1 SCOPE

a. This specification establishes the requirements for two part resin systems used for structural repair of composites.

b. This specification requires qualified products.

1.1 CONTENTS

1.1 CONTENTS (Continued)

1.1 CONTENTS (Continued)

LIST OF FIGURES

LIST OF TABLES

2 CLASSIFICATION

a. Class 1

Class 1, Grade 1 is a 200 to 250 F curing resin system.

Class 1, Grade 2 is a 150 to 200 F curing resin system.

If Grade is not mentioned for Class 1, Grade 1 shall be used.

b. Class 2 is a 150 F curing resin system.

c. Class 3 is a 150 F curing resin system with improved Hot/Wet properties.

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 herein indicated.

ASTM D 2393	–	Standard Test Method for Viscosity of Epoxy Resin and Related Components
ASTM D 3846	–	In–Plane Shear Strength of Reinforced Plastics
BAC5317	–	Fiber Reinforced Composite Parts
BAC5317–1	–	Carbon and Aramid Fiber Reinforced Composite Parts, 350 F (177 C) Cure
BAC5010	–	Application of Adhesives
BAC5514–589	–	Application of Corrosion Inhibiting Adhesive Primer
BAC5555	–	Phosphoric Acid Anodizing of Aluminum for Structural Bonding
BSS7260	–	Advanced Composite Compression Tests
BSS7286	–	Statistical Process Control of Designated Engineering Characteristics
D6–53356	–	Requirements for Process Control Documents for Suppliers of Nonmetallic Raw Materials
MIL–STD–401	–	Sandwich Constructions and Core Materials: General Test Methods
RE–ADD–030	–	Hazard Communication Program
OSHA 1910.1200	–	Hazard Communication Standard

4 DEFINITIONS

Not applicable to this specification.

5 MATERIAL REQUIREMENTS

Health hazard evaluation shall be performed for each new material qualified to this specification in accordance with RE–ADD–030 to establish its usage precautions.

5.1 APPEARANCE

Each component of the resin system shall be homogeneous material.

5.2 BLENDING

The manufacturer shall furnish information on the proper blending proportions of Parts A and B. The amount of hardener (Part B) shall be expressed in terms of one hundred parts by weight of base material (Part A). Parts A and B shall blend readily to produce a uniform product, with 2 to 3 minutes of hand mixing.

5.3 CURE

Material		Cure Schedule
Class 1,	Grade 1	The cure cycle is 200 ± 10 F for 220 ± 5 minutes or 250 ± 10 F for 150 ± 5 minutes
Class 1,	Grade 2	The cure cycle is 150 ± 5 F for 180 ± 5 minutes or 200 ± 5 F for 120 ± 5 minutes
Class 2,		The cure cycle is 150 ± 5 F for 180 ± 5 minutes
Class 3,		The cure cycle is 150 ± 5 F for 65 ± 5 minutes

The heat up rate for any Class or Grade from ambient to cure temperature shall not exceed 8 F per minute.

The cured resin systems covered by this specification shall meet the property requirements in Section 5.5 when blended in accordance with the manufacturer's recommendations and cured in accordance with the above temperature schedule under a minimum pressure equivalent to a vacuum of 22 inches of mercury.

5.4 STORAGE LIFE

The storage life shall be determined from the date of receipt at the purchaser's facility. If materials are not to be consumed immediately, they should be kept stored below 40 F upon receival.

5.4.1 CLASS 1 STORAGE LIFE

Class 1 (Grade 1 and Grade 2) component materials shall be capable of meeting the requirements of this specification if stored at 40 to 80 F in unopened containers for a minimum of 6 months or a minimum of 12 months at temperatures below 40 F for Part A. Part B shall be capable of being stored for 12 months at 40 to 80 F, but may also be kept below 40 F with Part A. Part A is the temperature sensitive component.

5.4.2 CLASS 2 STORAGE LIFE

Class 2 component materials shall be capable of meeting the requirements of this specification if stored in unopened containers for a minimum of 3 months at 40 to 80 F or a minimum of 6 months at temperatures below 40 F for Part A. Part B shall be capable of being stored for 12 months at 40 to 80 F, but may also be kept below 40 F with Part A. Part A is the temperature sensitive component.

5.4.3 CLASS 3 STORAGE LIFE

Class 3 component materials (Part A and Part B) shall be capable of meeting the requirements of this specification for a minimum of 12 months when stored at 40 to 80 F in unopened containers.

5.4.4 KIT STORAGE TIME

a. Class 1 (Grade 1 and Grade 2)

Provided the Class 1 material has remained below 40 F for Part A until breaking down into small kits for shop use, the maximum storage time at 40 to 80 F shall be 6 months, with a total storage time at all temperatures not to exceed 1 year.

b. Class 2

Provided the Class 2 material has remained below 40 F for Part A until breaking down into small kits for shop use, the maximum storage time for kits at 40 to 80 F shall be 3 months, with a total storage time at all temperatures not to exceed 6 months for Part A or 12 months for Part B.

c. Class 3

The maximum storage time for kits at 40 to 80 F shall be 12 months from the date of receipt.

5.5 CURED RESIN PROPERTIES

The resin systems shall meet the applicable requirements in Table I and Table II when tested in accordance with Section 8.1.

5.5 CURED RESIN PROPERTIES (Continued)

TABLE I CURED RESIN PROPERTIES, CLASS 1 RESINS FL 7

TEST	TEST TEMP. (F ± 5 F)	EXPOSURE	REIN–FORCE MENT	CLASS 1							TEST METHOD SECT.
				GRADE 1			GRADE 2				
				200 F CURE	250 F CURE		150 F CURE			200 F CURE	
							Average				
				MIN. IND.	MIN. AVG.	MIN. IND.	MIN.	MAX.	MIN. IND.	MIN. IND.	
Dynamic Mechanical Analysis, ksi	100 150 200	None None None	None None None	150 140 130	— — —	165 140 130	— — —	— — —	190 160 65	180 155 130	8.1.2
	100 **FL 1** 150 **FL 1** 200 **FL 1**	Water at 200 F for 24 hrs.	None None None	150 130 115	— — —	150 130 115	— — —	— — —	160 140 100	180 155 130	
Tensile Strength, Ultimate, ksi	–65	None	3K–70–P, BMS9–8		24	20	28.0	37.0	22.0		8.1.3
	160 **FL 1**	Hot/Wet **FL 6**	3K–70–P, BMS9–8		16	10	15.0	20.0	12.0		
Compressive Interlaminar Shear Strength, ksi	–65	None	3K–70–P, BMS9–8		6	4	7.5	11.0	5.0		8.1.4
	75 **FL 2** **FL 5**	None	3K–70–P, BMS9–8		5	3	7.5	10.0	6.0		
Long Beam Flexure											
Ultimate (lbs)	75	None	BMS9–8, 3K–70–P		310	260	385	510	300		8.1.5
	160	Hot/Wet **FL 6**	BMS9–8, 3K–70–P		220	135	320	370	295		
P/Y (lbs/inch)	75	None	BMS9–8, 3K–70–P		320	290	320	365	295		
	160	Hot/Wet **FL 6**	BMS9–8, 3K–70–P		315	300	315	360	290		
Ultimate (lbs)	75	None	BMS9–3, Style 1581 or 7781		—	—	325	450	250		
	160	Hot/Wet **FL 6**	BMS9–3, Style 1581 or 7781		—	—	230	300	185		
P/Y (lbs/inch)	75	None	BMS9–3, Style 1581 or 7781		—	—	225	280	195		
	160	Hot/Wet **FL 6**	BMS9–3, Style 1581 or 7781		—	—	200	260	160		
Flatwise Tension, psi	75	None	BMS9–8, 3K–70–P		610	440	880	1100	630		8.1.6

5.5 CURED RESIN PROPERTIES (Continued)

TABLE I CURED RESIN PROPERTIES, CLASS 1 RESINS FL 7(Continued)

