BOMBARDIER

de Havilland
Material Specification

TITLE:	**FABRIC, ARAMID FIBER, HIGH MODULUS, 350^{O}F CURE EPOXY RESIN IMPREGNATED (FOR EXTERIOR USE)**
SPECIFICATION NUMBER:	**DHMS P 1.39**
ISSUE:	**M**
AMENDMENT:	**1**
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PAGE:	**1 of 24**

Prepared by: Approved by:

SIGNED ORIGINAL ON FILE

Hai Yen Tran
Materials Technology

Stephen Mabee
Chief, Stress and Materials Technology

REVISION RECORD

Issue	Page	Description and Reason for Change
F	10	A sketch of test panels, sandwich construction for class 1 material was added to section 4.2.1.
	QPL	Specification was expanded to 23 pages.
	QPL	Specification requirement on Climbing Drum Peel Torque:30 in-lb/3 in.width was added to Cytec, supplier of Class 1, type 3 material.
	QPL	Specification change on resin flow and gel time for Cytec, supplier of Class 1, type 3 material. Resin flow: 33±6% @ 325°F Gel time @ 325°F: 17±7 Min.
F Amd.1	QPL	Requirement of Resin Flow for Cytec, supplier of Class 1, type 3 material, changes from 33±6% to 20-33%.
G		This is a complete revised issue. Detailed changes have not been noted.
H	13	Lay up procedure changes to use class 2 type 2 film adhesive.
	Table 6	Acceptance test Peel torque requires only for Class 2 material.
	QPL	Reference to 30 in.lb/3 in. width, of Cytec material was deleted.
	4	3.4.1 Storage Life changed from 180 days from date receipt to 180 days from date of shipment. (Standardize with DHMS P1.24).
	7	3.5.2 Flexural test: Specimen size changed to 3" x1", L/d=16. (Standardize with DHMS P1.24)
	11	Table 4: Climbing Drum Peel Torque value To Be Determine.
	15	Figure 6. Clarified Vent vacuum only when curing Laminates.
	17	Table 6. Climbing Drum Peel test only parallel to ribbon, both tool side and bag side.
H Amd. 1	7 10, Table 3	Specified apply load at the toolside for Flex and Short Beam Shear testing. Requirement for Short Beam Shear changed.

REVISION RECORD

Issue	Page	Description and Reason for Change
H	7	Specified Flex test with support span of 2", load span of 0.67"
Amd.2		Shear test with crosshead speed of 0.05"/min and support span of
		0.5" for specimen thickness up to 0.130"
		0.65" for specimen thickness greater than 0.130"
Amd. 3	3	Changed ASTM D790 to ASTM D6272
	5	Replaced Al foil with 2 plies of perforated release film for Resin Flow Test of Type 3.
	7	Changed ASTM D790 to ASTM D6272
	11	Changed peel torque requirement for Class 2, Type 3. Changed sandwich panel lay up - warp face against core instead of fill face.
	QPL	Added JD Lincoln
Amd. 4	5	Clarified Flow test method.
	11	Revised para. 3.6.1, 3.6.2 and Table 4 to specified the requirement values is average,and removed the word "individual".
I		Not used.
J	All	This is a complete revised issue. Detailed changes have not been noted.
		Updated Resin content test method.
K		This is a complete revised issue.
	6	Reword Tack Test
	7	Width dimension Was: -0.25", + 0.5", Now: ± 0.5"
	7, 10	Updated section 3.5, specified 60% max relative humidity. Condition of test specimens Was: "40hrs, Now: "24 hrs"
		Clarified Flex test is 4 point bend.
		Five specimens are required for each test, not 3 sets of five.
	11,16,17	Reword section 3.7, 4, 5,6 standardize with other specs.

