

1 SCOPE

- a. This specification establishes the material requirements for epoxy resin preimpregnated glass fabrics to be used in fabricating solid glass fabric reinforced laminates and glass fabric laminate faced honeycomb sandwich details using an autoclave process.
- b. This specification requires qualified products.

1.1 CONTENTS

Section	Subject	Page
1	SCOPE.....	1
1.1	CONTENTS.....	1
2	CLASSIFICATION.....	3
2.1	CLASSES.....	3
2.2	STYLES.....	3
3	REFERENCES.....	3
4	DEFINITIONS.....	4
5	MATERIAL REQUIREMENTS.....	6
5.1	PREPREG PROPERTIES.....	6
5.1.1	PHYSICAL PROPERTIES.....	6
5.1.2	DIMENSIONAL REQUIREMENTS.....	6
5.1.3	GENERAL REQUIREMENTS.....	7
5.1.4	STORAGE STABILITY AND OUT OF REFRIGERATION TIME REQUIREMENTS.....	7
5.2	LAMINATE/SANDWICH PROPERTIES.....	8
5.3	NONCONFORMING MATERIALS.....	10
6	QUALIFICATION.....	10
7	QUALITY CONTROL.....	12
7.1	SUPPLIER QUALITY CONTROL.....	12
7.1.1	STATISTICAL PROCESS CONTROL (SPC).....	13
7.2	PURCHASER QUALITY CONTROL.....	13
8	MATERIAL TEST METHODS.....	14

Authorizing Signatures on File

GLASS FABRIC PREIMPREGNATED
HIGH-TEMPERATURE-RESISTANCE
EPOXY RESIN

BMS8-139N

CAGE CODE 81205

BOEING MATERIAL SPECIFICATION

PAGE 1 OF 22

1.1 CONTENTS (Continued)

<u>Section</u>	<u>Subject</u>	<u>Page</u>
8.1	VOLATILE CONTENT.....	14
8.2	GEL TIME.....	15
8.3	RESIN FLOW.....	15
8.4	RESIN SOLIDS CONTENT.....	15
8.5	MECHANICAL PROPERTIES.....	16
8.5.1	TEST LAMINATE FABRICATION PROCEDURE.....	16
8.5.2	LAMINATE TESTS.....	16
8.5.3	SANDWICH PANEL FABRICATION PROCEDURE.....	17
8.5.4	SANDWICH TESTS.....	18
8.6	FLAMMABILITY PROPERTIES.....	19
8.7	HYDRAULIC FLUID RESISTANCE.....	19
9	MATERIAL IDENTIFICATION.....	20
10	PACKAGING AND MARKING.....	20
10.1	CARRIER.....	20
10.2	ROLL SIZE.....	21
10.3	CORE CONFIGURATION.....	21
10.4	COLOR CODING.....	21
10.5	CONTAINER.....	22
10.6	MARKING.....	22
10.7	SHIPPING.....	22

LIST OF FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
FIGURE 1	PREPREG REFRIGERATION LIFE.....	8
FIGURE 2	PREPREG OUTTIME LIFE.....	8
FIGURE 3	SANDWICH TEST PANEL CONFIGURATION.....	18
FIGURE 4	HYDRAULIC FLUID RESISTANCE TEST CONFIGURATION.....	20

LIST OF TABLES

<u>Number</u>	<u>Title</u>	<u>Page</u>
TABLE I	PREPREG PHYSICAL PROPERTIES.....	6
TABLE II	LAMINATE MECHANICAL AND PHYSICAL PROPERTIES.....	8
TABLE III	LAMINATE MECHANICAL PROPERTY REQUIREMENTS AFTER 100 HOUR AGING AT 350 F.....	9

1.1 CONTENTS (Continued)

<u>Number</u>	<u>Title</u>	<u>Page</u>
TABLE IV	SANDWICH MECHANICAL PROPERTY REQUIREMENTS.....	9
TABLE V	NUMBER OF PREPREG PLIES USED FOR RESIN FLOW TESTS.....	15

2 CLASSIFICATION

This specification consists of the following classes and styles.

2.1 CLASSES

Class refers to properties required of the prepreg and cured laminate and determines application locations.

When no Class is specified, Class 1 shall be used.

- Class 1 (obsolete designation is Class I) material is not intended to be used inside the pressure shell of the airplane. It is not required to meet flammability properties. Class 1 reinforcement fabric meets the requirements of [BMS9-3](#).
- Class 2 (obsolete designation is Class II) material is intended for possible use inside the pressure shell of the airplane. It is required to meet flammability properties. Class 2 reinforcement fabric meets the requirements of [BMS9-3](#).
- Class 3 (obsolete designation is Class III) material is intended for use in areas requiring material which only meets the prepreg physical and hydraulic fluid resistance requirements. Class 3 material is not intended for use inside the pressure shell of the airplane. Class 3 reinforcement fabric meets the requirements of [AMS 3824](#) or [MIL-Y-1140](#).