TEST	TEST TEMP. (F ± 5 F)	EXPOSURE	REIN–FORCE MENT	CLASS 1 GRADE 1 200 F CURE MIN. IND.	CLASS 1 GRADE 1 250 F CURE MIN. AVG.	CLASS 1 GRADE 1 250 F CURE MIN. IND.	CLASS 1 GRADE 2 150 F CURE Average MIN.	CLASS 1 GRADE 2 150 F CURE Average MAX.	CLASS 1 GRADE 2 150 F CURE MIN. IND.	CLASS 1 GRADE 2 200 F CURE	TEST METHOD SECT.
	75	None	BMS9–3, Style 1581		600	470	695	900	575		
Open Hole Compression, Ultimate Load, 10^3 lbs	–65	None	BMS9–8, 3k–70–P		——	——	9.4	11.0	8.7		8.1.7
	75	None	BMS9–8, 3k–70–P		——	——	7.6	8.9	6.8		
	160	Hot/Wet **FL 6**	BMS9–8, 3k–70–P		——	——	5.8	6.7	5.4		
Filled Hole Tension, Ultimate Load, 10^3 llbs	–65	None	BMS9–8, 3k–70–P		——	——	4.2	4.8	3.8		8.1.8
	75	None	BMS9–8, 3k–70–P		——	——	4.3	5.1	3.9		
	160	Hot/Wet **FL 6**	BMS9–8, 3k–70–P		——	——	3.9	5.0	3.1		
Hydraulic Fluid Resistance	75	None	BMS9–8, 3k–70–P		——	6H	——		5H		8.1.9
	75	Test Fluid at 160 F for 48 to 72 hrs **FL 4**	BMS9–8, 3k–70–P		——	4H **FL 3**	——		5H		

FL 1 It is a requirement to conduct either DMA tests or tensile strength tests on exposed specimens for supplier quality control. Cure cycles corresponding to tensile test data shall be used for DMA Test.

FL 2 This test is required for Supplier Quality Assurance.

FL 3 Maximum reduction in hardness shall be 2 pencil hardnesses. There shall be no evidence of delamination due to exposure.

FL 4 Test fluid – BMS3–11, Type IV, Class 1, Grade A.

FL 5 Key Characteristic

FL 6 140 ± 5 F, 90 –100 percent RH for 10 days.

FL 7 These properties are only valid when test panels are fabricated in accordance with the processes detailed in this document. Other processes may lead to lower values.

5.5 CURED RESIN PROPERTIES (Continued)

TABLE II CURED RESIN PROPERTIES, CLASS 2 AND CLASS 3 FL 7

TEST	TEST TEMP. (F± 5 F)	EXPO–SURE	RESIN FORCE–MENT	CLASS 2 150 F CURE		CLASS 3 150 F CURE			TEST METHOD SECTION
						AVERAGE			
				MIN. AVG.	MIN. IND.	MIN.	MAX.	MIN. IND.	
Dynamic Mechanical Analysis (DMA G, ksi	100 150 200	None None None	None None None	— — —	120 90 —	— —	— —	150 120 85	8.1.2
	100 **FL 1** 150 **FL 1** 200 **FL 1**	Water at 200 F for 24 hrs.	None None None	— — —	100 45 —	— — —	— — —	105 75 55	
Tensile Strength, Ultimate, ksi	–65	None	3K–70–P, BMS9–8	19	14	31	38.5	26.5	8.1.3
	160 **FL 1**	Hot/Wet **FL 6**	3K–70–P, BMS9–8	5.8	3.1	12.5	15.5	10.5	
Compressive Interlaminar Shear Strength, ksi	–65	None	3K–70–P, BMS9–8	7.0	5.0	8.3	11.9	6.1	8.1.4
	75 **FL 2 FL 5**	None	3K–70–P, BMS9–8	5.0	4.0	5.5	8.2	3.8	
Long Beam Flexure									
Ultimate (lbs)	75	None	BMS9–8, 3K–70–P	340	310	350	430	300	8.1.5
	160	Hot/Wet **FL 6**	BMS9–8, 3K–70–P	120	80	215	255	190	
P/Y (lbs/inch)	75	None	BMS9–8, 3K–70–P	310	290	290	340	260	
	160	Hot/Wet **FL 6**	BMS9–8, 3K–70–P	220	190	275	325	245	
Ultimate (lbs)	75	None	BMS9–3, Style 1581	—	—	330	445	255	
	160	Hot/Wet **FL 6**	BMS9–3, Style 1581 or 7781	—	—	150	180	125	
P/Y (lbs/inch)	75	None	BMS9–3, Style 1581 or 7781	—	—	210	250	185	
	160	Hot/Wet **FL 6**	BMS9–3, Style 1581 or 7781	—	—	155	185	140	
Flatwise Tensile, psi	75	None	BMS9–8, 3K–70–P	—	—	980	1150	890	8.1.6
	75	None	BMS9–3, Style 1581 or 7781	530	260	620	820	500	

5.5 CURED RESIN PROPERTIES (Continued)

TABLE II CURED RESIN PROPERTIES, CLASS 2 AND CLASS 3 FL 7(Continued)

TEST	TEST TEMP. (F± 5 F)	EXPO–SURE	RESIN FORCE–MENT	CLASS 2 150 F CURE		CLASS 3 150 F CURE			TEST METHOD SECTION
						AVERAGE		MIN. IND.	
				MIN. AVG.	MIN. IND.	MIN.	MAX.		
Open Hole Compression Ultimate Load, 10^3 lbs	–65	None	BMS9–8, 3K–70–P	——	——	9.5	11.2	8.4	8.1.7
	75	None	BMS9–8, 3K–70–P	——	——	7.0	8.2	6.3	
	160	Hot/Wet **FL 6**	BMS9–8, 3K–70–P	——	——	3.5	4.9	2.7	
Filled Hole Tension Ultimate Load, 10^3 lbs	–65	None	BMS9–8, 3K–70–P	——	——	4.5	5.5	3.9	8.1.8
	75	None	BMS9–8, 3K–70–P	——	——	4.3	5.0	3.9	
	160	Hot/Wet **FL 6**	BMS9–8, 3K–70–P	——	——	3.5	4.2	3.0	
Hydraulic Fluid Resistance	75	None	BMS9–8, 3K–70–P	——	6H	——		5H	8.1.9
	75	Test Fluid at 160 F for 48 to 72 hrs **FL 4**	BMS9–8, 3K–70–P	——	4H **FL 3**	——		6H	

FL 1 It is requirement to conduct either DMA tests or tensile strength tests on exposed specimens for supplier quality control. Cure cycles corresponding to tensile test data shall be used for DMA Test.

FL 2 This test is required for Supplier Quality Assurance.

FL 3 Maximum reduction in hardness shall be 2 pencil hardnesses. There shall be no evidence of delamination due to exposure.

FL 4 Test fluid – BMS3–11, Type IV, Class 1, Grade A.

FL 5 Key Characteristic

FL 6 140 ± 5 F, 90 to100 percent RH for 10 days.

FL 7 These properties are only valid when test panels are fabricated in accordance with the processes detailed in this document. Other processes may lead to lower values.

5.6 UNCURED PROPERTIES

The resin systems shall meet the applicable requirements in Table III when tested in accordance with Section 8.2.

TABLE III UNCURED RESIN PROPERTIES

TEST	TEST TEMP. F (± 5 F)	CLASS 1 REQUIREMENTS		CLASS 2 REQUIRE–MENTS	CLASS 3 REQUIRE–MENTS	TEST METHOD SECTION
		GRADE 1	GRADE 2			
Viscosity, cps	75 **FL 1**	(QPL)	(QPL)	(QPL)	(QPL)	8.2.1
Density g/cc	75 **FL 1**	(QPL)	(QPL)	(QPL)	(QPL)	8.2.3
Gel Time, Minutes	75 **FL 2 FL 3**	120 Minimum	120 Minimum	40 Minimum	60 Minimum	8.2.2

FL 1 This test is required for Supplier Quality Assurance.

FL 2 This test is required for both Supplier and Purchaser Quality Assurance.

FL 3 Key Characteristic

6 QUALIFICATION

6.1 REQUESTS

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

b. Prior to submitting a material for qualification to this specification, the supplier shall provide its Material Safety Data Sheet (MSDS), and if requested, its chemical formulation. Agreements for non–disclosure and control of proprietary information shall be considered and executed as appropriate. The information provided shall be submitted to the appropriate Boeing Safety, Health, and Environmental Affairs organization (SHEA) to evaluate it in accordance with RE–ADD–030, to determine whether it is adequate or whether additional information is necessary. SHEA shall identify and document appropriate precautions for the material's use.