REVISION RECORD

Issue	Page	Description and Reason for Change
K	18	Table 6 , Clarified batch acceptance test requirements for supplier and user/ purchaser.
	22, 23	QPL, Added Cytec Winona site Removed Hexel product R2602/285 as product no longer available.
Amd. 1	19	Table 6 note, Clarified peel test is applicable to Class 2 Type 3 only.
Amd. 2	21	8.2.1 Clarified the non-adherent film on the outside .
L		
	4	3.3 Defect: Max defect allowable 5%. 3.4.2 Working Life: Maximum humidity of 60% 3.4.3 Formability: Clarified temperature and humidity
	6	3.4.8 Tack: Maximum humidity 60% 3.4.10 Marking: Added example of marking
	7	3.4.12 Reword Workmanship
	10	Table 3 Specified test within an hour of conditioning
	18	Table 6, Revised acceptance test requirements for both Supplier and Purchaser/User.
	23	QPL: Cytec name changed to Cytec Solvay Group

REVISION RECORD

Issue	Page	Description and Reason for Change
M	2	Table 1: Resin content Was: "47-55%", Now: "46-54%"
	4	3.4.3 Formability: Clarified temperature, form over radius of 0.15"-0.25"
		Table 2: Fabric weight, Was: "5.0± 0.30", Now: "4.79-5.4"
	4,5	3.4.4 Volatile: Specified drying time 8-15 minutes.
	5	3.4.5 Resin Content: Added alternative dry temperature of 240 F for 5 min.
	6	3.4.8 Tack: Specified temperature range 65-80 F.
	7	3.6.2 Flex Test: Clarified the use of 0.25" diameter rod for load and support
	10	Table 3: Changed ASTM Ref of Flex test: Was: "ASTM D790", Now: "ASTM D6272 "
		Updated mechanical properties.
	11	4.1 Test laminate size , typically 18" warp X 12" fill. Other size can be used .
	19	Table 6: Note 3 clarified that for all mechanical acceptance test, condition1 testing is required.
	23	QPL: Removed Costa Mesa site, L730HT-285K product.
		Added Cytec Solvay product Cycom 985 K285 , noted that tack is classified as Medium to Heavy by Cytec.
Amd. 1	13	Figure 3, Revised sandwich panel layup with fill face against the core.

1 SCOPE

This specification establishes the requirements for a 350° F cure epoxy resin impregnated, aramid fabric/unidirectional tape, supplied in a "B" stage condition, suitable for autoclave pressure laminating of exterior composite panels.

1.1 Classification

The materials supplied to this specification shall be furnished in the following Classes and Types:

Class 1 - Non self-bonding, requiring an approved film adhesive for use with honeycomb core material.

Class 2 - Self-bonding, not requiring the use of film adhesive for use with honeycomb cores.

Table 1:

Type	Style	Resin Content	Cured Ply Thickness (nominal)
3	285	46 - 54%	0.011"
6	Unidirectional Tape (4560 Denier)	37 - 43%	0.010"

2 APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein. In the event of conflicting requirements between this and the specifications listed below, the requirements of this specification shall govern. Where a specific issue of a document is not specified, the current issue shall be used.

2.1 U.S. Government Specifications

2.1.1 Federal Aviation Administration

Advisory Circular No: 21-26 - Quality Control for the Manufacture of Composite Structures

2.1.2 Military Specifications

MIL-STD-401 - Sandwich Constructions and Core Materials; General Test Methods

2.1.3 American National Standard Institute

ANSI B46.1-78 - Surface Texture

2.2 American Society for Testing & Materials

ASTM C297 - Tension Test of Flat Sandwich Construction in Flatwise Plane

ASTM D6272	-	Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials by Four-Point Bending
ASTM D1781	-	Climbing Drum Peel Test for Adhesives
ASTM D2344	-	Apparent Horizontal Shear Strength of Reinforced Plastics by Short Beam Method
ASTM D3039	-	Test Method for Tensile Properties of Polymer Matrix Composite Materials
ASTM D3410	-	Compressive Properties of Unidirectional or Crossply Fiber Resin Composites