2.2 STYLES

Styles are based upon fabric reinforcement used:

DESIGNATION	FABRIC REINFORCEMENT	OBSOLETE DESIGNATION
a. Style 120	BMS9-3 , Type D, Style 120	Type 120
b. Style 1581	BMS9-3 , Type H-2, Style 181-150	Type 181 and 1581
c. Style 7781	BMS9-3 , Type H-3, Style 181-77	Type 7781
d. Style 1582	BMS9-3 , Type J-2, Style 182-150	Type 182 and 1582
e. Style 1584	BMS9-3 , Type K-2, Style 184-150	Type 184 and 1584
f. Style 1543	BMS9-3 , Type F-2, Style 143-150	Type 183 and 1583
g. Style 108	AMS 3824 or MIL-Y-1140 , Style 108	None
h. Style 220	BMS9-3 , Type D-1, Style 220	None

3 REFERENCES

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

AMS 3824	- Cloth Glass Finished for Resin Laminates
ASTM D 638	- Standard Test Method for Tensile Properties of Plastics
ASTM D 695	- Standard Test Method for Compressive Properties of Rigid Plastic

3 REFERENCES (Continued)

- [ASTM E 4](#)
 - [BMS9-3](#)
 - [BSS7061](#)
 - [BSS7101](#)
 - [BSS7230](#)
 - [BSS7276](#)
 - [BSS7286](#)
 - [BSS7335](#)
 - [BSS7336](#)
 - [BSS7337](#)
 - [MIL-Y-1140](#)
 - OSHA 1910.1200
 - SAE-AMS-STD-401
- Standard Practices for Force Verification of Testing Machines
 - Glass Fabric Reinforcements for Laminated Plastic Products
 - Requirements for Time and Temperature Recorders Used with Time and Temperature Sensitive (TATS) Material
 - Requirements for the Process Control Documents (PCD) for Suppliers of Raw Material Specifications
 - Determination of Flammability Properties of Aircraft Materials
 - Gel Time, Prepreg, Test Method for Determination of
 - Statistical Process Control of Designated Engineering Characteristics
 - Resin Flow of Prepreg Fabric and Tape, Test Method for
 - Resin Content and Fiber Areal Weight of Prepreg Fabric and Tape, Test Methods for
 - Volatile Content of Prepreg Fabric and Tape, Test Methods for
 - Yarn, Cord, Sleeving, Cloth and Tape Glass
 - Hazard Communication Standard
 - 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:

- Capable Process
 - A process is said to be capable when the process capability ratios of all key characteristics and key process parameters of the process are equal to or greater than 1.00.
- Control
 - A process is said to be in control when all variations in the process are due to causes inherent in the process, not outside influences. The process average of such a process stays about the same, and the variation about the average stays at about the same level.
- Crease
 - A condition of the surface of the material where the nominal thickness is not appreciable changed, but the material is permanently formed into a ridge.
- Date of Manufacture
 - The date when the fiberglass reinforcement is impregnated with one resin mix in one continuous operation.
- Dry (Boardy) Areas
 - Portions of the prepreg that do not drape easily or exhibit an unnatural drape or exhibit very little tack.
- Fabric Fill Face
 - That side of the fabric where the majority of the area is composed of yarns running perpendicular to the selvage.
- Fabric Warp Face
 - That side of the fabric where the majority of the area is composed of yarns running parallel to the selvage.
- Fill
 - The yarns running perpendicular to the longer dimension or selvage of the fabric reinforcements.
- Fold
 - A condition in which the fabric is laid back over itself.

4

DEFINITIONS (Continued)

- | | |
|--------------------------------|---|
| Handling Life | - The out-of-refrigeration time in which the material maintains its part producibility characteristics (tack and/or drape) and is capable of demonstrating properties in Section 5.1.1 . |
| Mechanical Life | - The out of refrigeration time over which the material remains capable of attaining cure and required mechanical properties if laid up and compacted within its handling life. |
| Mill Roll | - An uninterrupted roll of glass fabric cut from a loom and subjected to all subsequent fabric inspection, heat cleaning, and finishing operations as a single unit. |
| Out Time | - The maximum (cumulative) time that a prepreg may be kept at ambient conditions and still retain properties within the limits of this specification. |
| Prepreg Batch | - Prepreg containing fabric meeting the requirements of BMS9-3 , AMS 3824 or MIL-Y-1140 , as applicable, impregnated with one batch of resin in one continuous manufacturing operation with traceability to individual fabric lots. |
| Prepreg Lot | - Prepreg from one prepreg batch submitted for acceptance at one time. |
| Process Control Document (PCD) | - A document which describes the raw materials, manufacture and testing of a material to assure product quality and consistency. |
| Puckers | - Areas on prepreg material where the material has locally blistered from the separator film or release paper. |
| Resin Rich Areas | - An area with more than maximum allowable resin content. |
| Roll | - Any section from the batch furnished as a continuous roll of prepreg. |
| Room Temperature (RT) | - The temperature range from 75 ± 5 F. |
| Selvage | - The edge of woven fabric of different threads or weave from the body of the fabric. |
| Storage Life | - The period of time that the material may be kept under refrigeration so that it retains the properties within the limits of this specification. |
| Warp | - The lengthwise parallel yarns of the fabric reinforcements running parallel to the selvage. |
| Wrinkle | - A condition where one or more plies of prepreg are formed into a ridge. |

5 MATERIAL REQUIREMENTS**5.1 PREPREG PROPERTIES**

Reinforcement used in the manufacture of prepreg to this specification shall meet the requirements of [BMS9-3](#), [AMS 3824](#), or [MIL-Y-1140](#) as applicable, with traceability to original yarn lots. The impregnating resin shall be a high temperature resistant, rigid thermosetting epoxy resin. The resin shall be catalyzed and B-staged in such a manner so as to yield a preimpregnated fiberglass fabric which meets the requirements of this specification.

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	STYLE 108	STYLE 120 OR 220	STYLE 1581 OR 7781	STYLE 1582	STYLE 1584	STYLE 1543	TEST METHOD SECTION
Resin Solids Content (Percent), Average FL 1	42 ± 4	42 ± 3	36 ± 2	36 ± 2	34 ± 3	36 ± 2	Section 8.4
Flow (Percent) at 50 psi and 325 F, Average	See QPL	17 ± 5	17 ± 5	17 ± 5	17 ± 5	17 ± 5	Section 8.3
Gel Time (minutes), Average	4 ± 3	4 ± 3	4 ± 3	4 ± 3	4 ± 3	4 ± 3	Section 8.2
Volatiles (maximum percent each individual determination)	1.5	1.5	1.5	1.5	1.5	1.5	Section 8.1

FL 1 Supplier key characteristic in accordance with [BSS7286](#).