6.2 PROCESS CONTROL DOCUMENT (PCD)

a. Suppliers shall develop and maintain a Boeing approved PCD for the manufacture of resin materials.

b. D6–53356 shall be used as a guideline in PCD preparation.

c. The PCD shall define the manufacturing and quality control requirements and procedures for assuring consistent, uniform and compliant products.

d. Suppliers shall define in the PCD the raw materials, controlled process equipment, process flow, and the key process parameters (KPPs) which have a significant probability of affecting the consistency and quality of the product.

e. The PCD shall be reviewed by Boeing prior to the qualification audit, and at the time of the audit, or other times at Boeing's discretion.

f. The supplier shall not change any major requirement or major procedure in the PCD, as defined in D6–53356, without disclosure to and approval by Boeing prior to implementation. This shall be done through submittal of an Advance Change Notice (ACN) as outlined in the same document. Minor editorial changes may be made to the PCD, in accordance with the guidelines of D6–53356.

6.3 SAMPLES AND SUPPLIER TESTING

a. Qualification shall be based upon the manufacture and successful testing of three batches of material.

b. At the time of submission of qualification samples, the supplier shall submit a certified test report. The report shall include the following information:

(1) Supplier product designation.

(2) Designation of class and grade, in accordance with this specification and designating latest revision letter of the specification.

(3) Test results on minimum of three production batches for all tests specified in Section 8, including all individual tests and actual test values obtained for each class and grade of resin desired for qualification.

(4) Identification of testing facilities used for the tests in Section 6.3b.(3).

6.4 QUALIFICATION APPROVAL

a. If the vendor data meet the requirements of this specification, Materiel shall request Materials Technology to perform all tests in accordance with Section 8. These tests shall meet the requirements of Section 5.

b. After review of supplier data and Boeing's tests of the samples submitted, the supplier will be advised by Materiel as to whether product approval has been granted. The adequacy of the manufacturing facility may be verified, as deemed necessary, by representatives of The Boeing Company by a survey of such facilities. Qualified products will be listed in the Qualified Products List (QPL) showing the supplier's product designation.

c. No changes in the method of manufacture affecting the properties or performance of the product, or in raw materials or plant location shall be made without notification and prior written approval from Boeing. Requalification of the revised material may be required and a revised supplier designation may be requested.

d. All suppliers shall either have test facilities required to test in accordance with this specification or shall utilize the services of certified commercial laboratories with capability to test in accordance with this specification. The adequacy of the test facilities may be verified, as deemed necessary, by a survey of the facilities conducted by representatives of The Boeing Company.

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

f. Requalification may be required at any time as deemed necessary by The Boeing Company.

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

7 QUALITY CONTROL

Materials controlled by this specification are subject to inspection by representatives of the Boeing Company to assure conformance to its requirements.

7.1 SUPPLIER QUALITY CONTROL

Suppliers shall perform tests, in accordance with Section 7.1.1 or Section 7.1.2, for each production batch of resin to show conformance with the designated requirements. A copy of the data shall be furnished with each batch and shall be identified with the specification revision letter in effect.

7.1.1 SUPPLIERS WITHOUT STATISTICAL PROCESS CONTROL (SPC)

Suppliers without a Statistical Process Control system approved by The Boeing Company shall do the following designated tests:

a. Each production shipment of qualified material shall be accompanied by a test report, giving actual test data obtained from each batch contained in that production shipment.

b. This report shall show conformance with the requirements designated in Table I, Table II and Table III, and shall identify such data with the specification revision letter in effect.

7.1.2 SUPPLIERS WITH STATISTICAL PROCESS CONTROL (SPC)

The supplier shall establish and maintain procedures and requirements for a SPC system based on key characteristics (KCs) and key process parameters (KPPs), in accordance with the requirements of this specification and BSS7286. KPP's shall be specified in the approved Process Control Document (PCD), in accordance with Section 6.2.

a. Table I, Table II and Table III list properties that may be designated as KCs by the supplier. As a minimum, the KCs for composite structural repair resins are:

   (1) Compressive interlaminar shear strength.

   (2) Gel time

b. The process for selecting and documenting KPPs is described in Section 7.1.2.1.

7.1.2.1 Key Process Parameters

a. The selection of KPPs shall be the responsibility of the supplier, with Boeing concurrence. KPPs shall be identified in the PCD.

b. KPPs shall include, at a minimum, those process parameters in each stage of the manufacturing process which have a significant influence on key characteristics and the performance of the final product.

c. The supplier shall establish the nominal target value and tolerance limit for each KPP.

d. The inspection method and monitoring frequency for each KPP shall be documented in the PCD.

7.1.2.2 Analysis and Review

a. The supplier shall conduct statistical analysis on 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 20 of the most recent and consecutive batches shall be used to establish control limits.

c. If statistical analysis determines that a KC or KPP becomes out of control, the supplier shall:

(1) Investigate the cause(s).

(2) Eliminate special causes of variation and re–establish statistical control.

d. When a KC becomes out of statistical control, the supplier shall take corrective action to re–establish control. The supplier may use Section 7.1.1 during this period to accept or reject their product.

e. The supplier shall document all corrective actions affecting the process and assure the effectiveness of the actions.

f. The Boeing Company reserves the right to review the results of all SPC analysis, capability calculations and corrective actions.

7.1.2.3 Material and Data Submittal

a. Suppliers shall furnish test data when submitting material showing conformance with the requirements of Section 7.1.2a., and shall state on the certification/inspection report for each batch that the material is SPC Approved Product to BMS8–301 (latest revision letter).

b. If reduced testing is approved in accordance with Section 7.1.2.4, the certification/inspection report shall reflect the latest batch tested.

7.1.2.4 Reduced Testing

a. The supplier may propose a reduced testing plan based on the performance of the KCs and KPPs. This plan shall be submitted to and approved by Boeing prior to implementation.

b. The reduced testing plan shall be documented as part of the supplier’s PCD.

7.1.3 SUPPLIER RECORD RETENTION

The supplier shall retain all tests reports, SPC data and other results on file for a minimum of 8 years.

7.2 PURCHASER QUALITY CONTROL

7.2.1 RECEIVING INSPECTION – STANDARD

a. 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.

b. Purchaser Quality Assurance shall perform those tests Table III which are required for receiving inspection.

c. When consistent conformance to specification acceptance requirements has been demonstrated, Purchaser Quality Assurance may implement reduced testing in accordance with a suitable sampling plan. Authorization of reduced testing and implementation approval shall be on a Boeing Company Division basis and on Boeing Company documentation.

7.2.2 STATISTICAL PROCESS CONTROL APPROVED SUPPLIERS

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

b. Purchaser Quality Assurance shall review receiving tests on each batch of material, except as noted in Section 7.1.2.3b., unless the supplier's material has been source accepted.

c. When consistent conformance to specification acceptance requirements has been demonstrated, Purchaser Quality Assurance may implement reduced testing in accordance with a suitable sampling plan. Authorization of reduced testing and implementation shall be on a Boeing Company Division basis and on Boeing Company documentation.

7.2.3 SOURCE ACCEPTANCE

A team comprised of Boeing Materiel, Engineering, and Quality Assurance, in conjunction with Boeing Procurement Quality Assurance, may approve Source Acceptance in lieu of Purchaser Quality Assurance testing.

7.2.3.1 Purchaser Responsibilities

a. Purchaser Quality Assurance shall have a quality system in place detailing the procurement process of source accepted material.

b. Purchaser Quality Assurance shall establish a program to audit and monitor the manufacturing and testing facilities used by the Supplier.

c. Purchaser Quality Assurance has the authority to witness manufacturing and/or testing of each batch of material.

d. Purchaser Quality Assurance shall certify each batch of material prior to shipment from the supplier.

7.2.3.2 Supplier Responsibilities

Before the Boeing team approves Source Acceptance the Supplier shall demonstrate that the following criteria have been met:

a. Manufacturing processes are performed in accordance with an approved PCD as specified in Section 6.2.

b. Manufacturing processes are shown to be in control if:

(1) Analysis of Supplier's SPC results shows manufacturing processes are in control. The Supplier's SPC system requires Boeing approval and documentation in the Supplier's PCD.

OR

(2) Data and control charts provided by the Supplier show a continuous history of meeting the specification requirements as established in the PCD.

7.2.4 DELEGATION OF SOURCE ACCEPTANCE

In conjunction with a team comprised of Boeing Materiel, Engineering and Quality Assurance, Boeing Procurement Quality Assurance may approve the delegation of Source Acceptance.

Purchaser Quality Assurance may receive the shipment without additional testing but shall review the certification test report for each shipment. If discrepancies with the BMS8–301 specification requirements are found, Purchaser shall perform full supplier inspection testing.