2.3 de Havilland Specifications & Standards

DHMS A6.08	-	Epoxy Adhesive Film for Composites
DHMS P1.26	-	Core, Honeycomb, Fibrous Aramid Base, Phenolic Coated
DSC 234	-	Composite Manufacture Expendable Materials

2.4 Boeing Material Specifications

BMS 3 - 11	-	Hydraulic Fluid, Fire Resistant

2.5 Aerospace Material Specifications

AMS 3901	-	Organic Fiber, Yarn and Roving, High Modulus for Structural Composites
AMS 3902	-	Cloth, Organic Fiber, High Modulus, For Structural Composites
AMS 3903	-	Cloth, Organic Fiber, High Modulus, Epoxy Resin Impregnated

3 REQUIREMENTS

3.1 Fabric/Unidirectional Tape

The aramid fiber fabric, Type 3 shall meet all the requirements of AMS 3902. See **Table 2** for the make-up of fabric.

The filaments used in the fabrication of the Type 6 material shall meet the requirements of AMS 3901.

3.1.1 Ends - The fabric shall not contain any unspliced yarns or tow ends.

3.1.2 Fabric/Unidirectional Tape, Unimpregnated Weight - The basic weight of the fabric/unidirectional tape shall meet the requirements given in **Table 2**. For acceptance test, the weight of the fabric/ unidirectional tape shall be determined as per **Para.3.4.5**.

Table 2: Unimpregnated Fabric/Tape

Type	Style	Construction Ends/ Inch (Denier)	Weave	Basic Weight oz/sq.yd.	Thickness Inches (Nominal)
3	285	17(1140) x 17(1140)	Crowfoot	4.79-5.4	0.010"
6	Unidirectional Tape	4560 Denier	Unidirectional Tape	7.0 ± 0.35	0.010"

3.2 Preimpregnated, Aramid Fiber Fabric/Unidirectional Tape

The product shall be the fabric/unidirectional tape noted in Para.3.1 of this specification, impregnated with an epoxy resin system, supplied in the "B" stage condition, and shall be formulated to meet the requirements specified herein.

3.3 Defects

Materials may not contain defects in excess of totalling more than 5% of the area of the complete roll. Defects shall be flagged by placing a strip of polyethylene backing, or other identifying material, at the location of the defect and extending it out to one or both ends of the roll. Additional material may be added to the roll to compensate for all defect areas occurring in the roll or the supplier will deduct the defect length from the roll length sold to the customer. Compensating material shall be the full roll width for each length of affected area. Alternatively, the purchase liability shall be reduced equal to the amount of compensating material otherwise due.

3.4 Physical Properties and Test Methods of Uncured Impregnated Fabric/Unidirectional Tape

Tests shall be performed on the product as received, after warming to above the dew point prior to sampling and in accordance with the test methods specified herein.

3.4.1 Storage Life - The storage life of the prepreg shall be a minimum of 180 days from the date of shipment or 270 days from the date of manufacture, when stored at a temperature of 10°F or below.

3.4.2 Working Life - The product shall meet the requirements of this specification when tested after exposure to a temperature not greater than 77° F, with a humidity not greater than 60%, for a continuous period of up to 10 days.

3.4.3 Formability - Formability is defined as the ability of the product to be deformed or contoured over a mould during normal fabrication processes at a temperature range of 65-80°F with maximum humidity of 60% and be cured in that position. The product shall be formable over, or into, a 0.15 inch-0.25 inch radius and remain in position throughout fabrication. Heat may be applied locally to aid in achieving this requirement.

3.4.4 Volatile Content - Three 4" x 4" specimens of the uncured material shall be weighed individually on an analytical balance to the nearest 10 mg and placed in an air circulating type oven at 325° ± 10° F for

8-15 minutes. The specimens shall be removed from the oven, placed in a desiccator, cooled to room temperature and reweighed, in order to calculate the volatile content.

Volatile Content, % by weight = $\frac{W1 - W2}{W1} \times 100$

W1 = Original Weight

W2 = Weight After Heating Cycle

The volatile content, by weight, shall not be greater than 2%.