5.1.2 DIMENSIONAL REQUIREMENTS

- a. The measured width of the material shall not include selvages and shall be within ± 1 inch of that specified on the purchase order. Other tolerances shall be as specified on the purchase order.
- b. Prepreg materials may be purchased as follows:
 - (1) Normal Form - Single ply of prepreg with polyethylene parting film on one or both faces.
 - (2) Preplied Form - Multiple plies plied together and separated from other multiple plies with polyethylene parting film on one or both sides.
 - (a) Style 120 preplied prepreg (3 plies) shall be nested with fill face and warp face interfaces as specified in the Supplier's PCD.
 - (b) Style 1581, 7781 or 120 preplied prepreg (2 plies) shall be nested with fill face and warp face interfaces as specified in the Supplier's PCD.
- c. The polyethylene parting film shall be applied to the roll immediately after impregnation so that the longest dimension of the embossed diamond pattern is parallel with the glass fabric warp direction.

5.1.2 DIMENSIONAL REQUIREMENTS (Continued)

- d. Slit prepreg material narrower than the test requirements of [Section 8](#) may be purchased if accompanied by material from the same batch wide enough to permit performance of the required testing.
- e. Unless otherwise specified on the purchase order, the roll lengths for prepreg are as follows:

Normal Form

Style 108, 120, 220 - 125 Nominal yards/roll

Style 1543, 1581, 7781, 1582 - 60 Nominal yards/roll

Style 1584 - 35 Nominal yards/roll

Preplied Form

Style 120 -40 Nominal yards/roll (2 plies preplied)

Style 120 - 40 Nominal yards/roll (3 plies preplied)

Style 1581 - 30 Nominal yards/roll (2 plies preplied)

Style 7781 - 30 Nominal yards/roll (2 plies preplied)

5.1.3 GENERAL REQUIREMENTS

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

5.1.4 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 shown in [Figure 1](#) and [Figure 2](#).

5.1.4 STORAGE STABILITY AND OUT OF REFRIGERATION TIME REQUIREMENTS
(Continued)

- Storage Life - 270 days minimum from date of manufacture, stored at 10 F or below in a sealed moisture proof container.
- Supplier out-time; 72 hours maximum at room temperature.
- Handling Life - 360 hours minimum at 75° ± 5°F.
- Mechanical Life - 720 hours minimum at 75° ± 5°F.
- Unless specified on the purchase contract, there shall be a minimum of 180 days of storage life remaining from the date of receipt at the purchaser's facility.

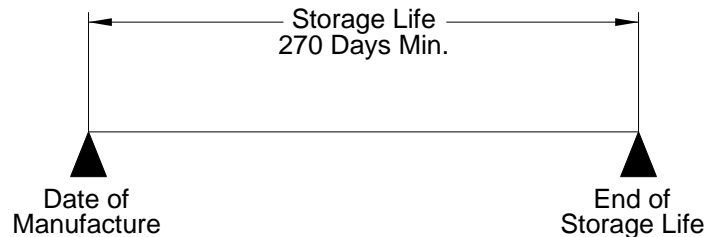


FIGURE 1 - PREPREG REFRIGERATION LIFE

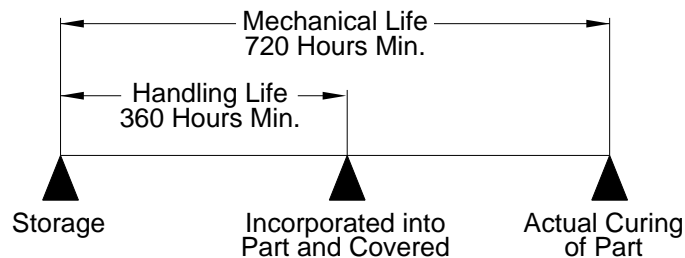


FIGURE 2 - PREPREG OUTTIME LIFE

5.2 LAMINATE/SANDWICH PROPERTIES

Laminates and sandwich panels fabricated in accordance with [Section 8.5.1](#) and [Section 8.5.3](#) shall meet the requirements of [Table II](#), [Table III](#) and [Table IV](#), as applicable.

TABLE II - LAMINATE MECHANICAL AND PHYSICAL PROPERTIES

STYLE	108	120 OR 220		1581 OR 7781		1582		1584		1543		TEST METHOD SECTION
CLASS	3	1	2	1	2	1	2	1	2	1	2	
No. of Plies												Section 8.5.2 Section 8.6
Mech/physical Test	---	24	24	10	10	8	8	4	4	10	10	
Flammability Tests	---	---	6	---	3	---	2	---	2	---	3	
Mechanical Properties												Section 8.5.2.b.
Compression Ult. (ksi)												
75 ± 5 F FL 2	FL 1	54	45	54	45	45	41	36	33	80	73	
350 ± 5 F		27	24	32	25	27	24	20	18	47	42	

5.2

LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE II - LAMINATE MECHANICAL AND PHYSICAL PROPERTIES (Continued)

