program
SAE–AMS–STD–401	–	Sandwich Constructions and Core Materials; General Test Methods

4 DEFINITIONS

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

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 BMS9–8 yarn lots.

4 DEFINITIONS (Continued)

Fabric Prepreg Batch – Prepreg containing fabric meeting the requirements of BMS9–8, impregnated with one batch of resin in one continuous manufacturing operation with traceability to individual BMS9–8 fabric lots.

Fuzz Balls – These occur when individual filaments are abraded or broken during the manufacture of the preimpregnated material. These broken filaments and/or abraded particles collect as loose filament bundles or balls which are occasionally incorporated into the impregnated material.

Handling Life – The out–of–refrigeration time over which the material maintains its handleability, that is capable of demonstrating properties in Section 5.1.1 and Section 5.1.2.

Mechanical Life – The–out–of–refrigeration time over which the material remains capable of attaining cure and mechanical properties, specified in Section 5.2, if laid up and compacted within its handling life.

Out–time – The maximum (cumulative) time that a prepreg may be kept at ambient conditions 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 from the separator film or release paper.

Resin Batch – Resin blended together in one homogenous mix with traceability to individual component lots, or resin mixed in one mixer in one operation.

Room Temperature (RT) – The temperature range of 75 ± 10 F.

Surface Resin Starvation – Incomplete resin filling of the part surface.

Storage Life – The time in storage at 10 F or below, while contained in sealed packaging, over which the material maintains its handling life, its mechanical life as well as all other requirements of this specification.

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 BMS9–8 fiber lots.

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

5.1 PREPREG PROPERTIES

a. This specification requires product qualification prior to acceptance of production orders.

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

5.1.1 PHYSICAL PROPERTIES

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

TABLE I PREPREG PHYSICAL PROPERTIES

PROPERTY	REQUIREMENT				TEST METHOD SECTION
	TYPE I	TYPE II	TYPE III	TYPE IV	
Resin Content, percent wt. **FL 1 FL 2 FL 5**	42.0 ± 2.0	35.0 ± 2.0	37.0± 2.0	40.0 ± 2.0	8.1.1
Volatiles Content, percent wt. **FL 1**	2.5 (absolute) max. **FL 4**	2.5 (absolute) max. **FL 4**	2.5 (absolute) max. **FL 4**	2.5 (absolute) max. **FL 4**	8.1.2
Flow, percent wt. **FL 1**	As specified in QPL	As specified in QPL	As specified in QPL	As specified in QPL	8.1.3
Gel Time, minutes **FL 1**	As specified in QPL	As specified in QPL	As specified in QPL	As specified in QPL	8.1.4
Moisture Content, percent wt. **FL 1** (Class 3 only)	0.3 max.	0.3 max.	0.3 max	– – –	8.1.5
Tape width **FL 3** (Class 3 only)	As Specified in Section 5.1.3.3c.	As Specified in Section 5.1.3.3c.	As Specified in Section 5.1.3.3c.	– – –	8.1.8
Roll Edge **FL 3** Alignment Variance (Class 3 only)	As Specified in Section 5.1.3.3d.	As Specified in Section 5.1.3.3d.	As Specified in Section 5.1.3.3d.	– – –	8.1.9
Areal Weight carbon fiber only gm/m^2 **FL 1 FL 5**					8.1.1
Grade 95	95 ± 5				
Grade 145	145 ± 5				
Grade 190	190 ± 5				
Style 3K–70–PW	193 ± 8				
Style 3K–135–8H	364 ± 14				

FL 1 Required supplier and purchaser tests.

FL 2 Supplier test: For Grade 95 tape, it is acceptable for any roll of any prepreg lot to be within ± 3 percent of nominal. For all other Grades and Styles, it is acceptable for 20 percent or one roll of any prepreg lot to be within ± 3 percent of nominal.

Purchaser test: For all Grades and Styles, it is acceptable for all sampled rolls of any prepreg lot to be within ± 3 percent of nominal.

FL 3 Required supplier test

FL 4 Unless otherwise specified in Qualified Products List

FL 5 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 (IR) **FL 3**	As Specified on QPL **FL 2**	8.4.1
Resin Component Analysis (HPLC) **FL 1 FL 3**	As specified on QPL **FL 2**	8.4.2

FL 1 Supplier key characteristic in accordance with BSS7286.

FL 2 Requirements for each supplier shall be determined using D6–54717.

FL 3 Required supplier test.

5.1.3 VISIBLE DEFECT LIMITATIONS AND DIMENSIONAL REQUIREMENTS – CLASS 1 AND 3 (TAPES)

5.1.3.1 General Requirements

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, in accordance with the requirements of this specification.

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 are 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 are 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 is not necessary to remove the fuzz ball from the prepreg.

5.1.3.2 Class 1 Tapes

In addition to the requirements of Section 5.1.3.1, the following requirements shall apply to Class 1 Tapes:

a. Open spaces between fibers shall not be more than 10 inches long nor more than 0.030 inches wide. One open space 0.010 to 0.030 inches wide and not exceeding 10 inches long is acceptable in each 10 square feet of prepreg. Open spaces less than 0.010 inches wide not exceeding 10 inches long are acceptable.

b. 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 inches per foot of length.

c. Tolerance on width of the material is ± 0.050 inch.

5.1.3.3 Class 3 Tapes

In addition to the requirements of Section 5.1.3.1, the following requirements shall apply to Class 3 Tapes:

a. Open spaces between fibers shall not be more than 3 inches long nor more than 0.020 inches wide. One open space 0.010 to 0.020 inches wide and not exceeding 3 inches long is acceptable in each 20 square feet of prepreg. Open spaces less than 0.010 inches wide and not exceeding 3 inches long are acceptable.

b. The orientation of the yarn within the prepreg tape shall not deviate from a straight line parallel to the centerline of the prepreg by more than 0.025 inches in 1 foot of length.

c. The measured width of the material shall be one of the following:

(1) 2.970 ± 0.030 inches

(2) 5.970 ± 0.030 inches

(3) Within ± 0.030 inches of that specified in the purchase contract.

d. The roll edge alignment variance, when measured in accordance with Section 8.1.9, shall not exceed 0.080 inches.

5.1.4 VISIBLE 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.

b. Visible indications of impurities, dry areas, areas of non–uniformity, incomplete impregnation, cured resin, hard spots, and localized color differences in the impregnated fabric shall be marked as nonconforming defects or defective areas. For weaving defects, mark the following as nonconforming: creases, cuts, tears, smashes, fabric splices, and weave separations as well as those defects exceeding the fabric quality requirements of BMS9–8 (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.

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

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 the length of the distorted area (L) and the maximum deviation (D) shall be greater than or equal to 10 (see Figure 1). When the deviation (D) is less than 0.25 inches, the L/D requirement is waived.

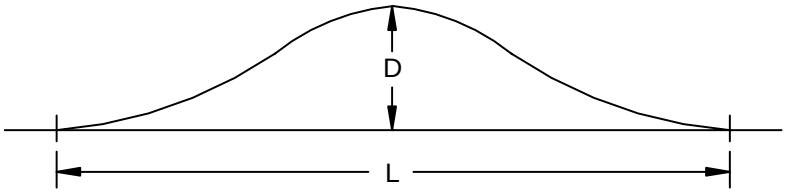


FIGURE 1 DEFINITION OF L/D

5.1.5 NONCONFORMING MATERIAL (ALL CLASSES TAPES AND FABRICS)

a. Class 1 and 2

(1) Areas of materials not conforming to Section 5.1.3 and Section 5.1.4 shall be identified along the edge of the prepreg roll by markers at the beginning and the end of the defective area. Markers shall be of a single color, distinguishable from the prepreg and carrier, and removable without damaging the prepreg.

(2) For single point defects, use single markers.

(3) For areas of continuous defects encompassing more than 3 feet along the material's length, markers shall be placed at the beginning, at 2 feet (maximum) intervals, and at the end of the continuous defect.

(4) It is acceptable to cut and splice prepreg to remove defects. Prepreg splicing procedures shall be approved by The Boeing Company and documented in the Supplier Process Control Document (PCD).

(5) Material shall have a roll maximum defect limit of 15 percent by weight. Defect weight limit shall be on the full width weight.

(6) 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.

(7) The type, 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 to within 3 feet relative to the outside of the prepreg roll.

(8) Defective areas shall not be counted toward the amount purchased.

5.1.5 NONCONFORMING MATERIAL (ALL CLASSES TAPES AND FABRICS) (Continued)

b. Class 3

(1) Areas of unacceptable material that do not conform to Section 5.1.3.3, shall be cut from the roll and the material shall be spliced in accordance with Figure 2 or patched in accordance with Figure 3.

(2) No two splices shall be closer than 50 feet and no splice or patch shall be closer than 50 feet to a roll end.

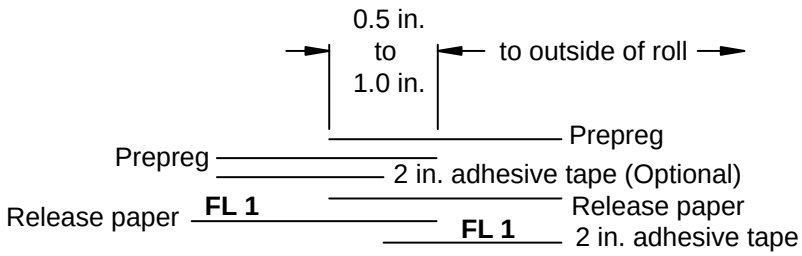
(3) The location of the tape splices or patches shall be indicated on a defect log accompanying each roll of material. The defect log shall indicate the location of patches and splices, within 3 feet, from the outside end of the roll.