7.2.5 PACKAGING AND MARKING

Purchaser Quality Assurance shall verify that packaging and marking are in compliance with Section 10.

7.2.6 PURCHASER RECORD RETENTION

The purchaser shall retain all test reports, SPC data and other results on file for a minimum of 8 years.

8 MATERIAL TEST METHODS

8.1 CURED RESIN TESTS

Unless otherwise specified, the number of specimens for cured resin tests shall be five. Prior to preparation of specimens for mechanical property tests, the resin content of each laminate shall be verified to be 44 ± 4 percent by weight and honeycomb face sheets shall be 40 ± 5 percent by weight as determined in accordance with Section 8.1.8 for carbon fiber reinforced materials. The resin content for fiberglass honeycomb face sheets shall be 33 ± 5 percent by weight. These resin contents can be verified using the burnout method employed for fiberglass reinforced materials in accordance with Section 8.1.9. Panels with resin contents outside these ranges shall not be used for tests.

8.1.1 IMPREGNATION AND CURE

Cut and weigh the required number of plies of dry fabric. The plies shall be large enough to provide 2 inch excess on all sides. Weigh equal amount of resin mix for an initial resin/fabric weight ratio of 1/1. Gently mix the two components into a uniform mixture, taking care not to whip excessive amount of air into the resin.

8.1.1.1 Ply Impregnation

For ply impregnation, follow the procedure outlined below, using a larger portion of the resin to impregnate the first few plies, so that during vacuum impregnation the up and outward flow of resin can remove the entrapped air from the interior regions of the laminate. As a general rule, use 1/2 of the resin mix for the first 1/3 of the plies, use 2/3 of the remaining resin for the second 1/3 of the plies, and use the remaining resin on the last 1/3 of the plies.

a. Pour some resin on the prepared surface of the tool, or the precured laminate surface, and center the first ply of fabric on top of it.

b. Allow the resin to flow up through the fabric. Using a squeegee, gently spread the resin until the entire ply is fully saturated.

c. Pour some more resin over the middle of the first ply, place the second ply on top of it, and gently squeegee the resin around until the second ply is fully saturated.

d. Continue the procedure for all the plies in the laminate.

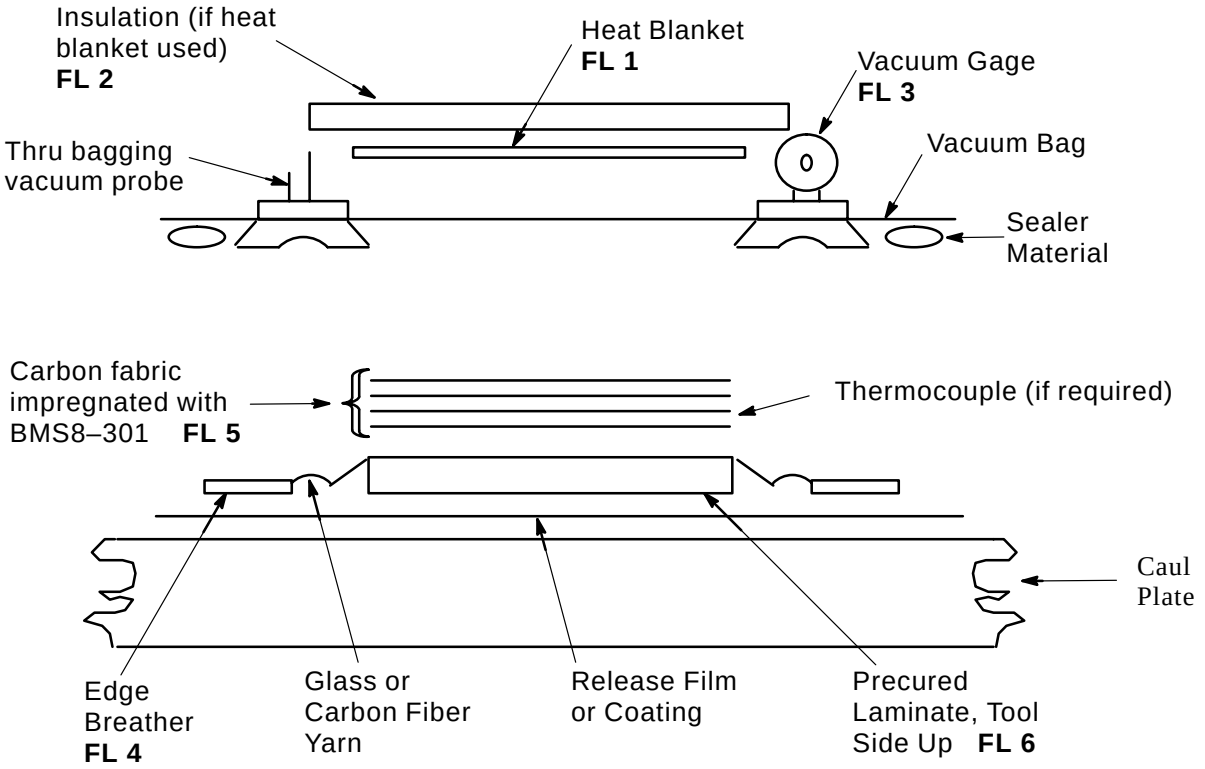
e. Bagging procedure

(1) For Laminate test panel, apply the vacuum bag directly over the laminate, without a release film, and pull vacuum, in accordance with Figure 1. The use of a release film on top of the laminate will lead to the formation of wrinkles on the bagside of the laminate during cure. The vacuum bag may be treated with a release agent for easier debagging after cure.

(2) For Sandwich test panel, cover the laminate with a ply of release film. The release film will be removed after laminate impregnation in order to place the core detail on top of the laminate.

f. Once the vacuum bag is pulled tight without any wrinkles over the laminate, and no leak is detected, start the impregnation process by firmly, but slowly, sweeping the excess resin out of the laminate into the surrounding breather cloth, using a squeegee and radially moving from the middle toward the edges. This procedure should be done as slowly as possible without exceeding the resin potlife. To aid in sweeping, a light coating of Vaseline or other suitable lubricant may be applied over the vacuum bag.

8.1.1.1 Ply Impregnation (Continued)



FL 1 Use of heat blanket with or without a repair console is an option for cure. Typical method is an oven cure.

FL 2 Four to six plies of fiberglass cloth or other suitable insulation is recommended.

FL 3 Or use gage attached to vacuum probe.

FL 4 Four to six plies of fiberglass cloth is recommended. Place material approximately 1 inch from wet layup plies and connect with a glass or carbon fiber yarn at each corner.

FL 5 See Figure 3 or Figure 4 of this specification for the number and orientation of plies.

FL 6 Precured laminate required for Compressive Interlaminar Shear specimens only. See Figure 4 of this specification.