STYLE	108	120 OR 220		1581 OR 7781		1582		1584		1543		TEST METHOD SECTION
CLASS	3	1	2	1	2	1	2	1	2	1	2	
Compression Mod. (msi)	FL 1											Section 8.5.2.c.
75 ± 5 F FL 2		2.9	2.5	3.1	2.7	2.9	2.5	2.7	2.4	4.5	3.9	
350 ± 5 F		2.2	2.1	2.7	2.6	2.5	2.4	2.3	2.2	3.9	3.8	
Tensile Ult. (ksi)												Section 8.5.2.a.
75 ± 5 F FL 2		41	41	47	47	44	44	44	44	74	74	
350 ± 5 F		25	25	27	27	24	24	24	24	42	42	
Tensile Mod. (msi)												Section 8.5.2.a.
75 ± 5 F FL 2	2.9	2.9	3.1	3.1	3.1	3.1	2.9	2.9	4.5	4.5		
350 ± 5 F	2.4	2.4	2.6	2.6	2.6	2.6	2.4	2.4	3.7	3.7		
Physical Properties	All Styles Shall Meet Requirements Listed in Section 8.7.d., Section 8.7.g. and Section 8.7.h.											
Aviation Hydraulic Test Fluid Resistance												
Flammability Properties	NOTE: Flammability requirements apply to Class 2 only.											
60 Second Vertical	Material shall be self extinguishing within 15 second of flame removal, shall burn no more than 6 inches and resin drips shall extinguish within 3 seconds.											Section 8.6
30 Second - 45 Degree Angle	Material shall be self extinguishing within 15 seconds of flame removal, afterglow shall cease within 10 seconds and there shall be no complete penetration of the material.											Section 8.6

FL 1 These tests not required for Class 3.**FL 2** Required supplier quality control tests. Supplier key characteristic in accordance with [BSS7286](#).

TABLE III - LAMINATE MECHANICAL PROPERTY REQUIREMENTS AFTER 100 HOUR AGING AT 350 F

STYLE	120 OR 220		1581 OR 7781		TEST METHOD SECTION
CLASS	1	2	1	2	
No. of Plies per laminate	24	24	10	10	- - -
Compression Strength 0 Degree to Warp at 350 F (ksi)	22	20	32	25	Section 8.5.2.b.
Compression Modulus 0 Degree to Warp at 350 F (msi)	2.2	1.9	2.7	2.6	Section 8.5.2.c.
Tensile Ult. 0 Degree to Warp at 350 F (ksi)	25	25	27	27	Section 8.5.2.a.
Tensile Modulus 0 Degree to Warp at 350 F (msi)	2.4	2.4	2.6	2.6	Section 8.5.2.a.

TABLE IV - SANDWICH MECHANICAL PROPERTY REQUIREMENTS

CLASS	1 AND 2		TEST METHOD SECTION
STYLE	120 OR 220	1581 OR 7781	
No. of plies per face	3	2	- - -

5.2 LAMINATE/SANDWICH PROPERTIES (Continued)

TABLE IV - SANDWICH MECHANICAL PROPERTY REQUIREMENTS (Continued)

CLASS	1 AND 2		TEST METHOD
STYLE	120 OR 220	1581 OR 7781	SECTION
Peel (lb-in/3in. width)	12	12	Section 8.5.4.a.
Long Beam Flexure Ult. Load (lb)	145	245	Section 8.5.4.b.
Long Beam Flexure P/Y (lb/in.)	115	210	Section 8.5.4.b.

5.3 NONCONFORMING MATERIALS

- a. Portions of rolls not conforming to [Section 5.1.3](#) shall be identified along one selvage edge of the prepreg roll by markers. Markers shall be a single color distinguishable from the prepreg and carrier and removable without damaging the prepreg.
- b. For single point defects, use single markers.
- c. Successive single point defects, 3 feet or less apart, shall be considered as one continuous defect.
- d. For continuous defective areas, markers shall be placed at the beginning, at 2 feet (maximum) intervals and at the end of the continuous defect.
- e. Prepreg may be cut and spliced to remove defects. Prepreg splicing shall be approved by The Boeing Company and documented in the Supplier Process Control Document (PCD).
- f. Material shall have a roll maximum defect limit of 15 percent of the roll length. Defect length limit shall be on the full width.
- g. Ninety percent of each roll shall have 50 feet minimum lengths between defects or splices. The remaining 10 percent shall have 15 feet minimum lengths between defects or splices.
- h. The location and length (for continuous defects) of each marked defect and the locations of the splices shall be indicated on a defect log accompanying each roll of prepreg. Defect and splice locations shall be identified relative to the outside of the prepreg roll.
- i. Defective areas shall not be counted toward the amount purchased.

6 QUALIFICATION

- a. Direct all requests for qualification to a Supplier Management (SM) organization of The Boeing Company. SM 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 procedures.

6

QUALIFICATION (Continued)

- c. Qualification shall be based upon the manufacture and successful test of three prepreg batches of the material, and successful demonstration of manufacturing characteristics under production conditions. The three batches shall contain at least two different resin batches and at least two different lots of the reinforcement.
- d. Suppliers seeking qualification to this specification shall submit to an audit of their product manufacturing operations, raw material traceability, process records, test procedures, and quality assurance records. If deemed necessary to the supplier, The Boeing Company will enter into a nondisclosure agreement with the supplier to protect the proprietary rights of both. The Boeing Company reserves the right to reaudit any or all follow-on production orders subsequent to qualification.
- e. When requested by The Boeing Company, SM Department, 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 Style submitted. The test facility (supplier or test laboratory) used in determination of the data shall be identified. The test data shall demonstrate prepreg compatibility with both adhesives specified in [Figure 3](#) by meeting the requirements in [Table IV](#).
- f. Prior to submitting a material for qualification to this specification, the material supplier shall provide a Material Safety Data Sheet (MSDS) for the candidate material. Prior to completing qualification, the material supplier shall provide the detailed chemical formulation, percent composition, and CAS (Chemical Abstract Service) numbers 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 Environment, Health, and Safety (EHS) organizations to perform a health hazard evaluation. These organizations determine whether the information as supplied is adequate (or alternatively, whether additional information is necessary) to identify and document appropriate precautions for the material's use.
- g. Materials submitted for qualification shall be tested against the requirements of this specification both as-received and after exposure to the maximum storage periods.
- h. Materials submitted for qualification shall be evaluated for manufacturing suitability.
- i. After review of supplier data and completion of Boeing tests, the supplier will be advised of qualification status. Qualified Products will be listed in the QPL showing the supplier's product designation.
- j. The supplier shall submit a Process Control Document (PCD) for Boeing review prior to the 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](#). No change in approved product formulation, raw materials, basic methods of manufacture, or plant site for a material qualified to this specification shall be made without notification and prior approval in writing from The Boeing Company. It may be necessary to requalify material manufactured with the proposed change, and a revised product designation may be required.
- k. Any or all of the qualification tests may be repeated at any time by the purchaser and the material shall pass the qualification requirements.