(4) Impregnated materials shall be defect free in accordance with Section 5.1.5b. Material from different rolls of the same batch may be spliced provided that this is so noted on the material certification report.

(5) Defects in Class 3 material listed in Section 5.1.3.1 and Section 5.1.3.3 shall be corrected as follows:

crimped fiber	– patch
cured resin particles	– splice
foreign particles	– splice or remove (in accordance with supplier PCD)
twists	– patch
dry or boardy areas	– splice
puckers	– splice
moisture	– splice
gap	– splice or rework (in accordance with supplier PCD)
fiber ball (surrounds the yarn)	– allow or remove (in accordance with supplier PCD)
fuzzballs	– allow or remove (in accordance with supplier PCD)
unwetted fibers	– patch
width variation	– patch or splice
tow splice	– allow or rework (in accordance with supplier PCD)
fiber cross over	– allow or splice (in accordance with supplier PCD)

NOTE: Defects over 10 inches long shall be removed by splicing.



FL 1 Denotes adhesive side of tape.

FIGURE 2 SPLICING AFTER DEFECT REMOVAL FOR CLASS 3 TAPE

5.1.5 NONCONFORMING MATERIAL (ALL CLASSES TAPES AND FABRICS) (Continued)

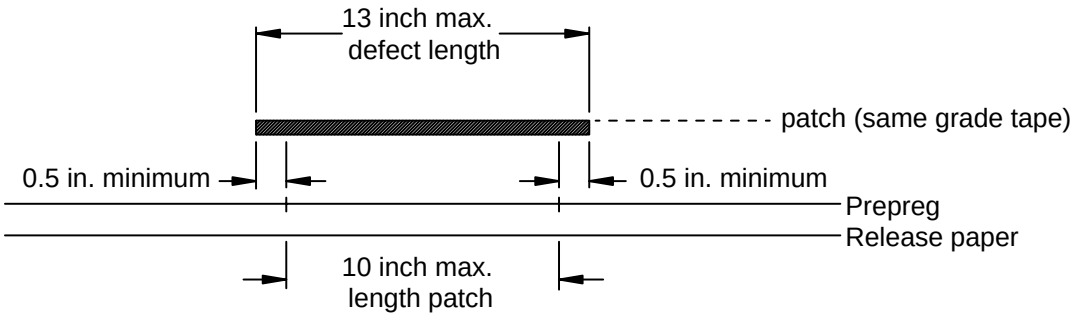


FIGURE 3 PATCHING FOR DEFECT REMOVAL FOR CLASS 3 TAPE

5.1.6 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. (See Figure 4 and Figure 5).

a. Storage Life – 450 days minimum from the date of manufacture, stored at 10 F or below, packaged in accordance with Section 10.5b.

b. Supplier Out–Time – 72 hours maximum at room temperature.

c. Handling life – 240 hours minimum at room temperature.

d. Mechanical Life – 720 hours minimum at room temperature

e. Unless specified on the purchase contract, there shall be a minimum of 270 days of storage life remaining from the date of receipt at the purchaser's facility.

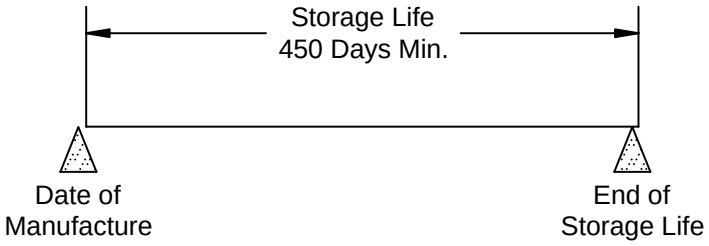


FIGURE 4 PREPREG REFRIGERATION LIFE

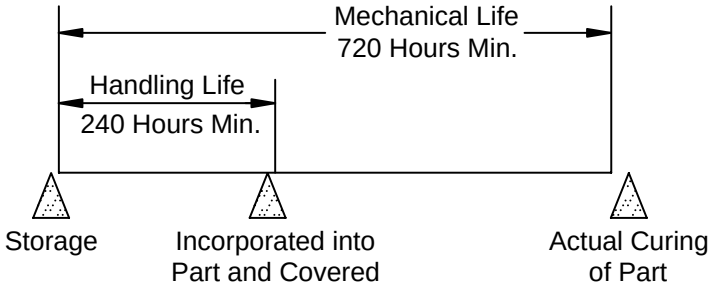


FIGURE 5 PREPREG OUTTIME LIFE

5.2 LAMINATE/SANDWICH PROPERTIES

a. Laminates and sandwich panels fabricated in accordance with Section 8.3 shall meet the requirements of Table III, Table IV, Table VI, Table VII, Table VIII, and Table IX when tested dry.

b. Laminate specimens, water soaked for 14 +1/–0 days at 160 ± 10 F prior to test, shall meet the requirements of Table X and Table XI.

TABLE III LAMINATE PHYSICAL PROPERTIES

PROPERTY	GRADE/ STYLE	REQUIREMENT				TEST METHOD SECTION
		TYPE I	TYPE II	TYPE III	TYPE IV	
Ply Thickness, mils **FL 1 FL 4**	95	3.0 to 3.7	3.4 to 4.0	3.6 to 4.2	– – –	8.1.6
	145	4.7 to 5.6	5.2 to 6.1	5.5 to 6.4	– – –	
	190	6.2 to 7.2	6.9 to 8.0	7.3 to 8.4	– – –	
	3K–70–PW	6.6 to 8.0	6.9 to 8.2	NR	7.5 to 9.1	
	3K–135–5H	12.4 to 14.7	13.2 to 15.8	13.8 to 16.4	– – –	
Laminate Porosity	3K–70–PW	**FL 2**	**FL 2**	**FL 2**	**FL 2**	8.1.7.1
Surface Resin Starvation, percent area **FL 3**	3K–70–PW	0.3 max	0.3 max	– – –	0.3 max	8.1.7.2

FL 1 Required supplier and Purchaser test.

FL 2 The average flow reading for the laminate shall be equal to or less than the average reading obtained in calibration.

FL 3 The worst 1 square inch area shall be used to determine the maximum surface resin starvation.

FL 4 Supplier key characteristic in accordance with BSS7286.

TABLE IV LAMINATE MECHANICAL PROPERTIES (CLASS 1 AND CLASS 3 TAPES)

TEST	TEST TEMPERATURE	TYPE II REQUIREMENTS **FL 1**		TYPE III REQUIREMENTS **FL 1**		TEST METHOD SECTION
		MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Strength Ultimate, ksi, 0 degrees	–65 F (–54C)	175	155	160	135	8.2.1
	RT **FL 2 FL 3**	185	160	180	150	
	160 F (71C)	185	160	180	150	
	270 F (132C)	185	160	180	150	

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE IV LAMINATE MECHANICAL PROPERTIES (CLASS 1 AND CLASS 3 TAPES) (Continued)

TEST	TEST TEMPERATURE	TYPE II REQUIREMENTS **FL 1**		TYPE III REQUIREMENTS **FL 1**		TEST METHOD SECTION
		MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Modulus, msi, 0 degrees	–65 F (–54C)	18.0 to 21.0	17.0 to 22.0	17.0 to 20.0	16.0 to 21.0	8.2.1
	RT **FL 2 FL 3**	18.0 to 21.0	17.0 to 22.0	17.0 to 20.0	16.0 to 21.0	
	160 F (71C)	18.0 to 21.0	17.0 to 22.0	17.0 to 20.0	16.0 to 21.0	
	270 F (132C)	18.0 to 21.0	17.0 to 22.0	17.0 to 20.0	16.0 to 21.0	
Tensile Strain Ultimate, micro–in./in., 0 degrees	–65 F (–54C)	9,000	7,000	9,000	7,000	
	RT **FL 2**	9,500	7,500	9,500	7,500	
	160 F (71C)	9,000	7,000	9,000	7,000	
	270 F (132C)	9,000	7,000	9,000	7,000	
Compression Strength Ultimate, ksi, 0 degrees	–65 F (–54C)	175	150	170	145	8.2.2
	RT	165	150	160	140	
	160 F (71 C) **FL 2 FL 3**	155	130	150	125	
	270 F (132 C)	135	110	130	105	
Compression Modulus, msi, 0 degrees	–65 F (–54C)	16.5 to 19.0	14.0 to 22.0	15.5 to 18.0	13.5 to 21.0	
	RT	16.5 to 19.0	14.0 to 22.0	15.5 to 18.0	13.5 to 21.0	
	160 F (71C)	16.5 to 19.0	14.0 to 22.0	15.5 to 18.0	13.5 to 21.0	
	270 F (132 C)	16.5 to 19.0	14.0 to 22.0	15.5 to 18.0	13.5 to 21.0	
Compression Strain Ultimate, Micro–in./in., 0 degrees	–65 (–54C)	8,500	– – –	8,500	– – –	
	RT	8,500	– – –	8,500	– – –	
	160 F (71C)	7,700	– – –	7,700	– – –	
	270 F (132C)	7,700	– – –	7,700	– – –	

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 accordance with Table V.

FL 2 Required supplier and purchaser test.

FL 3 Supplier key characteristic in accordance with BSS7286.