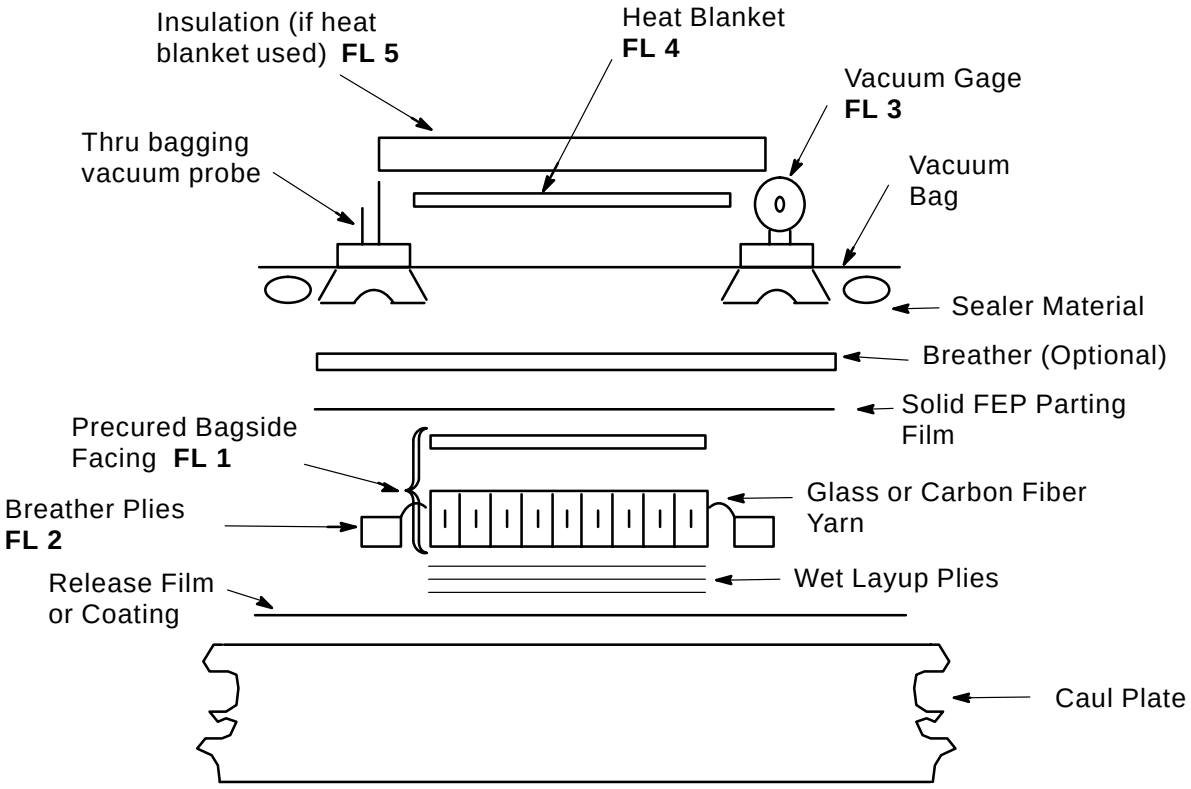
FIGURE 1 VACUUM BAG LAYUP FOR LAMINATES

g. Stop the impregnation process when the fabric weave can just be felt under the bag, and the laminate has a uniform flat surface as well as a uniform thickness.

8.1.1.2 Cure

For laminates, cure the test panel under the same vacuum bag that was used for impregnation. Removal of the vacuum bag may result in the incorporation of air into the laminate. In case of damage to the bag, apply a second vacuum bag over the first bag. If the bag is removed, resweep the laminate under the new bag to drive out the air.

For sandwich panels, remove the vacuum bag and gently peel off the release film from the top of the impregnated laminate. Roller coat the toolside of the honeycomb core detail with 0.5 to 0.6 grams of resin mix per square inch of core surface, mixed with 3.5 percent by weight Cabosil M–5. Pre–saturate the roller with the same resin, in order to compensate for the resin that is lost to the roller and is not transferred to the core. Place the core over the impregnated laminate in proper orientation, and bag in accordance with Figure 2.



FL 1 See Figure 5 of this specification.

FL 2 Four to six plies of fiberglass cloth is recommended. Place material approximately 1 inch from honeycomb and connect with a glass or carbon fiber yarn at each corner.

FL 3 Or use gage attached to vacuum probe.

FL 4 Use of heat blanket with or without a repair console is an option for cure. Typical method is an oven cure.

FL 5 Four to six plies of fiberglass cloth or other suitable insulation is recommended.

FIGURE 2 VACUUM BAG LAYUP FOR HONEYCOMB SANDWICH PANELS

8.1.2 DYNAMIC MECHANICAL ANALYSIS (DMA)

Prepare specimens 0.475 ± 0.005 by 2.500 ± 0.005 inch from 0.060 to 0.065 inch thick, unreinforced resin casting(s). Cure the casting(s) in an autoclave at 85 + 10/–0 psi. Determine storage shear modulus (G') using a Rheometrics Dynamic Mechanical Spectrometer or equivalent using the following test parameters:

Sweep Type –Time/Cure

Starting temperature –25 C

Ending temperature –100 C beyond the temperature of first major drop in G'

Temperature increment –2 C/minute

Time/measurement –60 seconds

Computer correlate – delay time – 0.5 cycle

Strain level –0.05 percent

Strain rate –10 radians per second

8.1.3 TENSILE TEST

a. Prepare tensile specimens in accordance with Figure 3.

b. Test in a universal test machine at a load rate of 0.05 inch per minute. Insert specimen into test machine grips to the tab taper edge.

c. $$\textit{Ultimate tensile strength, psi} = F_t = \frac{P}{A} = \frac{P}{bt}$$

where

P – ultimate tensile load, lb

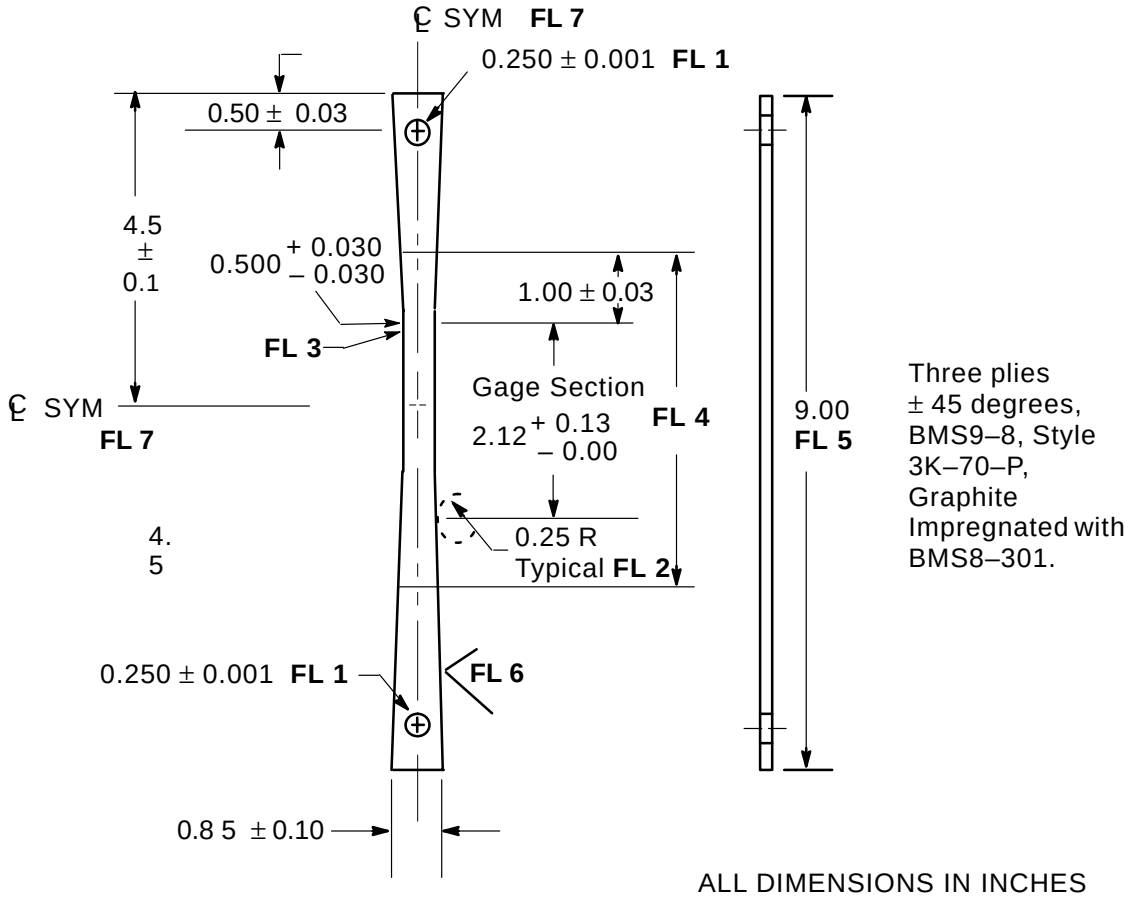
A – specimen cross–sectional area, square inches

b – width, measured to nearest 0.001 inch

t – actual thickness, measured to nearest 0.001 inch

d. Test values shall meet the requirements listed in Table I.

8.1.3 TENSILE TEST (Continued)



FL 1 Alignment holes are optional. If holes are used, holes shall be within 0.005 inch of specimen centerline.

FL 2 Transition from center section to tapered section shall be smoothly joined in the area of 0.25 radius.

FL 3 The width outward from the ends of the gage section shall be increased at a constant taper to prevent abrupt changes in dimension.

FL 4 Minimum length of ungripped section is 4.06 inches. Results obtained from specimens which fail entirely outside of gage section may be disregarded.

FL 5 Specimen length may exceed 9.20 inches, and any extension beyond 9.20 may have parallel sides.