6 QUALIFICATION (Continued)

- l. Production material shall be capable of meeting all qualification requirements.
- m. Qualified products are listed in the Qualified Products List.

7 QUALITY CONTROL

7.1 SUPPLIER QUALITY CONTROL

- a. Verify that the material has been manufactured in accordance with the approved PCD.
- b. Test each batch of material prior to shipping.
 - (1) Test resin content in material taken from each mill roll and at intervals not exceeding 250 yards within the mill roll.
 - (2) Test gel time, percent flow, and volatile content on the first and last roll in the prepreg batch, at a minimum.
 - (3) Perform the designated tests in [Table II](#) on at least one roll, selected at random, per prepreg batch and include the results with the supplier test report. A minimum of one batch of Class 2 material for shipment to The Boeing Company shall be tested each year for flammability properties as described in [Section 8.6](#). The batch number and results shall be identified on the test report of batches not tested.
- c. A minimum of one batch of Class 2 material for shipment shall be tested each year for flammability properties as described in [Section 8.6](#). The batch number and results shall be identified on the test report of batches not tested.
- d. Furnish actual test data comprised of the average and individual 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 the failed property in accordance with [BSS7101](#) is allowed. All data including chromatograms, spectra, and peak tables, shall accompany the material shipment.
- 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 Manufacturing and Quality Assurance Plan. Such records shall be available for inspection by authorized representatives of The Boeing Company.
- f. Suppliers shall provide Boeing (SM) summary reports of Statistical Process Control (SPC) data including control charts, nominal values, standard deviation, number of batches, and Cpk for each Key Characteristic (KC) and Key Process Parameter (KPP). SPC data must be submitted every 6 months. If the control limits change from a previous report, suppliers shall report old and new control limits.
- g. In lieu of performing the tests 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 Technology, and Quality Assurance organizations. Requests for approval should include a summary of data demonstrating consistent conformance, copies of documented provisions for process controls, a copy of the plan for reduced testing (including revision control and Supplier Quality Control approval), as well as any other relevant information (for example, studies identifying key process parameters).

7.1 SUPPLIER QUALITY CONTROL (Continued)

- h. If reduced testing is in place so that the reporting of test results is affected, the supplier must 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](#) and [Table II](#).
- 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.
- 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 and marking to verify conformance to the appropriate sections of this specification. 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.

7.2 PURCHASER QUALITY CONTROL (Continued)

- b. Quality Assurance tests for all Styles shall consist of those listed in [Table I](#). Test one roll from each batch, if multiple shipments are received from the same batch number, test one roll from each lot. One of every five prepreg batches of Style 120, 220, 1581, and 7781 shall be tested for laminate tensile and compression properties (75 ± 5 F only) as described in [Section 8.5.2](#). Values shall meet the requirements of [Table II](#).
- c. When consistent conformance to specification acceptance (receiving) requirements has been demonstrated, Quality Assurance may implement reduced testing in accordance with a suitable sampling plan. Authorization of a reduced testing plan shall be approved by Boeing Quality Assurance.
- d. When a Supplier has demonstrated consistent conformance to required testing in accordance with [Section 7.1](#), Purchaser testing may be removed as requirement for material procured from that Supplier. Appropriate Boeing Quality Assurance documentation such as [D1-4426](#) shall indicate which products do not require Purchaser testing.
- e. Verify that each lot of prepreg meets the storage condition requirements in [Section 5](#) and [Section 10.7](#) of this specification during shipping.
 - (1) The purchaser shall document the procedure used to verify temperature exposure.
 - (2) If the time and temperature exposure exceeds the maximum mechanical life conditions in [Section 5.1.4](#), 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 5.1.4](#) for material in that lot. Temperature excursions during shipment of up to +10 F above the maximum storage temperature are allowed without mechanical life deduction as long as the total time of the excursions does not exceed 60 minutes.
 - (4) If the storage conditions cannot be verified, material in the shipment shall be tested in accordance with [Section 7.2.b.](#). 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**

The test methods described below shall be used. Requests for use of an equivalent test method shall be directed to a SM organization of The Boeing Company. Requests for deviations in test methods shall include data demonstrating that the alternate method is statistically equivalent to the specification method. Use of the equivalent test methods shall be referenced in the PCD and shall be approved by the responsible Boeing Engineering Group(s).

8.1 VOLATILE CONTENT

- a. Prepare a minimum of two specimens of (nominally) 4 by 4 inches from samples taken in accordance with [Section 7.1.b.](#) as applicable.
- b. Set the oven at 325 ± 10 F. Set the devolatilizing time at 8 ± 1 minutes.

8.1 VOLATILE CONTENT (Continued)

- c. Determine the volatile content in accordance with [BSS7337](#), Method I, Hook/Clip Method.
- d. Report the individual values.