TABLE V LAMINATE NOMINAL PER–PLY THICKNESS

GRADE/STYLE	NOMINAL THICKNESS, INCHES			
	TYPE I	TYPE II	TYPE III	TYPE IV
95	0.0034	0.0037	0.0039	– – –
145	0.0051	0.0056	0.0059	– – –
190	0.0067	0.0074	0.0078	– – –
3K–70–PW	0.0073	0.0075	– – –	0.0083
3K–135–8H	0.0136	0.0144	0.0150	– – –

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE VI LAMINATE MECHANICAL PROPERTIES (CLASS 2– FABRICS)

TEST	TEST TEMPERATURE	TYPE II REQUIREMENTS **FL 1**		TYPE III REQUIREMENTS **FL 1**		TYPE IV REQUIREMENTS **FL 1**		TEST METHOD SECTION
		MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	MIN AVERAGE OR RANGE	MIN. INDIVIDUAL OR RANGE	
Tensile Strength Ultimate, ksi Warp and Fill	–65 F (–54 C)	65	55	62	53	55	45	8.2.1
	RT **FL 2 FL 3**	70	60	67	58	60	50	
	160 F (71 C)	70	60	67	58	60	50	
	270 F (132 C)	70	60	67	58	60	50	
Tensile Modulus msi, Warp and Fill	–65 F (–54 C)	8.5 to 11.0	8.0 to 12.5	8.2 to 10.6	7.7 to 12.0	7.7 to 10.0	7.2 to 11.3	
	RT **FL 2 FL 3**	8.5 to 11.0	8.0 to 12.5	8.2 to 10.6	7.7 to 12.0	7.7 to 10.0	7.2 to 11.3	
	160 F (71 C)	8.5 to 11.0	8.0 to 12.5	8.2 to 10.6	7.7 to 12.0	7.7 to 10.0	7.2 to 11.3	
	270 F (132 C)	8.5 to 11.0	8.0 to 12.5	8.2 to 10.6	7.7 to 12.0	7.7 to 10.0	7.2 to 11.3	
Tensile Strain Ultimate micro–in./in. Warp and Fill	–65 F (–54 C)	6,000	– – –	6,000	– – –	6,000	– – –	
	RT **FL 2**	7,000	– – –	7,000	– – –	7,000	– – –	
	160 F (71 C)	6,700	– – –	6,700	– – –	6,700	– – –	
	270 F (132 C)	6,500	– – –	6,500	– – –	6,500	– – –	
Compression Strength Ultimate, ksi, Warp and Fill	–65 F (–54 C)	70	50	67	48	65	45	8.2.2
	RT	70	50	67	48	65	45	
	160 F (71 C) **FL 2 FL 3**	60	45	58	43	55	40	
	270 F (132 C)	50	40	48	38	45	30	
Compression Modulus msi, Warp and Fill	–65 F (–54 C)	7.5 to 10.0	7.0 to 11.0	7.2 to 9.6	6.7 to 10.6	6.7 to 9.0	6.3 to 10.0	
	RT	7.5 to 10.0	7.0 to 11.0	7.2 to 9.6	6.7 to 10.6	6.7 to 9.0	6.3 to 10.0	
	160 F (71 C)	7.5 to 10.0	7.0 to 11.0	7.2 to 9.6	6.7 to 10.6	6.7 to 9.0	6.3 to 10.0	
	270 F (132 C)	7.5 to 10.0	7.0 to 11.0	7.2 to 9.6	6.7 to 10.6	6.7 to 9.0	6.3 to 10.0	
Compression Strain Ultimate micro–in./in., Warp and Fill	–65 F (–54 C)	6,800	– – –	6,800	– – –	6,800	– – –	
	RT	6,800	– – –	6,800	– – –	6,800	– – –	
	160 F (71 C)	5,900	– – –	5,900	– – –	5,900	– – –	
	270 F (132 C)	5,000	– – –	5,000	– – –	5,900	– – –	

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 accordance with Table V.

FL 2 Required supplier and purchaser test. Test in fill direction only.

FL 3 Supplier key characteristic in accordance with BSS7286.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE VII SANDWICH MECHANICAL PROPERTIES (ALL CLASSES)

TEST **FL 1**	GRADE/STYLE	TYPE II AND III CLASS 1 AND 3 TAPES		TYPE II, III AND IV CLASS 2 FABRICS		TEST METHOD SECTION
		MIN. AVERAGE	MIN. INDIVIDUAL	MIN. AVERAGE	MIN INDIVIDUAL	
Flatwise Tensile, psi	– – –	600	540	600	540	8.2.3
Long Beam Flexure, Load, lb	Grade 95	200	180	– – –	– – –	8.2.4
	Grade 145	240	216	– – –	– – –	
	Grade 190	200	180	– – –	– – –	
	Style 3K–70–PW	– – –	– – –	210	189	
	Style 3K–135–8H	– – –	– – –	420	378	
Long Beam Flexure, P/Y, lb/in	Grade 95	240	216	– – –	– – –	
	Grade 145	300	270	– – –	– – –	
	Grade 190	240	216	– – –	– – –	
	Style 3K–70–PW	– – –	– – –	200	180	
	Style 3K–135–8H	– – –	– – –	400	360	

FL 1 All tests to be conducted at room temperature.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE VIII TYPE I LAMINATE MECHANICAL PROPERTIES (CLASS 1 TAPES)

TEST	TEST TEMPERATURE	MIN AVERAGE OR RANGE **FL 1**	MIN. INDIVIDUAL OR RANGE **FL 1**	TEST METHOD SECTION
Tensile Strength Ultimate, ksi, 0 degrees	–65 F (–54 C)	190	170	8.2.1
	RT **FL 2 FL 3**	200	180	
	160 F (71 C)	200	180	
	270 F (132 C)	200	180	
Tensile Modulus, msi, 0 degrees	–65 F (–54 C)	19.0 to 22.5	18.0 to 24.0	
	RT **FL 2 FL 3**	19.0 to 22.5	18.0 to 24.0	
	160 F (71 C)	19.0 to 22.5	18.0 to 24.0	
	270 F (132 C)	19.0 to 22.5	18.0 to 24.0	
Tensile Strain Ultimate, micro–in./in., 0 degrees	–65 F (–54 C)	9,000	7,000	
	RT **FL 2**	9,500	7,500	
	160 F (71 C)	9,000	7,000	
	270 F (132 C)	9,000	7,000	
Compression Strength Ultimate, ksi, 0 degrees	–65 F (–54 C)	195	165	8.2.2
	RT	180	160	
	160 F (71 C) **FL 2 FL 3**	170	140	
	270 F (132 C)	150	120	
Compression Modulus, msi, 0 degrees	–65 F (–54 C)	19.0 to 22.0	16.0 to 24.0	
	RT	19.0 to 22.0	16.0 to 24.0	
	160 F (71 C)	19.0 to 22.0	16.0 to 24.0	
	270 F (132 C)	19.0 to 22.0	16.0 to 24.0	
Compression Strain, Ultimate, micro–in./in., 0 degrees	–65 F (–54 C)	8,500	– – –	
	RT	8,500	– – –	
	160 F (71 C)	7,700	– – –	
	270 F (132 C)	7,000	– – –	

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

FL 2 Required supplier and purchaser test.

FL 3 Supplier key characteristic in accordance with BSS7286.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE IX TYPE I LAMINATE MECHANICAL PROPERTIES (CLASS 2–FABRICS)

TEST	TEST TEMPERATURE	MIN. AVERAGE OR RANGE **FL 1**	MIN. INDIVIDUAL OR RANGE **FL 1**	TEST METHOD SECTION
Tensile Strength Ultimate, ksi, Warp and Fill	–65 F (–54 C)	65	55	8.2.1
	RT **FL 2 FL 3**	70	60	
	160 F (71 C)	70	60	
	270 F (132 C)	70	60	
Tensile Modulus, msi, Warp and Fill	–65 F (–54 C)	8.5 to 11.0	8.0 to 12.5	
	RT **FL 2 FL 3**	8.5 to 11.0	8.0 to 12.5	
	160 F (71 C)	8.5 to 11.0	8.0 to 12.5	
	270 F (132 C)	8.5 to 11.0	8.0 to 12.5	
Tensile Strain Ultimate, Micro–in./in., Warp and Fill	–65 F (–54 C)	6,000	– – –	
	RT **FL 2**	7,000	– – –	
	160 F (71 C)	6,700	– – –	
	270 F (132 C)	6,500	– – –	
Compression Strength Ultimate, ksi, Warp and Fill	–65 F (–54 C)	75	65	8.2.2
	RT	75	60	
	160 F (71 C) **FL 2 FL 3**	65	50	
	270 F (132 C)	55	45	
Compression Modulus, msi	–65 F (–54 C)	8.5 to 11.0	8.0 to 12.0	
	RT	8.5 to 11.0	7.5 to 12.0	
	160 F (71 C)	8.5 to 11.0	7.5 to 12.0	
	270 F (132 C)	8.5 to 11.0	7.5 to 12.0	
Compression Strain Ultimate, Micro–in./in., Warp and Fill	–65 F (–54 C)	6,800	– – –	
	RT	6,800	– – –	
	160 F (71 C)	5,900	– – –	
	270 F (132 C)	5,000	– – –	

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

FL 2 Required supplier and purchaser test. Test in fill direction only.

FL 3 Supplier key characteristic in accordance with BSS7286.

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE X LAMINATE WET (FL 1) MECHANICAL PROPERTIES–TYPES II, III AND IV

CLASS	TEST	TEST TEMPERATURE	TYPE II REQUIRE–MENTS		TYPE III REQUIRE–MENTS		TYPE IV REQUIRE–MENTS		TEST METHOD SECTION
			MIN. AVG	MIN. IND	MIN AVG	MIN. IND	MIN AVG	MIN. AVG	
1 and 3	Compression Strength, ksi, 0 degrees	RT	165	150	155	140	– – –	– – –	8.2.2
		160 F (71 C)	130	90	125	85	– – –	– – –	
		270 F (132 C)	75	35	60	30	– – –	– – –	
2	Compression Strength, ksi, Warp and Fill	RT	70	50	67	48	65	45	
		160 F (71C)	60	45	58	43	55	40	
		270 F (132 C)	35	25	34	24	30	20	

FL 1 Water soak at 160 F ± 10 F for 14 +1/–0 days prior to test.