FL 6 125 RA edge finish is required in accordance with ANSI B46.1.

FL 7 The specimen shall be symmetrical about the vertical centerline and horizontal centerline within 0.002 inch.

FIGURE 3 ± 45 TENSION TEST

8.1.4 COMPRESSIVE INTERLAMINAR SHEAR

a. Prepare compressive interlaminar shear specimens in accordance with Figure 4.

b. Test in accordance with ASTM D 3846 at a deflection rate of 0.05 inch/minute.

c. Calculate compressive interlaminar shear strength as follows:

$$\textit{Compressive Interlaminar Shear Strength Ultimate} = \frac{P}{A} = \frac{P}{bl}$$

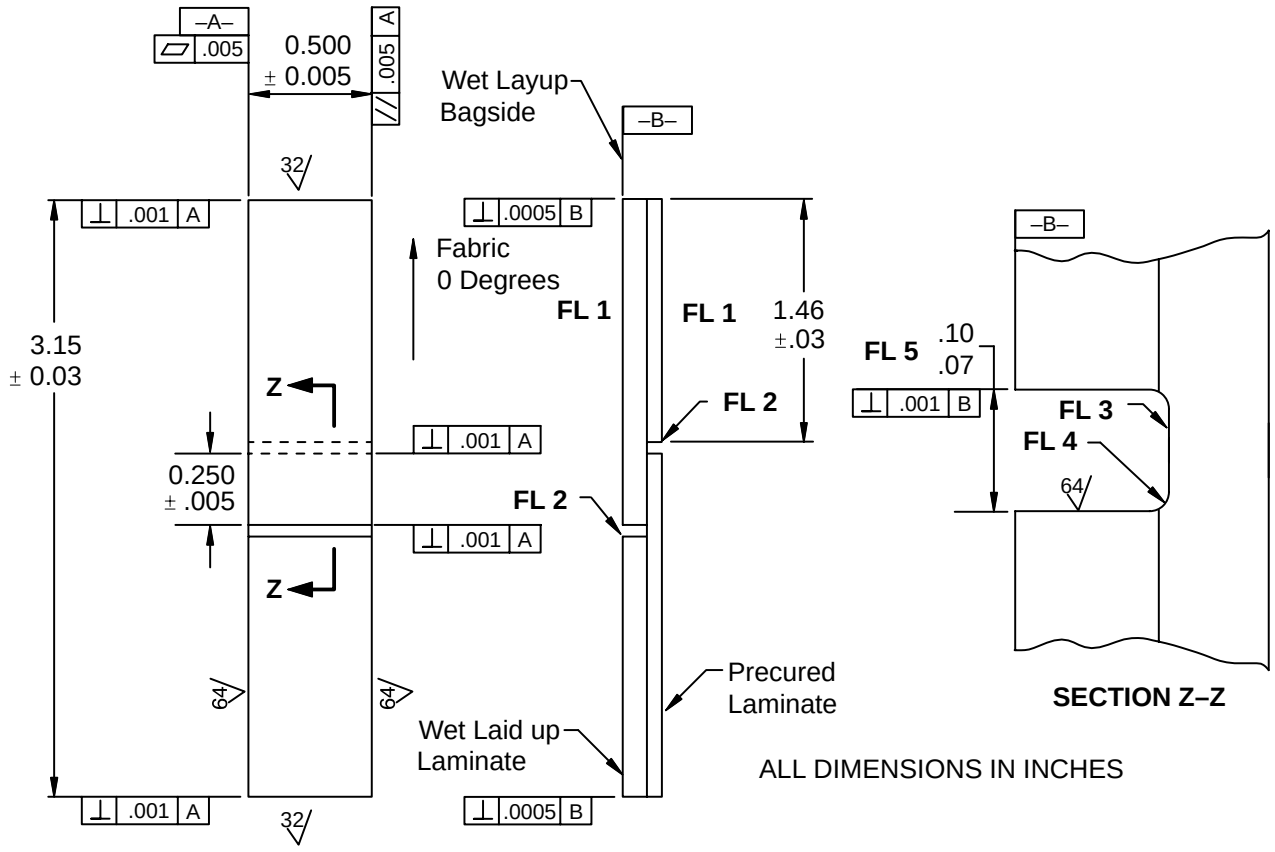
where

P – ultimate compressive load, pounds

A – specimen overlap area, square inches

b – specimen width, measured to nearest 0.001 inch

l – overlap length, measured to nearest 0.001 inch



8.1.4 COMPRESSIVE INTERLAMINAR SHEAR (Continued)

FL 1 Wet layup of BMS9–8, 3K–70–P, impregnated with BMS8–301 on precured laminate of BMS8–212, 3K–70–PW. Use a caul plate on the bagside of BMS8–212 laminate to assure uniform thickness. Prior to wet layup, using a micrometer measure the thickness of the precured laminate in at least 10 locations in the general area where slots will be machined in the specimens and record the values. The average of these values will be used as the nominal thickness to locate the interfacial plane between the wet layup and the precured laminate. Lightly abrade the toolside of the precured laminate, just enough to remove the gloss. Use a light sandblasting, keeping the nozzle always in motion. or use No 240 or finer Scotchbrite or No. 150 or finer sandpaper. Do not expose or damage the reinforcement. Peel ply, compatible with BMS8–212, may also be used. Solvent wipe the prepared surface using isopropyl alcohol, or an equivalent, to remove contaminants prior to the layup of the 3K–70–PW.

FL 2 To be cut with an abrasive wheel (saw).

FL 3 Machine notches 0.003 ± 0.001 inch deep into opposing material

FL 4 Radius is required, 0.005 to 0.010 inch.

FL 5 Dimensions typical for both cuts.

MATERIAL	ORIENTATION	NO. OF PLIES PER ADHERENT
BMS8–212 3K–70–PW (cured)	Warp	12
BMS9–8 3K–70–P Impregnated with BMS8–301	Warp	12

FIGURE 4 COMPRESSIVE INTERLAMINAR SHEAR SPECIMEN

8.1.5 SANDWICH LONG BEAM FLEXURE

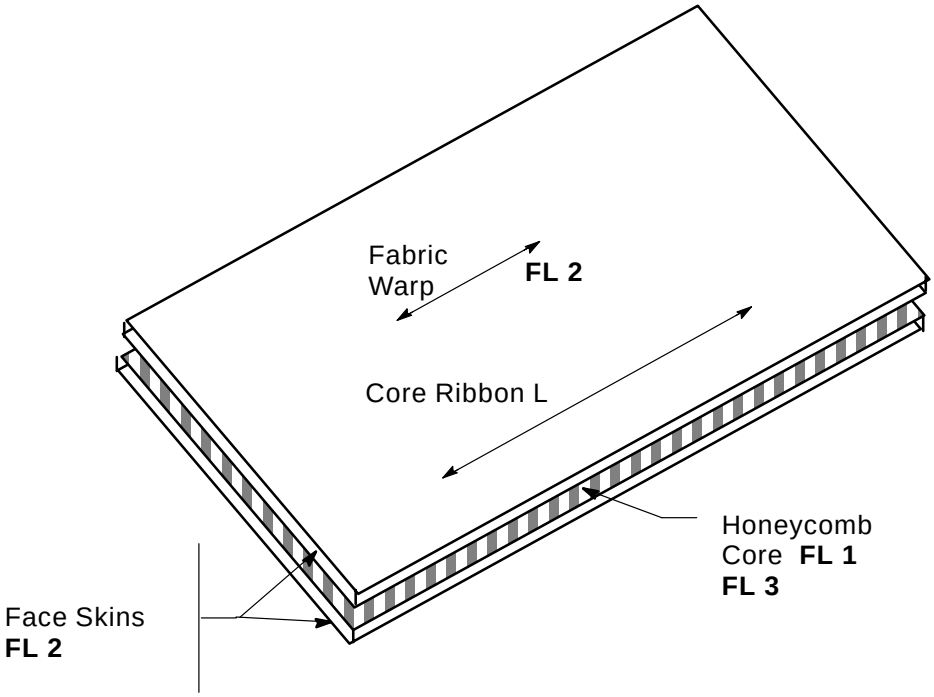
a. Machine long beam flexure test specimens 3.00 ± 0.03 inches wide by a nominal 24 inches long, with core ribbon direction parallel to the long direction, from panel shown in Figure 5.

b. Use two–point loading on a 4.0 inch span in contact with the BMS8–301 impregnated face with support bars on 22.0 ± 0.3 inch centers, employing 1 inch wide steel blocks with a rubber pad (1 by 3 by 1/3 inches) of Shore A durometer of 60 at the center loading only. Deflection (Y) is measured at the center of the span in accordance with Figure 6. Loading diagram is shown in Figure 6.