8.2 GEL TIME

- a. Prepare at least two specimens appropriate to the intended test method. Each specimen shall be either (nominally) 0.25 by 0.25 inch for [BSS7276](#), Method II or a 2.0 by 2.0 inch stack of at least 20 grams for [BSS7276](#), Method I. Cut specimens from samples taken in accordance with [Section 7.1.b.](#) as applicable.
- b. Set the test temperature at 325 ± 5 F.
- c. Determine the gel times of two specimens in accordance with [BSS7276](#), Method I (Platen Press Method) or Method II (Temperature-Controlled Hot Plate Method).
- d. Report the average value.

8.3 RESIN FLOW

- a. Prepare (nominally) 4 by 4 inch test plies from samples taken in accordance with [Section 7.1.b.](#) as applicable. The number of plies per specimen shall be in accordance with [Table V](#).
- b. Set the platen press at 325 ± 5 F and 50 ± 5 psi. In addition, set the timer at 5 minutes plus the measured prepreg gel time.
- c. Determine the resin flow in accordance with [BSS7335](#), Method I, Nonbleeder Method, Type 1 or 2, Nonperforated release film or aluminum foil.
- d. The average percent flow shall meet the requirements of [Table I](#), and the two flow determinations shall not vary more than 3 flow percent.

TABLE V - NUMBER OF PREPREG PLYS USED FOR RESIN FLOW TESTS

	STYLE 108	STYLE 120 OR 220	STYLE 1581 OR 7781	STYLE 1582	STYLE 1584	STYLE 1543
No. of Plies for Flow Test	40	20	10	10	5	12

8.4 RESIN SOLIDS CONTENT

- a. Prepare a minimum of three specimens in accordance with [BSS7336](#).
- b. Determine the resin solids content by one of the following two methods:
 - (1) Determine the resin solids content in accordance with [BSS7336](#), Method I, Burn-out Method.
 - (2) Determine resin solids content by extracting the resin from the samples in methyl ethyl ketone, methylene dichloride, or acetone in accordance with [BSS7336](#), Method II, Type I, Beaker Extraction.
- c. The average resin solids content shall meet the requirements of [Table I](#).

8.5 MECHANICAL PROPERTIES

The following general requirements apply to mechanical property testing:

- a. Test machines shall comply with [ASTM E 4](#).
- b. All values listed in [Table II](#), [Table III](#) and [Table IV](#) are minimum average requirements. Minimum individual requirements are 90 percent of the minimum average requirement.
- c. Unless otherwise specified in the test method, a minimum of five specimens shall be tested for each laminate property and a minimum of four specimens shall be tested for each sandwich property.
- d. 350 F specimens shall be conditioned at 350 ± 5 F for 10 ± 3 minutes immediately before testing at 350 ± 5 F.

8.5.1 TEST LAMINATE FABRICATION PROCEDURE

All test laminates fabricated for testing to the requirements of this specification shall be processed in accordance with this procedure:

- a. The number of plies in the laminate shall be as listed in [Table II](#) for the applicable Style.
- b. The laminate shall be of sufficient size to allow the required number of specimens to be machined. The plies shall be parallel laminated with the warp face up. A panel 14 inches in the fill direction by 22 inches in the warp direction is recommended. If aluminum tooling is used, a protective coating or barrier film shall be placed between the tool and laminate.
- c. Edge breathers shall be offset 0.5 inch minimum from part edge.
- d. Apply vacuum bag. Teflon or FEP release film shall be employed between the surface of the laminate and bag. A breather consisting of two plies of 181 glass cloth or equivalent breather material may be placed between the nonperforated top release film and vacuum bag.
- e. Apply vacuum (20 inches of mercury minimum) and 15 ± 5 psig autoclave pressure. Vent vacuum bag to atmospheric pressure after 15 psig is reached.
- f. Heat to 190 ± 10 F at a rate of 0.5 to 7 F per minute and hold for 15 to 60 minutes.
- g. At end of 190 F stage, increase autoclave pressure to 45 ± 5 psig.
- h. Heat to 350 ± 10 F at a rate of 0.5 to 7 F per minute and hold for $90 \pm 15/-0$ minutes.
- i. Cool under pressure until the part temperature is 140 F, or less.

8.5.2 LAMINATE TESTS

The material, when laminated as described in [Section 8.5.1](#), shall be tested as follows and shall meet the requirements of [Table II](#) and [Table III](#). A minimum of five specimens shall be tested for each mechanical property.

- a. Tensile Properties

8.5.2 LAMINATE TESTS (Continued)

Ultimate tensile strength and modulus of elasticity at zero degree to the warp shall be determined in accordance with [ASTM D 638](#), Type II, except that the rate of crosshead travel shall be 0.05 inch per minute until the initial straight line portion of the stress strain curve has been obtained for modulus calculation. The extensiometer shall then be removed and the rate of travel of the crosshead increased to 0.20 to 0.25 inch/minute until failure occurs.

NOTE: Strain gauges can be used to take measurements in place of an extensiometer.

b. Compression Strength

Compression strength shall be determined zero degree to the warp in accordance with [ASTM D 695](#).

c. Compression Modulus

The compression modulus shall be determined at zero degree to the warp. Tests shall be accomplished in accordance with [ASTM D 695](#). The compression modulus specimens shall be instrumented with a compressometer to obtain the load strain curve. Do not use a deflectometer.