TABLE XI LAMINATE WET (FL 1) MECHANICAL PROPERTIES – TYPE I

CLASS	TEST	TEST TEMPERATURE	MIN. AVG.	MIN. IND.	TEST METHOD SECTION
1 and 3	Compression Strength, ksi, 0 degrees	RT	180	160	8.2.2
		160 F (71 C)	140	95	
		270 F (132 C)	80	35	
2	Compression Strength, ksi, Warp and Fill	RT	70	50	
		160 F (71 C)	60	45	
		270 F (132 C)	35	25	

FL 1 Water soak at 160 ± 10 F for 14 +1/–0 days prior to test.

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.

b. 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 products.

c. Prior to submitting a material for qualification to this specification, the 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 organizations 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.

6 **QUALIFICATION** (Continued)

d. Qualification shall be based upon the manufacture and successful test of three batches of the material. The three batches shall contain at least two different resin batches and at least two different lots of the reinforcement. For Class 2, the two different lots of reinforcement apply to the fill direction only.

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. The Boeing Company reserves the right to reaudit any or all follow on production orders subsequent to qualification.

f. When requested by The Boeing Company, SM&P organization, the supplier shall provide qualification material, quantities to be determined at the time of qualification. Additionally, the supplier shall submit two copies of test data including individual specimen values, showing that the material meets all the requirements of the specification, for the Type, Class and Grade/Style submitted. The test facility (supplier or test laboratory) used in determination of the data shall be identified.

g. Suppliers shall furnish the average cured resin density and carbon fiber density with the test data.

h. The supplier shall submit a Process Control Document (PCD) for Boeing review prior to qualification audit of production material. The PCD shall identify baseline chemical constituents, in–process test procedures and requirements, and manufacturing procedures in accordance with BSS7101.

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

j. No changes 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.

k. After review of supplier data and completion of Boeing tests, the supplier will be advised of qualification status.

l. Qualified products are listed in the Qualified Products List.

m. Any or all of the qualification tests may be repeated at any time by the purchaser and the material shall pass qualification requirements.

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

7 QUALITY CONTROL

7.1 SUPPLIER QUALITY CONTROL

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

b. Test each batch of material before shipping.

(1) Test each prepreg batch to the requirements of Table I, Prepreg Physical Properties. Test every roll for resin content and fiber areal weight. Test two rolls of each prepreg batch for volatile content, moisture content (Class 3 only), gel time, and flow.

(2) Test each prepreg batch to the requirements of Table II, Prepreg Chemical Properties. If the supplier cannot perform the tests of Table II, then the tests shall be conducted by a Boeing approved laboratory and listed in the PCD. Test one roll of the prepreg batch for infrared analysis. Test the first and last rolls of the prepreg batch for liquid chromatography analysis.

(3) Test each prepreg batch to the requirements of Table III, Table IV, Table VI, Table VII, Table VIII, and Table IX for laminate physical and mechanical properties as required by Type, Class, Grade, and Style. Test in accordance with the following matrix.

Material Quality Control Testing

No. of Pounds		
Class 1 and 3	Class 2	Prepreg Batch Test Frequency
1 to 250	1 to 500	Test 1 roll
251 to 500	501 to 1500	Test 2 rolls
501 +	1501 +	Test 2 rolls plus 1 roll for each additional 500 lbs (for Class 1 or Class 3) or 1500 lbs (for Class 2) or part thereof.

c. 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.

d. Suppliers shall submit the roll defect log(s) in accordance with Section 5.1.5 with each shipment and attach a copy to the roll container.

e. 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 Process Control Document (PCD). Such records shall be available for inspection by authorized representatives of The Boeing Company.

f. Perform dimensional inspection in accordance with Section 8.1.8 and Section 8.1.9 on Class 3 tape rolls sampled in accordance with BSS7286. A set of rolls slit from the full width of tape shall be considered one sample. Sampling shall be from the final winding of the rolls. Measurements shall be taken from each roll in the sample.

7.1 SUPPLIER QUALITY CONTROL (Continued)

g. 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 must be submitted every 6 months. If the control limits change from a previous report, suppliers shall report old and new control limits.

h. In lieu of performing the tests listed 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, 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 and 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 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 III, Table IV, Table VI, Table VIII, and Table IX. 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 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.

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 Type, Class, and Grade or Style shall be used to establish control limits.

7.1.1.2 Analysis and Review (Continued)

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

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

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

TABLE XII PURCHASER QUALITY CONTROL TEST

TEST	TEMPERATURE	TABLE	SECTION
Resin Content, percent wt. **FL 1**	——	I	8.1.1
Areal Weight Carbon fiber	——	I	8.1.1
Volatiles Content, percent wt.	——	I	8.1.2
Flow, percent wt.	——	I	8.1.3
Gel Time, minutes	——	I	8.1.4
Moisture Content, percent wt.	——	I	8.1.5
Ply Thickness	——	III	8.1.6
Tensile Strength, Modulus, Strain	RT dry	IV, VI, VIII, IX	8.2.1
Compression Strength	106F dry	IV, VI, VIII, IX	8.2.2

FL 1 Supplier Test: For Grade 95 tape, it is acceptable for any roll of any prepreg lot to be within ± 3 percent on nominal. For all other Grades and Styles , it is acceptable for 20 percent or one roll of any prepreg lot to be with ± 3 percent of nominal.

7.2 PURCHASER QUALITY CONTROL (Continued)

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+	4 plus 1 additional roll for each additional 40 rolls or part thereof

(2) If the purchaser has an implemented chemical characterization capability, perform the tests in Section 5.1.2 on each prepreg lot to the requirements of Table II.

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 the 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 5.1.6 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 mechanical life conditions in Section 5.1.6, 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 5.1.6 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 excursion does not exceed 60 minutes.

(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. Keep all test data and records 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.

a. Before taking a sample, allow the prepreg to warm to room temperature. Rolls of material stored at lower than room temperature shall be contained in sealed bags. Sealed bags shall not be opened if condensation forms on the surface of the bags after being wiped dry.

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 reclose the roll and sample(s) in moisture–proof bags before returning the unused prepreg to storage. Minimize outtime from refrigerated storage.

c. Use the test methods described below or Boeing approved equivalent test methods.

d. Condition and test all room temperature specimens at 75 ± 10 F.

e. Laboratory approval for HPLC and IR testing shall be granted after the requirements of D6–54717 have been met.

8.1 PHYSICAL PROPERTIES TEST

8.1.1 RESIN CONTENT/CARBON FIBER AREAL WEIGHT – UNCURED PREPREG

a. Class 1 and 2 Materials

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.

b. Class 3 Materials

Cut three samples, having a width equal to the full width and approximately 100 square cm in area. Samples shall be cut in sequence from the roll.

c. 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 1, Beaker Extraction.

d. Report 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 325 ± 10 F in accordance with BSS7337, Method II, (Pan Method).

b. Report the volatile content as the average of three samples.

8.1.3 FLOW

a. In accordance with BSS7335, Method II, Bleeder Method, determine the resin flow in a platen press at 350 ± 10 F, 100 ± 5 psi for 5 minutes plus the average qualification gel time listed on the QPL.

b. Three samples, representative of the prepreg, shall be tested and the average reported.

8.1.4 GEL TIME

a. Determine the gel time at 338 ± 5 F in accordance with BSS7276, Method II, Temperature–Controlled Hot–Plate Method.

b. Report the gel time as the average of three or more determinations.

8.1.5 MOISTURE CONTENT – PREPREG

a. Determine moisture content in accordance with BSS7309.

b. Report moisture content as the average of three determinations.

8.1.6 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 ply thickness as the average of 10 determinations uniformly dispersed over the laminate surface divided by the number of plies in the laminate.

8.1.7 LAMINATE POROSITY AND SURFACE RESIN STARVATION

8.1.7.1 Laminate Porosity

a. Prepare a 2–foot by 2–foot or 1–foot by 4–foot minimum, two ply laminate (0/45–degree orientation), using no peel ply. Vacuum bag as shown in Figure 6, and cure in accordance with Figure 7.

b. Calibrate test apparatus (Figure 8) 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 apparatus such that the hole is approximately at center location.

(3) Adjust valve until a steady reading of 20 to 21 inches Hg vacuum is obtained.

(4) Record the average of three indicated flow readings.

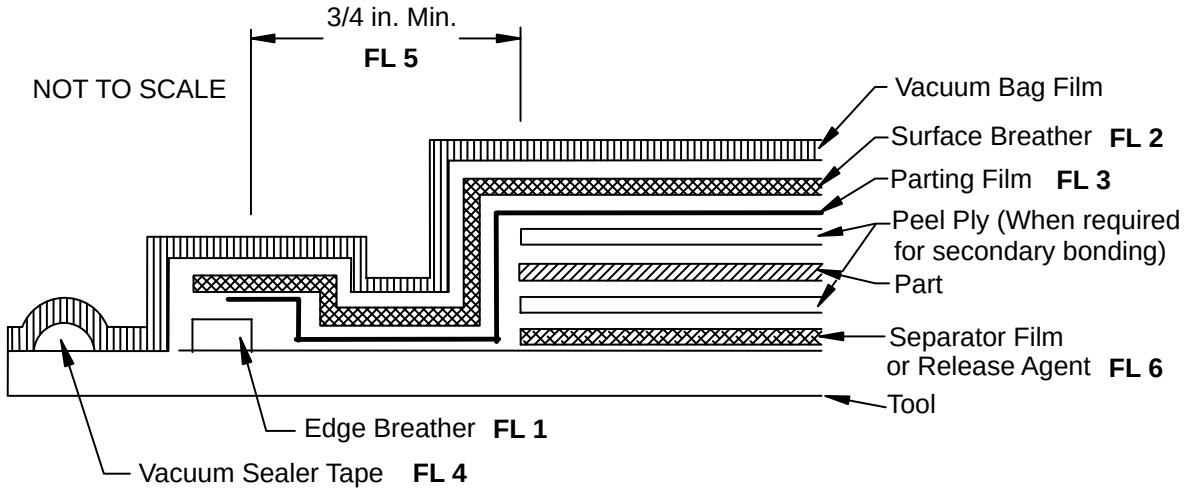
c. Place test laminate under apparatus.