8.1.5 SANDWICH LONG BEAM FLEXURE (Continued)

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

d. Report the ultimate load and the P/Y values (see Figure 7).



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

FL 2 For long beam flexure specimens, the toolside facing shall be BMS9–8, 3K–70–P, oriented 45, 0/90, 45 and impregnated with BMS8–301. The bagside facing shall be BMS8–212, 3K–70–PW, oriented from honeycomb surface outward at 45, 0/90, 45, 0/90, 0/90 with a layer of BMS8–245, Grade 05 or two plies of Grade 03 adhesive between the core and the first 45 degree ply. For flatwise tensile specimens, prepare a separate panel with BMS9–3, Style 1581 or 7781 fiberglass facing also oriented 45, 0/90,45 and impregnated with BMS8–301 on the toolside. The bagside facing is BMS8–212, 3K–70–PW fabricated as above. Note that for Class 1 materials, flatwise tensile specimens are tested from both BMS9–3 and BMS9–8 panels.

NOTE: Cure and bond the bagside facing of both panels to the core in accordance with BAC5317 and BAC5317–1 before layup of the BMS8–301 toolside facing.

FL 3 Add 3.5 percent Cabosil to that portion of the resin system under test which is used to roller coat honeycomb core on the wet layup face. Use 0.5 to 0.6 grams of resin per square inch of core surface area. Presaturate the roller with the same resin, in order to compensate for the resin that is retained by the roller and not transferred to the core.

FIGURE 5 SANDWICH PANEL FOR LONG BEAM FLEXURE AND FLATWISE TENSILE SPECIMENS

8.1.5 SANDWICH LONG BEAM FLEXURE (Continued)

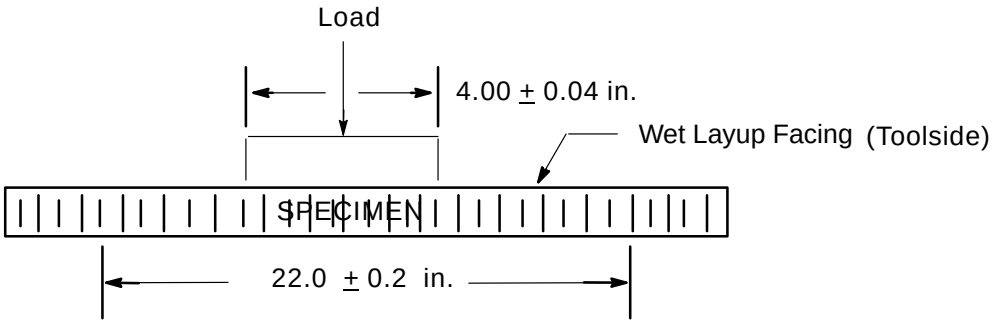
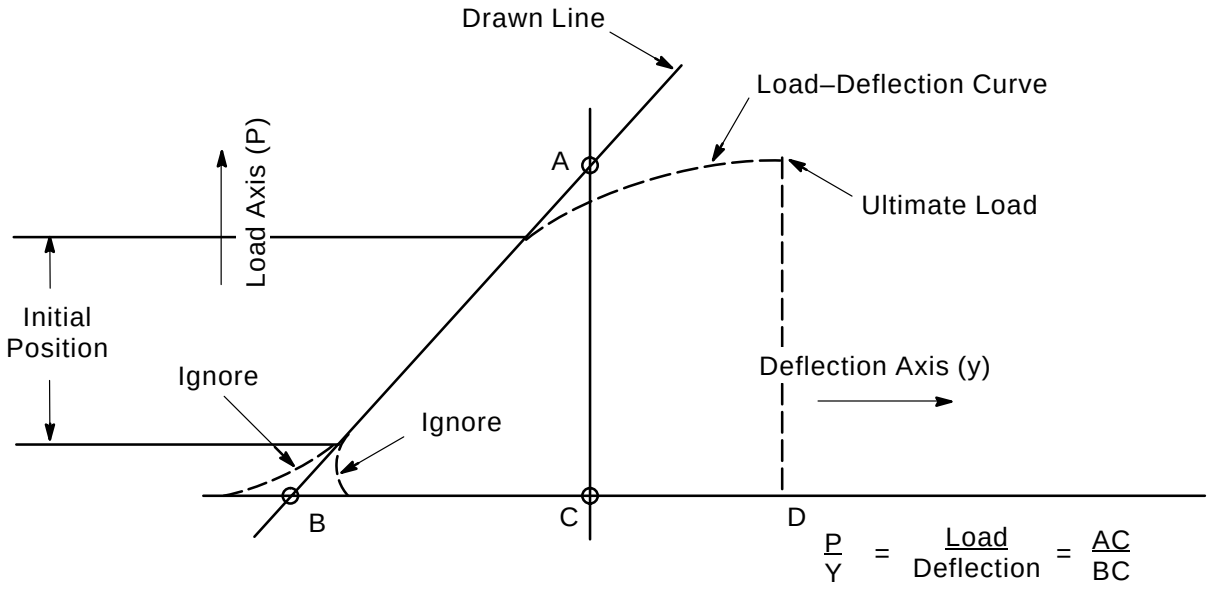


FIGURE 6 LONG BEAM FLEXURE TEST SETUP



NOTE: Measure deflection from zero load to at least one half of expected ultimate load.

FIGURE 7 LOAD–DEFLECTION CURVE

8.1.6 FLATWISE TENSILE TEST

a. Machine flatwise tensile test specimens 2.00 by 2.00 ± .01 inches square from panel shown in Figure 5. Lightly abrade specimen facings for bonding to loading blocks. Lightly sand blast, keeping the nozzle always in motion, or use No. 240 or finer Scotchbrite, or No. 150 or finer sandpaper. Do not expose or damage reinforcement.

b. To avoid postcuring the wet laid up facing, use a low temperature curing adhesive to bond aluminum blocks to specimens, according to the following procedure.

(1) Use new blocks if possible.

(2) Anodize blocks in accordance with BAC5555.

(3) Prime blocks in accordance with BAC5514–589.

(4) Bond blocks to specimens using BMS5–141, in accordance with BAC5010, Type 111, and cure at or below 100 F.

c. The test procedure shall be in accordance with MIL–STD–401.

d. Report the ultimate stress in pounds per square inch.

8.1.7 OPEN HOLE COMPRESSION

a. Fabricate Open Hole Compression laminate in accordance with Section 8.1, using 16 plies of BMS9–8, 3K–70–P with (± 45, 0/90, ± 45, 0/90)2s stacking sequence.

b. Machine and test the specimens in accordance with BSS7260, Type 1.

c. Report the ultimate load.

8.1.8 FILLED HOLE TENSION

a. Fabricated Filled Hole Tension laminate in accordance with Section 8.1, using 8 plies of BMS9–8, 3K–70–P, with (± 45, 0/90, ± 45, 0/90)s stacking sequence.

b. Machine the specimens in accordance with BSS7260, Type 1.

c. Fill the hole in each specimen using the following:

NOTE: Specimen exposure to temperature and humidity shall be carried out after installing the bolt in the specimen hole.

Titanium bolt:	BACB30NX8K3 (SAE NF 1/4–28)
Collar:	BACB30AB8S
Washer under bolt:	BACW10CT8CU, or equivalent
Washer under collar:	NAS1149C0432R, or equivalent

Torque to 60 to 80 inch–lbs

d. Test the specimens in tension at a deflection rate of 0.05 inch/minute.

e. Report the ultimate load.

8.1.9 HYDRAULIC FLUID RESISTANCE (PENCIL HARDNESS TEST)

a. Each test specimen shall be approximately 1 inch wide by 3 inches long.

b. Cut two specimens from excess of mechanical test or interlaminar shear 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 8). 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.

d. Place specimen in a horizontal position vacuum bag side up. Hold pencil at a 45 degree angle and push it across the specimen using firm, steady pressure (see Figure 8). Continue testing with the various hardness pencils until one is found that will just cut or scratch the panel. Make these tests at 80 ± 10 F.

e. Immerse each specimen in BMS3–11, Type IV, Class I, Grade A heated to 160 ± 5 F and hold immersed at temperature between 48 to 72 hours.

f. Remove specimens from bath and remove excess fluid from panels using clean, dry gauze.

g. Immediately retest hardness.

h. Examine exposed panel edges for evidence of delamination due to exposure. There shall be no evidence of delamination due to exposure.