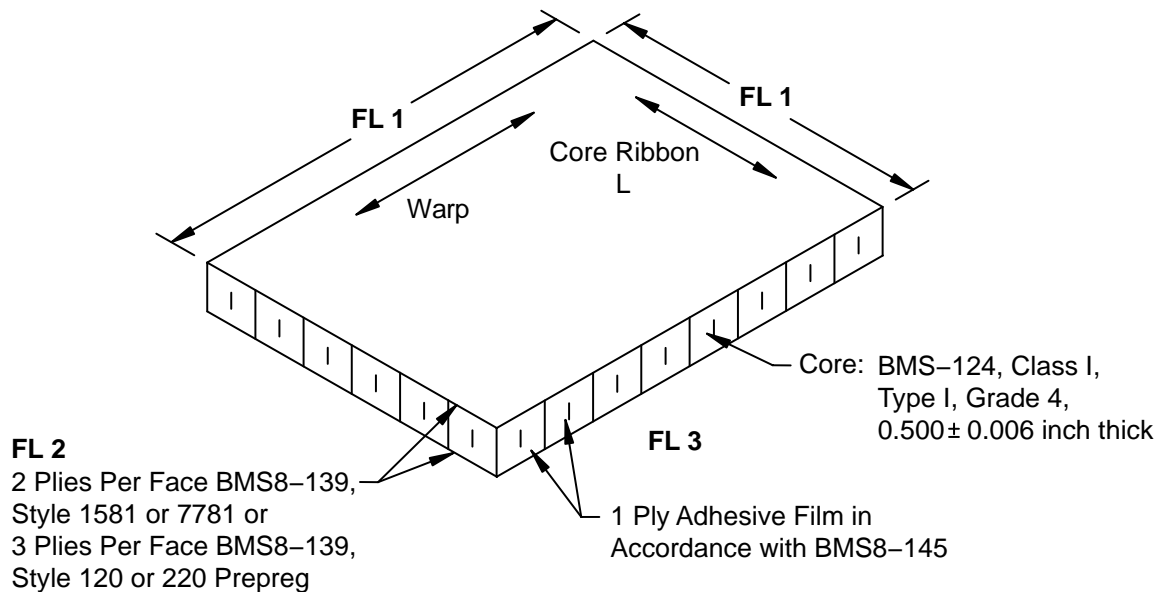
NOTE: Strain gauges can be used to take measurements in place of a compressometer.

8.5.3 SANDWICH PANEL FABRICATION PROCEDURE

All sandwich test panels fabricated for testing to the requirements of this specification shall be processed according to the following procedure.

- a. The configuration of the sandwich panel shall be as illustrated in [Figure 4](#) using the number of plies per facing listed in [Table IV](#) for the applicable style.
- b. The panel shall be processed as described in [Section 8.5.1](#). In addition to the requirements of [Section 8.5.1](#), a breather consisting of two plies of 181 glass cloth or equivalent breather material shall be placed between the nonperforated top release film and vacuum bag.

8.5.3 SANDWICH PANEL FABRICATION PROCEDURE (Continued)



- FL 1** Panel dimensions shall be such as to allow machining of the number and kinds of test coupons specified in [Table IV](#).
- FL 2** The prepreg shall be oriented so that the warp face of the fabric is against the adhesive on both sides.
- FL 3** The adhesive film shall be placed so that the side against the polyethylene film separator is against the core and the warp direction of the adhesive is aligned with the warp direction of the prepreg.

FIGURE 3 - SANDWICH TEST PANEL CONFIGURATION

8.5.4 SANDWICH TESTS

The material, when fabricated into a sandwich panel as described in [Section 8.5.3](#), shall be tested as follows and shall meet the requirements of [Table IV](#).

a. Peel

- (1) Eight peel specimens 3.00 ± 0.03 by 12.00 ± 0.25 inches shall be obtained from the test panel. The specimens shall be prepared so that the bag side is peeled on four specimens, and the caul plate side on four specimens.
- (2) The peel strength shall be determined using a climbing drum peel apparatus at a head speed of 1 inch per minute, in accordance with SAE-AMS-STD-401. A peel curve shall be obtained for each specimen so that the peel strength for each specimen may be computed using the curve average as determined over a 4 inch distance, peeled in the warp direction.
- (3) The reported peel strength shall include the torque necessary to bend the face sheet, the reported peel value shall be determined by rewinding the drum with a loose material such as Osnaburg cloth, and recording the average rewind value. This average rewind value shall be subtracted from the average peel value. The resultant value shall be used to determine the reported peel strength as follows:

8.5.4 SANDWICH TESTS (Continued)

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

Torque Arm = Radius of Flange - Radius of Drum = 0.5 in.

b. Long Beam Flexure

The test specimens shall be 3.00 ± 0.03 inches by 24.00 ± 0.25 inches, with the 24 inch dimension in the warp direction of the panel. A minimum of four specimens shall be tested, bag side up. The test shall be single point loading on an 18.0 ± 0.2 inch span, employing 1 inch nominal wide steel blocks with a 60D (Durometer) rubber pad (1 by 3 by 1/8 inch nominally) at the center loading point. Except for the above, test procedure shall be in accordance with SAE-AMS-STD-401. Ultimate load at failure, in pounds, and P/Y value shall be reported.

P/Y = Slope of tangent to initial portion of load deflection curve (lb/in.).

8.6 FLAMMABILITY PROPERTIES

- a. The 60 second vertical and 30 second 45 degree angle tests shall be performed in accordance with [BSS7230](#).
- b. Flammability properties shall meet requirements listed in [Table II](#).
- c. Fabricate a laminate panel in accordance with [Section 8.5.1](#) using the number of plies listed in [Table II](#) for flammability tests for the applicable style.