(1) Adjust valve to maintain 20 to 21 inches Hg vacuum.

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

8.1.7.1 Laminate Porosity (Continued)

d. Report pass or fail for the panel, as specified in Table III.



FL 1 One inch minimum width edge breather (see BAC5317, Non–Contact Materials, Edge Breather/Bleeder Material) with direct connection to vacuum source. At one corner of the layup, place one or more single fiberglass or nylon yarns (see BAC5317–1, Non–Contact Materials) 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 Surface breather is required and shall contact the edge breather but shall not make direct contact with prepreg.

FL 3 Parting film shall extend to the center of the edge breather.

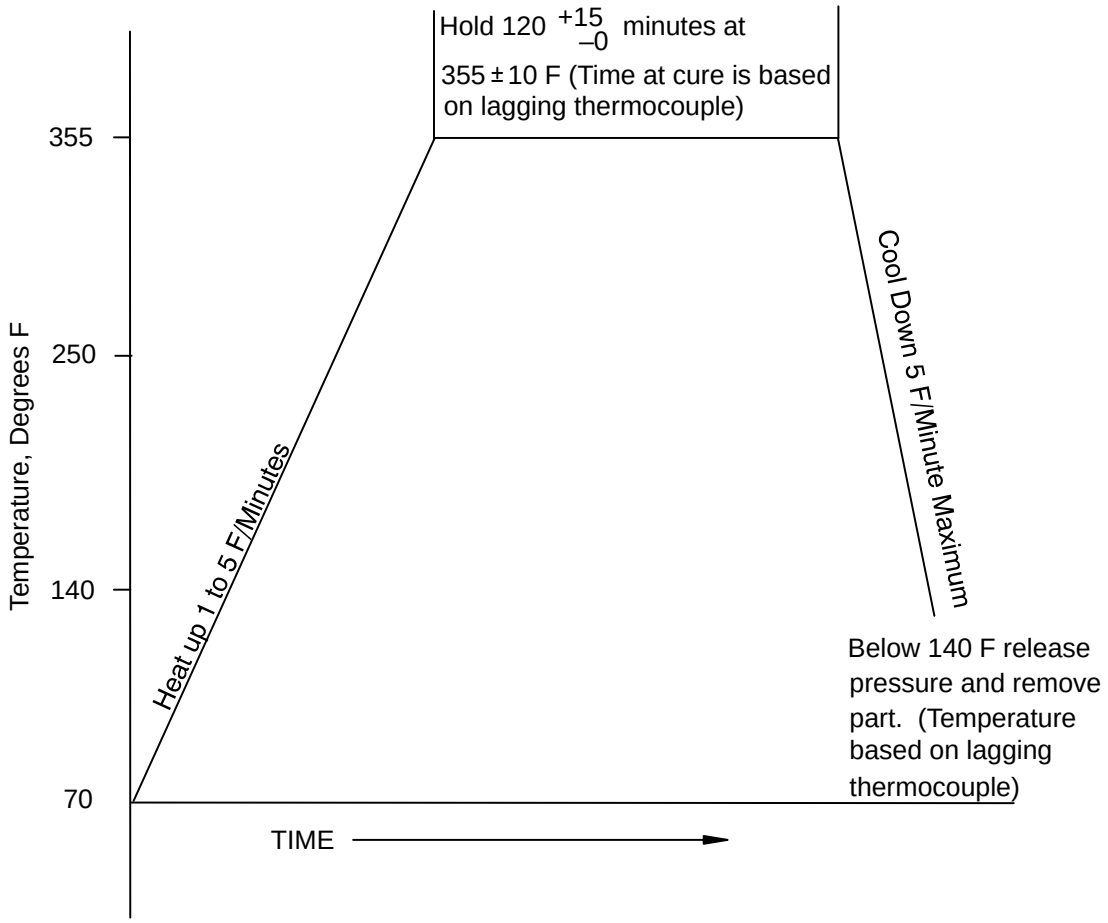
FL 4 Vacuum bag sealant material may be used in areas outside of the part trimline to avoid excessive resin bleed–out.

FL 5 Allow 3/4 inch minimum from part edge to edge of breather.

FL 6 Parting film may be applied to the tool surface using contact use elevated temperature pressure sensitive tape (see BAC5317, Contact Materials, Pressure Sensitive Tapes for Elevated Temperature Use (365 F maximum)). The tape may extend under the part excess to within 0.25 inches of the net trimline.

FIGURE 6 VACUUM BAG ASSEMBLY (TYPES II, III, AND IV)

8.1.7.1 Laminate Porosity (Continued)



Apply 22 inches Hg vacuum minimum to vacuum bag.

Apply 85 ± 15, –0 psi pressure for laminate

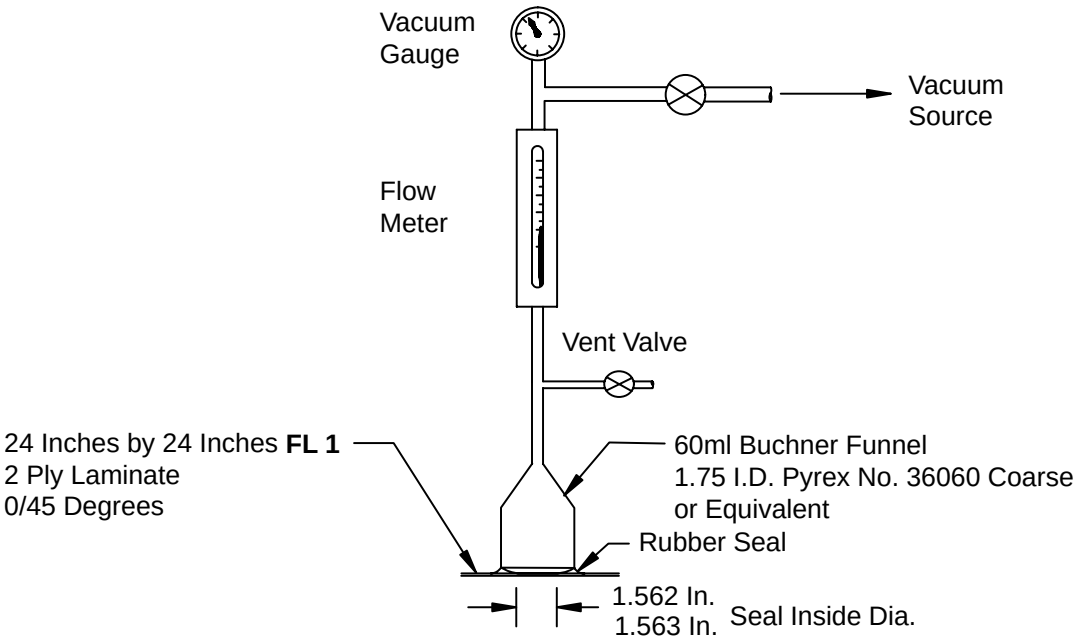
Apply 45 ± 5 psi pressure for sandwich

Vent vacuum bag to atmosphere when pressure reaches 20 psig

Maintain pressure under vacuum bag of 0 + 5, –0 psig

FIGURE 7 LAMINATE/SANDWICH CURE CYCLE (TYPES II, III, AND IV)

8.1.7.1 Laminate Porosity (Continued)



FL 1 A 12 inch by 48 inch (minimum) panel is optional.

FIGURE 8 LAMINATE POROSITY TEST

8.1.7.2 Surface Resin Starvation

Using the panel described in Section 8.1.7.1, visually examine the entire surface of the tool side using light at an oblique angle. Resin starved areas appear as spots of reflected light from exposed fibers or resin surfaces on the sides of holes down to exposed fibers. If there is any resin starvation, examine the worst area and calculate the percent resin starvation as noted below:

Method of Resin Starvation Calculation

a. Visually inspect overall panel and determine worst square inch area.

b. Using a comparator or equivalent with a circle diameter reticule, determine the diameter and the number of starved locations.

c. Calculate and report the percentage of the square inch area that is affected by surface resin starvation.

8.1.8 TAPE WIDTH (CLASS 3)

a. Use a vernier caliper or other suitable device to measure the tape/backing paper combination to an accuracy of 0.002 inches.

b. Report the average of three readings from one end of each roll in the sample.

8.1.9 ROLL EDGE ALIGNMENT VARIANCE (CLASS 3)

a. Press or flat drop the roll, edge down, on an inspection table to maximize tape edge contact with the table.

b. Traverse 3/16 inch diameter ball tipped indicator across each quadrant of the upper roll edge to measure the apparent high and low points of the surface.

c. Report the greatest difference between all readings as the roll edge alignment variance.