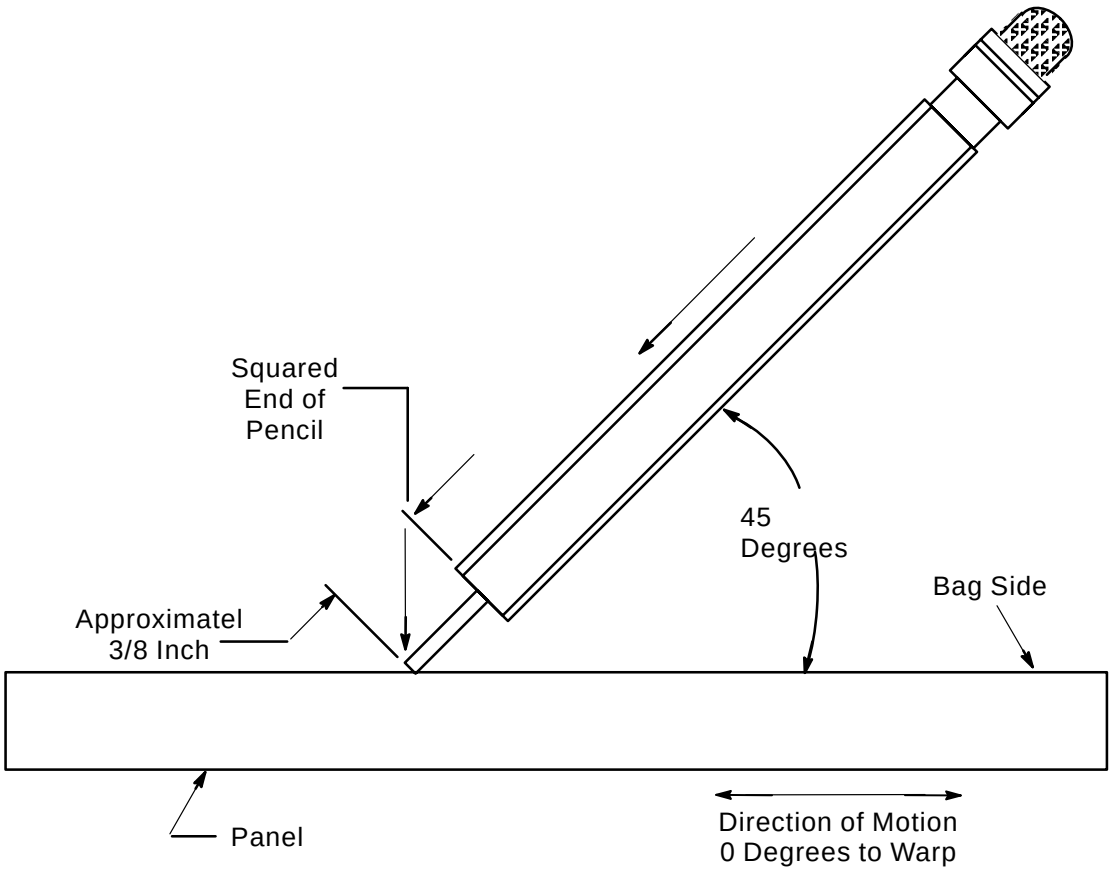


FIGURE 8 HYDRAULIC FLUID RESISTANCE TEST CONFIGURATION

8.1.10 CARBON FIBER RESIN SOLIDS CONTENT

a. Three specimens shall be cut from each panel made for laminate or honeycomb face skin mechanical properties. Use approximately 1 inch square minimum specimen size. Obtain specimens from areas of laminate that do not have peel ply. With honeycomb face skins, remove all honeycomb material from the skin before weighing. A very small amount of honeycomb residue left on the face, that cannot be removed without damage to the face sheet, will not be a major concern. Weigh each specimen (W_c). Use specimens that weigh a minimum of 0.30 gram.

b. Digest and separate fibers as follows:

(1) Place each sample in a beaker containing 50 milliliters minimum of reagent grade concentrated 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.

CAUTION Discard filtered acid and water before filtering acetone. Transfer the fibers to the filter and wash fibers with acetone.

c. Dry the fibers for 30 minutes at 230 ± 10 F, then allow to cool to 75 ± 10 F in a desiccator.

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

e. Calculate resin solids content from the formula

$$Percent\ resin\ solids\ content = \frac{W_c - W_f}{W_c} \times 100$$

where

W_c – weight of original sample

W_f – weight of fibers

8.1.11 FIBERGLASS RESIN SOLIDS CONTENT

a. From fiberglass laminate or fiberglass honeycomb face skins, cut three samples that are approximately 1 square inch minimum in size. Do not take specimens within 2 inches of the panel edge. With honeycomb face skins, be sure to remove all honeycomb material from the skin before weighing. A very small amount of honeycomb residue left on the face sheet, that cannot be removed without damage to the face sheet, will not be a major concern.

b. Weigh a numbered porcelain or quartz dish or crucible large enough to hold the specimens, on an analytical balance capable of weighing to the nearest 0.001 gram, and record the weight.

c. Weigh the fiberglass samples (W_1) and place in the tared and numbered dish or crucible.

d. Set the temperature of a muffle furnace at 1050 ± 50 F. Place the charged dishes or crucibles into the muffle furnace and burn out the resin until the fiberglass cloth becomes white, with no dark areas. The specimens may be put in the furnace as it is warming up or after it has stabilized at temperature.

e. Following burnout, remove charged dishes or crucibles to a desiccator and cool to 75 ± 10 F.

f. Reweigh charged dishes or crucibles to the nearest 0.001 gram.

g. Subtract charged dish or crucible weight from initial dish or crucible weight to obtain burnout weight of fiberglass cloth (W_2).

h. Calculate the resin content of each specimen as follows:

$$Resin\ Content\ = \frac{W_1 - W_2}{W_1} \times 100,\ percent$$

where

W_1 = weight of fiberglass cloth laminate specimen, g.

W_2 = weight of fiberglass cloth after burnout, g.

Report individual results as well as an average of the three samples.

8.2 UNCURED RESIN TESTS

Unless otherwise specified, all tests shall be performed at 77 ± 5 F. Thoroughly mix resin and hardener in accordance with suppliers recommendations. The number of specimens for uncured resin tests shall be three.

8.2.1 VISCOSITY

The viscosity of the individual resin and hardener components shall be determined in accordance with ASTM D 2393. Test values shall meet the requirements listed for individual components on the QPL.

8.2.2 GEL TIME

The gel time of the resin–hardener mixture shall be determined as follows:

a. Combine 50.0 ± 1.0 grams of the resin base (Part A) with the appropriate amount of hardener (Part B).

b. Blend the material two to three minutes by hand mixing, and allow to stand at 77+/–5F.

c. Report the gel time as the time elapsed from the start of blending to the initial formation of a nonfluid mass. This may be determined by probing the material until stringing no longer occurs.

d. For Supplier and Purchaser Quality Assurance, it is permissible to stop the test once the measured gel time exceeds the minimum requirement.

Note that gel time begins with the addition of Part A and Part B of the resin system.

8.2.3 DENSITY

Fill a tared (to nearest 0.1 gram) weight–per–gallon–cup of 83.1 ml volume with resin component previously stabilized at 77 ± 2 F. Reweigh to determine the weight of resin contained in the cup. The weight of resin in grams divided by 83.1 ml (or cc) equals the density in g/cc. Any other method of equal or better accuracy may be used.

9 MATERIAL IDENTIFICATION

Each container of a component BMS8–301 material shall be legibly and durably marked with the following information:

a. BMS8–301 (including the latest revision letter), Class and Grade

b. Manufacturer’s name and material designation

c. Manufacturer’s batch or lot number

d. Proportions and instructions for blending

e. Date of manufacture

f. Purchase order number

g. Quantity

h. Recommended storage temperature

i. A warning describing the toxicity of the components and handling precautions

10 PACKAGING AND MARKING

a. BMS8–301 shall be furnished in 1 quart kits unless otherwise specified on the purchase order.

b. Marking shall be as specified in Section 9.

c. Labeling shall conform to OSHA 1910.1200.