8.7 HYDRAULIC FLUID RESISTANCE

- a. Each test specimen shall be approximately 1 inch nominally wide by 3 inches nominally long.
- b. For Class 1 and Class 2, cut two specimens from excess of mechanical test panels. For Class 3 materials, cut two specimens from a laminate fabricated in accordance with [Section 8.5.1](#).
- c. Obtain drawing pencils ranging in hardness from 4H through 9H and square the tips (See [Figure 4](#)). This may be done by holding the pencil in a vertical position and moving the lead back and forth over 400 grit or finer abrasive paper. Resquare tips after each hardness test. [FL 1](#)
- d. Place specimen in a horizontal position vacuum bag side up. Hold pencil at a 45 degree nominal angle and push it across the specimen using firm, steady pressure (see [Figure 4](#)). Continue testing with the various hardness pencils until one is found which will just cut or scratch the panel. Make these tests at 80 ± 10 F and remove excess oil from panels using clean, dry gauze.
- e. Immerse each specimen in [BMS3-11](#), Type IV, Class I, Grade A heated to 160 ± 5 F and hold immersed and at temperature for 48 hours minimum.
- f. Remove specimens from bath, cool to 80 ± 10 F and remove excess oil from panels using clean, dry gauze.
- g. Immediately retest hardness. Surface hardness of the exposed panel shall not decrease more than two pencil lead harnessers.

8.7 HYDRAULIC FLUID RESISTANCE (Continued)

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

FL 1 The following drafting leads are acceptable: KO-I-NOOR 1500; Venus Drawing: A. W. Faber Castell; Eagle Turquoise.

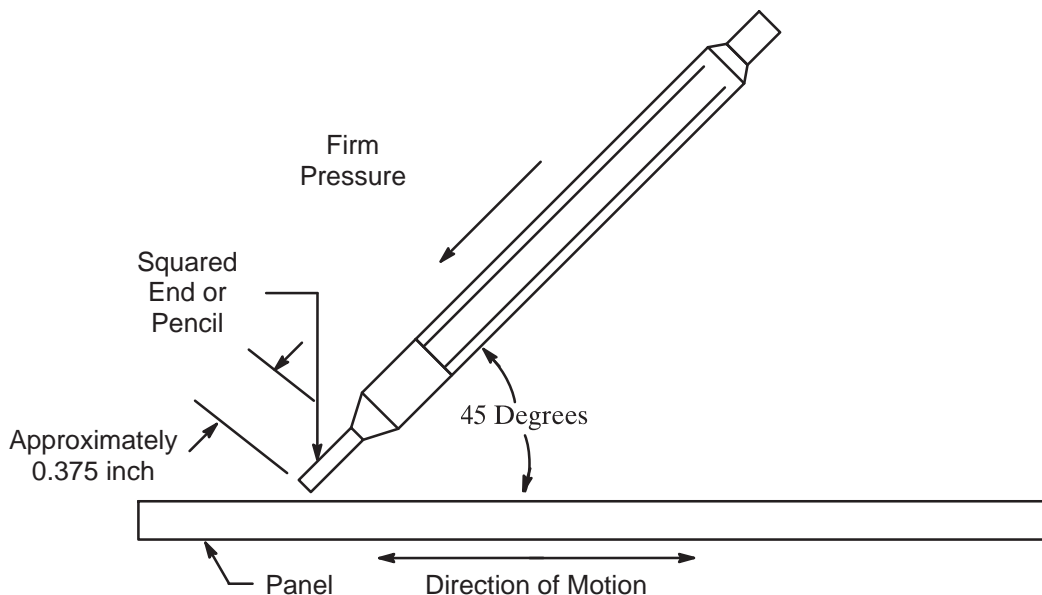


FIGURE 4 - HYDRAULIC FLUID RESISTANCE TEST CONFIGURATION

9 MATERIAL IDENTIFICATION

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

- Glass fabric preimpregnated with epoxy resin
- Manufacturer's name and product designation
- BMS8-139 including latest revision letter, Class and Style of prepreg.
- Date of impregnation
- Batch, roll number and roll length in linear yards.
- Roll length in linear yards
- Width of prepreg not including selvage
- Number of preplied plies in roll (if applicable)

10 PACKAGING AND MARKING

10.1 CARRIER

- All prepreg shall be interleaved with noncontaminating carrier material.

10.1 CARRIER (Continued)

- b. If the carrier or interleaf material has a release coating, the coating shall be fully cured and nontransferring. The carrier width shall be not less than the prepreg including selvages. The carrier material shall contain a nontransferring or noninhibiting color. The carrier material shall have a diamond embossed pattern, and shall be placed on the prepreg surface with the pattern long dimension parallel to the fabric warp direction and easily removable from the prepreg at 75 ± 5 F.

10.2 ROLL SIZE

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

10.3 CORE CONFIGURATION

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

10.4 COLOR CODING

Each prepreg roll shall be color coded as follows:

Class 1

Style Designations	Carrier Color
120	Blue
220	Blue
1581 or 7781	Blue
1582	Purple
1584	Green
1543	Yellow

Class 2

Style Designations	Carrier Color
120	Orange
220	Orange
1581 or 7781	Orange
1582	Orange
1584	Orange
1543	Orange

Class 3

Style Designations	Carrier Color
108	Green

10.5 CONTAINER

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

10.6 MARKING

- a. Each container of prepreg shall be permanently and legibly marked to give the information in [Section 9](#) and the following:

- (1) Purchaser order number

- (2) Date of shipment

NOTE: If Date of Shipment is listed on the packing list it does not need to be listed on the packaging.

- b. In addition, containers will be labeled on two sides in letters at least 2 inches, or a height agreed upon in the supplier's PCD, with the following or equivalent warnings:

- (1) SHIP AND STORE AT 10 F OR BELOW

- (2) DO NOT STAND ON END

- c. Labeling shall conform to OSHA 1910.1200.

10.7 SHIPPING

- a. Ship material at 10 F or below.
- b. Included sufficient temperature recorders with each lot shipped to assure that all temperature excursions above 10 F are recorded.
- c. The use and placement of temperature recorders shall be in accordance with [BSS7061](#).