8.2 MECHANICAL PROPERTIES TESTS

a. Except as otherwise noted in the test method, test five specimens for each property.

b. Perform all mechanical property testing using test machines complying with ASTM E–4.

c. Fabricate laminate and sandwich test panels in accordance with Section 8.3.

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

e. Condition and test specimens to be tested at room temperature at 75 ± 10 F.

f. Hold test specimens at test temperature of –65 ± 10 F, 160 ± 10 F, or 270 ± 10 F prior to initiating test load according to the following:

TEST	TIME AT TEST TEMPERATURE (MINUTES)
All dry tests except Flatwise Tension	10 ± 3
Flatwise Tension	30 + 5/–0
All wet tests	2 ± 1

8.2.1 TENSILE TESTS

a. Tensile specimens shall have the following number of plies:

	ORIENTATION **FL 2**		
STYLE/GRADE	(WARP)	(FIBER)	NO. OF PLIES
3K–70–PW	0 Degrees	– – –	14
3K–135–8H	0 Degrees	– – –	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 with warp face up.

FL 2 The zero degree direction is parallel to the specimen length.

b. Tab, machine and test tensile specimens in accordance with BSS7320.

c. 125 edge flatness is required in accordance with ANSI B–46.1.

d. Report the individual and average values.

8.2.2 COMPRESSIVE STRENGTH, MODULUS, AND ULTIMATE STRAIN

a. Laminate ply requirements for compression tests shall be the same as those for tensile tests.

b. Tabs shall be fabricated from BMS8–212, Class 1, or a Boeing approved equivalent material with 0–degree direction in the longitudinal direction of the specimens. Tabs shall be made of fourteen plies of Grade 95, nine plies of Grade 145, or seven plies of Grade 190.

c. Tabs shall be bonded using one of the following:

(1) For test temperatures between –65 F and 160 F, use one ply of BMS5–101, Type 2, Grade 10, or BMS5–129, Type 2 or 4, Grade 10.

(2) For test temperatures above 160 F, use one ply of BMS5–154, Type II, Grade 08.

(3) Or an adhesive that has been proven to be equivalent in performance and approved by Boeing.

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.

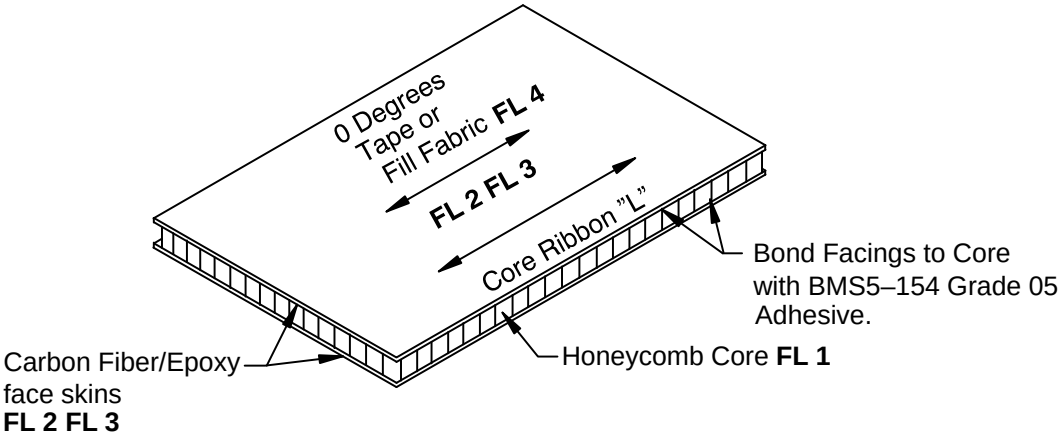
8.2.3 FLATWISE TENSILE TEST

a. Machine flatwise tensile test specimens 2.00 inches ± 0.03 inches by 2.00 inches ± 0.03 inches square to 0–degree tape fiber or fabric warp direction from panel shown in Figure 9.

b. Test in accordance with SAE–AMS–STD–401.

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

8.2.3 FLATWISE TENSILE TEST (Continued)



FL 1 Honeycomb core, BMS8–124, Class 1, Type I, Grade 8.0, 0.500 ± 0.006 inch thick. No splices are allowed in the core.

FL 2 Use peel ply or hand sand surface for flatwise tensile specimens. Do not use peel ply on long beam flexure specimens.

FL 3 The ply orientation for carbon fiber/epoxy sandwich panels shall be in accordance with the requirements shown below. 3K–135–8H fabric shall be laid up with the fabric warp face against the core. For Grade 190 tape, the 90 degree plies shall be next to the core.

FL 4 Test fabric in the fill direction.

TYPE	CLASS	GRADE/STYLE	NO. OF FACE PILES AND ORIENTATION
II, III IV	1	95	(0/90/90/0) degrees
II, III, IV	1	145	(0/90/0) degrees
II III, IV	1	190	(0/90) degrees
II, IV	2	3K–70–PW	2 Plies
II, III	2	3K–135–8H	2 Plies

FIGURE 9 SANDWICH PANEL FOR FLATWISE TENSILE AND LONG BEAM FLEXURE SPECIMENS

8.2.4 LONG BEAM FLEXURE

a. Machine long beam flexure test specimens 3.00 ± 0.03 inches wide by 24 inches minimum long, with core ribbon direction parallel to the long direction from panel shown in Figure 9.

b. Use two point loading on a 4.00 ± 0.04 inch span with support bars on 22.00 ± 0.20 inch centers, employing 1 inch wide steel blocks with a rubber pad (1 by 3 by 1/8 inches) of Shore A durometer of 60 at the center loading only. Deflection (Y) is measured at the center of the span. Loading diagram is shown In Figure 10. Test bagside up.

c. Except for the above, the test procedure shall be in accordance with SAE–AMS–STD–401.

d. Report the ultimate load (P) and the P/Y values. P/Y is the slope of the tangent drawn to the initial portion of the load–deflection curve (see Figure 11).

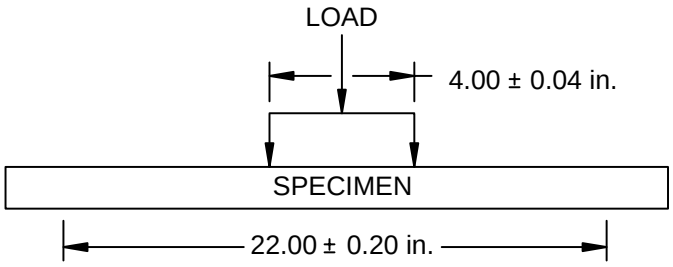


FIGURE 10 LONG BEAM FLEXURE TEST SETUP

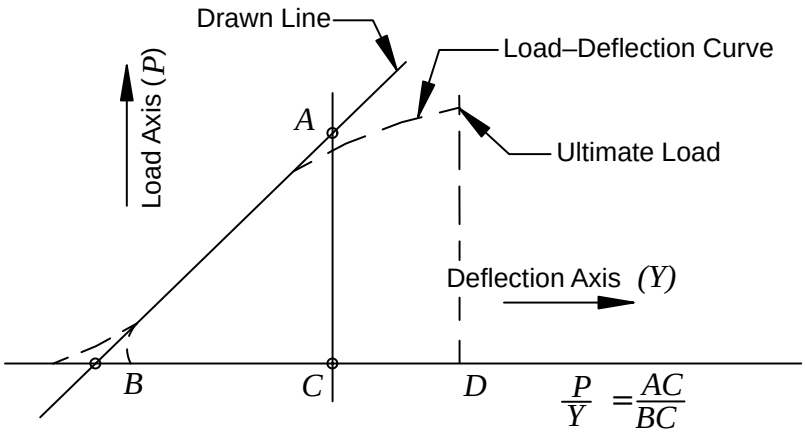


FIGURE 11 LOAD DEFLECTION CURVE

8.3 TEST PANEL PREPARATION

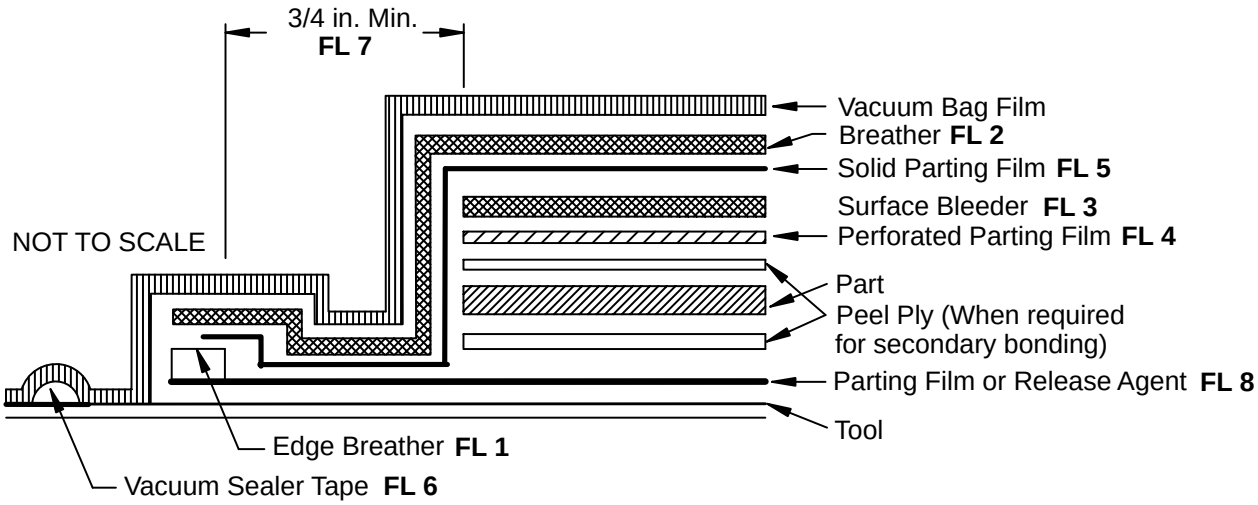
NOTE: For all layups, align carbon fibers. For fabrics, align warp yarns in layup.

a. Use bagging procedure shown in Figure 6 to fabricate Type II, Type III, and Type IV test panels. Use the Figure 12 bagging procedure for Type I test panels.

b. Perform a full vacuum leak check on each part prior to cure in accordance with BAC5317.

c. Cure Type II, Type III, and Type IV laminate or sandwich test panels in an autoclave using the Figure 7 cure cycle. Cure Type I laminate test panels in an autoclave using the Figure 13 cure cycle.

8.3 TEST PANEL PREPARATION (Continued)



FL 1 Use one inch minimum width edge breather (see BAC5317, Non Contact Materials, Edge Bleeder/Bleeder Materials) with direct connection to vacuum source. At one corner of the layup, place one or more single fiberglass or nylon yarns (see BAC5317–1, Non Contact Materials) 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 from trapped air.

FL 2 Surface breathers shall contact the edge breather but shall not make direct contact with prepreg.

FL 3 Use one ply of Type 120 or Type 220 glass or one ply of polyester paper for each 0.015 inches nominal cured thickness of laminate. For laminates less than 0.020, do not bleed. When a laminate has a thickness greater than 0.040 inches, count one peel ply as one bleeder ply.

Use one ply of Type 1581, or Type 7781 glass bleed or equivalent for each 0.030 inch nominal cured thickness of laminate or cured ply face thickness greater than 0.030 inches.

FL 4 For laminates less than 0.020 inches, use solid parting film in place of perforated parting film.

FL 5 Parting film shall extend to the center of the edge breather.

FL 6 Vacuum bag sealant material may be used in areas outside of the part trimline to avoid excessive resin bleed–out.

FL 7 Allow 3/4 inch minimum from part edge to edge breather.

FL 8 Parting film may be applied to the tool surface using contact use elevated temperature pressure sensitive tape (see BAC5317, Contact Materials, Pressure Sensitive Tapes for Elevated Temperature Use (365 F Maximum). The tape may extend under the part excess to within 0.25 inches of the net trimline.

FIGURE 12 VACUUM BAG ASSEMBLY FOR TYPE I LAMINATE

8.3 TEST PANEL PREPARATION (Continued)

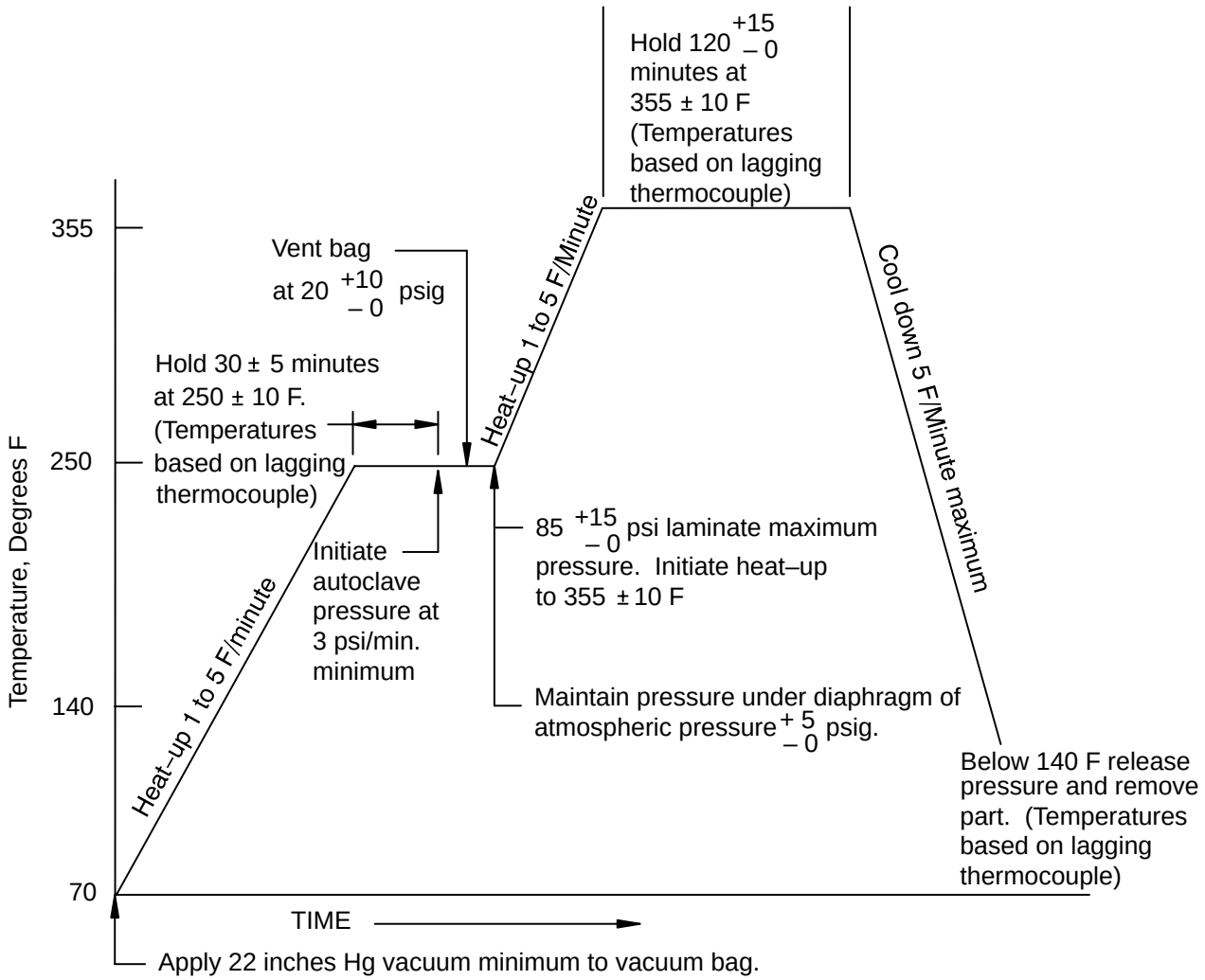


FIGURE 13 CURE CYCLE FOR TYPE I LAMINATES

8.4 CHEMICAL CHARACTERIZATION TESTS

8.4.1 INFRARED ANALYSIS (IR)

a. Instrument Parameters

(1) Calibrate IR instrument in accordance with the instrument manufacturer's specification.

(2) Using a polystyrene film standard (nominal thickness of 0.07 mm), scan between 4000 and 800 cm^{-1} varying scan parameters (resolutions for FT–IR) until the ratio of the 906 cm^{-1} peak absorbance to the 1601 cm^{-1} peak absorbance (906/1601) is 0.380 ± 0.015. Suggestions for the slit width variations are between the normal manufacturer's setting and twice the normal setting. The scan rate should be set at 150 cm^{-1} /min or slower.

8.4.1 INFRARED ANALYSIS (IR) (Continued)

(3) Calculate the absorbances as follows:

(a) Construct a baseline by drawing a straight line between the valleys at approximately 930 cm^{-1} and 850 cm^{-1} for the 906 cm^{-1} peak and between 1660 cm^{-1} and 1565 cm^{-1} for the 1601 cm^{-1} peak.

(b) Use the slit width and the scan rate or the FT–IR resolution obtained above for the sample resin analysis.

b. Sample Preparation

(1) Extract resin from 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 Na Cl plate. 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 (1520 cm^{-1}).

(2) Test in one location then rotate 120 degrees and perform second test. Prior to second test check that transmittance is within the limits specified above. If transmittance is not within the limits, prepare a second film to obtain the proper transmittance and repeat the test.

c. Report

(1) Compare the spectrum manually or computer aided with the standard on file, to detect any contaminants or gross change in formulation.

(2) The spectrum should have absorption peaks at the following wave numbers (cm^{-1}) as required, within a range of $\pm$ 10 cm^{-1}:

3470, 3370, 1730,1615, 1595, 1517, 1145, 1105, 975, 905

(3) Report the average absorbance ratios of A_{1145}/A_{1517} and A_{1730}/A_{1517}, where A_{1145}, A_{1517}, A_{1730} are the net absorbances at 1145 cm^{-1}, 1517 cm^{-1}, and 1730 cm^{-1}.

d. Any difference shall be within 15 percent of the mean for A_{1145}/A_{1517} ratios and within 30 percent of the mean for A_{1730}/A_{1517} ratios. If differences are outside the required limits, a third test shall be run and the mean value for three readings shall meet the requirements.

Calculate the net absorbances as follows:

(1) Construct a baseline by drawing a straight line between the valleys at approximately:

1684 cm^{-1} and 1766 cm^{-1} for the 1730 cm^{-1} peak

1485 cm^{-1} and 1553 cm^{-1} for the 1517 cm^{-1} peak

Intercept of spectrum with 1050 cm^{-1} and 1165 cm^{-1} valley for the 1145 cm^{-1} peak

(2) The net absorbance is calculated by subtracting from the peak absorbance the baseline absorbance at the peak position.

8.4.2 HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

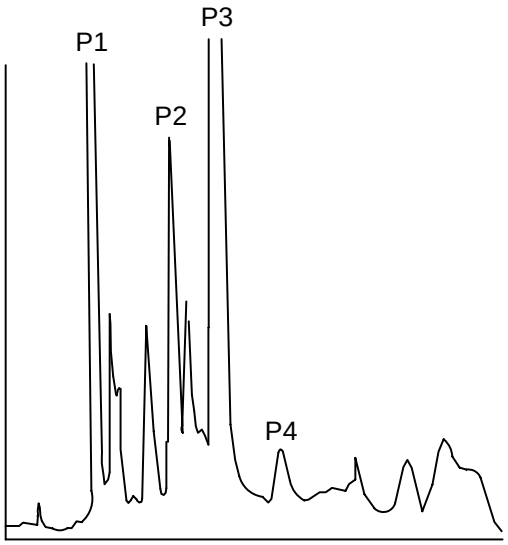
a. Perform column calibration and sample test in accordance with BSS7305, Method I.

b. Report

(1) Chromatogram for reference. Compare this chromatogram with the standard chromatogram to detect contaminant or gross change in formulation. (See Figure 14).

(2) Peak area ratios (average of two replicates) of the following peaks: P1/P3, P2/P3, P4/P3, as applicable. **FL 1**

FL 1 For area integration , vertical lines are dropped at the valleys points to the baseline to separate the fused peaks with no baseline correction. The baselines shall be straight lines between base points. The base points are (1) beginning of peak 1, (2) end of peak 3, and (3) end of the chromatogram.



Approximate retention times of the identified peaks:

P1 = 2.20 minutes
P2 = 4.00 minutes
P3 = 4.50 minutes
P4 = 5.70 minutes

FIGURE 14 STANDARD CHROMATOGRAM

9 MATERIAL IDENTIFICATION

9.1 LABELING OPTIONS

The information in Section 9.2 shall be provided for each roll of prepreg by one of the following methods:

a. A label containing the information in Sections 9.2b.(1) through (7) information shall be placed inside the core.

b. A label containing the information in Sections 9.2b.(1) through (4) shall be placed inside the core. In addition, a transferable label containing the information in Section 9.2b.(1) through (7) shall be affixed to the exterior of the prepreg shipping bag. This transferable label shall also state the following: “TRANSFER THIS LABEL TO THE CORE UPON INITIAL OPENING OF THE BAG”.

9.2 LABEL INFORMATION

a. Labeling shall conform to OSHA 1910.1200 Hazard Communication Standard.

b. The following information shall be provided for each roll of prepreg in accordance with Section 9.1:

(1) Batch number, roll number, roll length

(2) Quality and width

(3) Manufacturer and material designation

(4) Date of impregnation

(5) BMS8–212 (including latest revision letter), Type, Class and Grade/Style

(6) Fiber identification (BMS9–8 Grade) and manufacturer's designation

(7) Purchase order number

10 PACKAGING AND MARKING

10.1 CARRIER

a. All carbon fiber 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 shall be at least as wide as the prepreg including selvages. The carrier material shall contain nontransferring or noninhibiting color and be easily removable from the prepreg at ambient temperatures by manufacturing personal after normal handling during fabrication.

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 with the long dimension of the diamond pattern parallel to the fabric warp direction.

d. Carrier for Class 3 material shall be Daubert 2–80 BKG–1 or 99D, or Boeing approved equivalent.

10.2 ROLL SIZE

a. For Class 1 and Class 2, individual rolls shall be between 20 and 70 pounds of net conforming material weight. Only one roll of each batch may be below minimum weight.

b. For Class 3 materials, length of individual rolls shall be between 750 and 2700 feet.

10.3 CORE CONFIGURATION

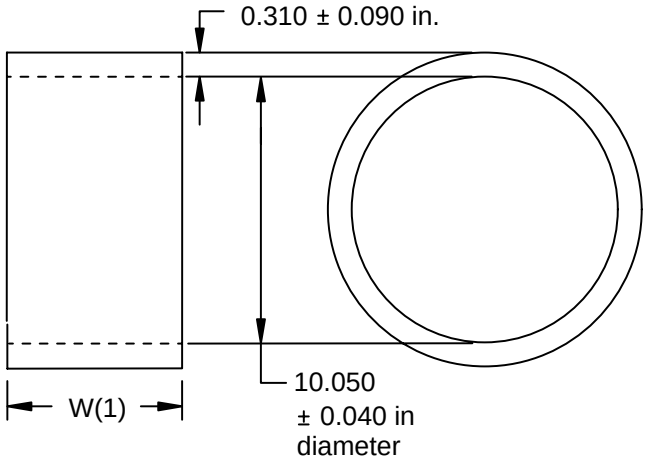
a. Rolls of prepreg shall be supported by a core that is not deformed by the material weight. The core itself should be supported at all times within the shipping container during shipping and storage in such a way that the material will not be damaged from its own weight.

b. Core inside diameter shall be 10 inches minimum for Class 1 prepregs, and 3 inches minimum for Class 2 prepreg.

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 inches on either side, for Class 1 materials.

e. Core configuration for Class 3 materials shall be in accordance with Figure 15.



NOTE: Core width (W) shall be within +0.060 in/– 0 in. of nominal tape width as specified in the purchase order.

FIGURE 15 ROLL CORE CONFIGURATION – CLASS 3 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:

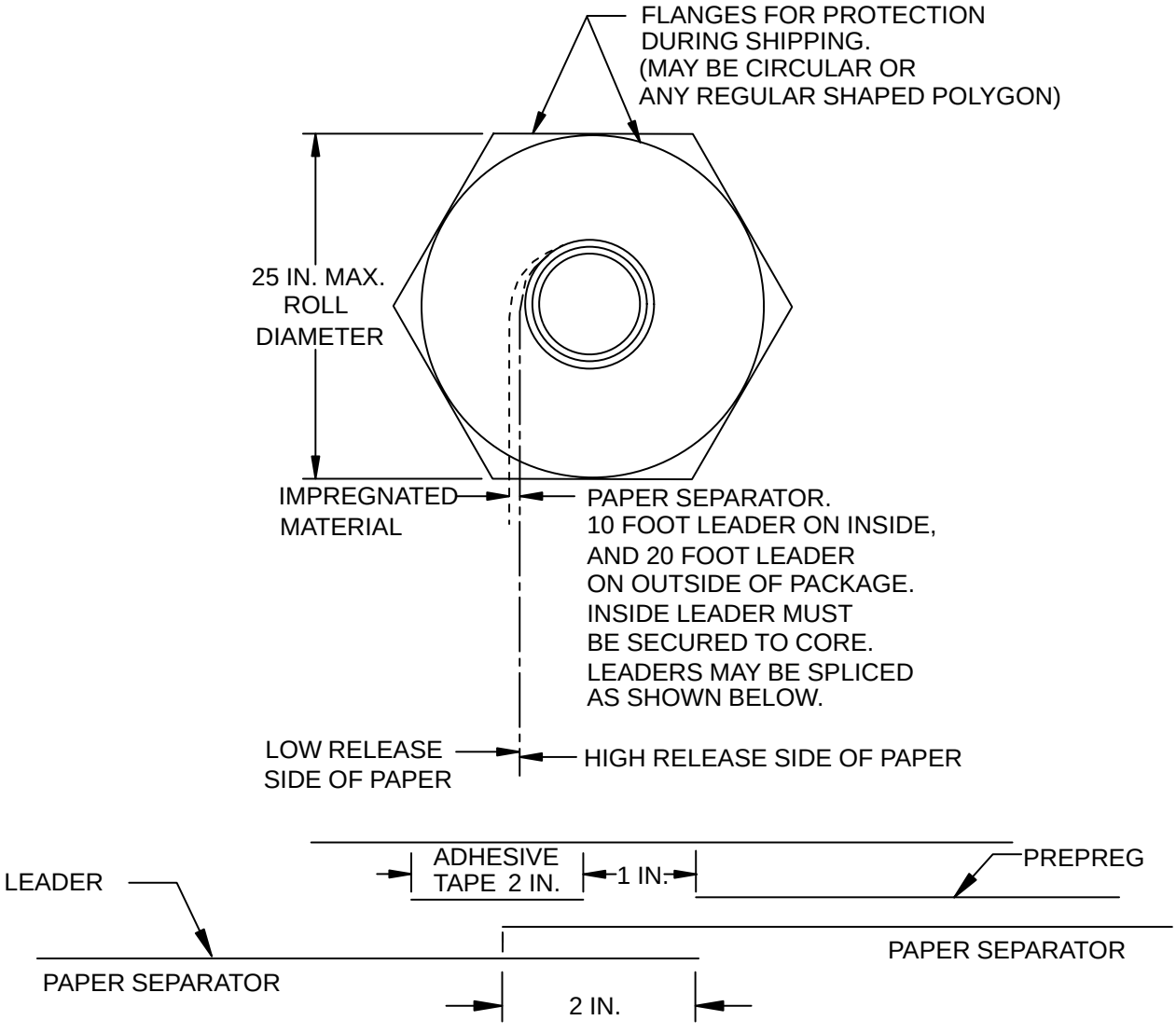
Grade/Style	Carrier/Roll Core Color
95	Blue
145	Green
190	Red
3K–70–PW	Blue
3K–135–8H	Blue

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. Class 3 materials shall be packaged as specified in Figure 16.

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 will allow free passage of air, moisture or other contaminates. Bags shall be either 0.006 inch minimum thickness polyethylene or a Boeing approved bag. A suitable 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.



NOTE: Inside leader is optional

FIGURE 16 PACKAGING REQUIREMENTS – CLASS 3 MATERIALS

10.6 MARKING

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

b. Letter on each container in letters at least 3/4 inch high, or use equivalent statement:

"SHIP AND STORE AT 10 F OR BELOW"

"DO NOT STAND ON END" (for containers carrying Class 2 materials only)

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

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.