3.4.5 Resin Content by Weight/ Fabric Weight - The resin content by weight shall be calculated and recorded and shall meet the requirements of **Table 1**. Three specimens, approximately 4" x 4" each, shall be cut from the roll so that one sample comes from the centre of the width and the other two from the edges.

Note: volatile content must be performed on different samples.

The three samples shall be individually weighed on an analytical balance and weights recorded to the nearest 10 mg. Completely submerge the three samples in separate beakers containing a minimum of 50 ml Methyl Ethyl Ketone, Acetone, or Methylene Chloride for at least 5 minutes. Decant the solvent, being careful to retain all fibers and replace with clean solvent. Continue to extract and decant the sample for a minimum of 3 extractions, until all traces of resin have been removed. Dry the fibers at 210° ± 10° F for 15 minutes. Alternatively, dry the fibers at 240° ± 10° F for 5 minutes mininum.The specimens shall then be cooled to room temperature in a desiccator, reweighed, and the resin content /fabric weight calculated as follows:

Resin Content, % by weight = $\frac{W1 - W2}{W1} \times 100$

Fabric Weight = *W2*

W1 = Original Weight

W2 = Weight After Extraction

3.4.6 Resin Flow by Weight -

(Type 3)

Three specimens, 4" x 4" x 4 plies each, of the uncured material shall be laid up cross plied (90° to each other) and weighed on an analytical balance to the nearest 10 mg. The specimens shall be positioned between aluminum foil (maximum thickness 0.020") coated with release agent or non-perforated release film A4000 and placed individually in a press, preheated to 325° ± 10° F at 50 ± 5 psi pressure and cured for 15 minutes. The film shall be removed, the flash broken off, each specimen individually reweighed to the nearest 10 mg, and the percent flow calculated.

(Type 6)

Three specimens, 4" x 4" x 4 plies of the uncured material each, shall be laid up cross plied (90° to each other) and weighed on an analytical balance to the nearest 10 mg. The specimens shall be positioned between two plies of porous teflon coated glass (Release Ease 234TFP or equivalent). Three plies of 1581 or 181 style glass fibre and aluminum foil (maximum thickness 0.020")shall be placed on both sides. The entire lay-up should be placed individually in a press, preheated to 325° ± 10° F at 50 ± 5 psi and cured for 15 minutes. The foil, glass fibre, and porous teflon shall be removed, the flash

removed, if any, and each specimen individually reweighed to the nearest 10 mg, and the percent flow calculated.

The resin flow shall be as specified on the Qualified Products List of this specification.

3.4.7 Gel Time

Method 1

Three specimens, each being approximately 1/4" square, shall be cut from the uncured material. A hot plate shall be preheated to 325° ± 10° F, unless otherwise specified, and a micro cover glass placed on the hot plate, allowing a minimum of 20 seconds for it to reach equilibrium. One specimen shall be placed at the centre of the micro cover glass and timing shall be commenced. Within 5 seconds, a second micro cover glass shall be placed over the specimen. When the resin softens during the first 30 seconds, the top micro cover glass shall be probed to isolate a drop of resin. The fluidity and colour of the isolated drop shall be observed periodically at first, and continuously as the end point approaches. The lateral spreading movement of the resin, upon probing, will decrease and the colour will change as the gel point approaches. The timer shall be stopped at the first indication of resin immobility and the elapsed time to the nearest minute shall be recorded.

Method 2

Apparatus:

1. Fisher-Johns melting point apparatus
2. Thickness No.2 18 mm cover glasses
3. Timer or stopwatch
4. Wooden picks or equivalent.

Procedure:

1. Preset the Fisher-Johns melting point apparatus to read 325° ± 10° F of the specified temperature.
2. Insert a 1/4'1 x 1/4" sample between 2 cover glasses and place on the Fisher-Johns apparatus.
3. Start the timer and probe the specimen with a wooden pick.
4. When resin gels (this is usually evident when no resin movement is seen when moderate pressure is applied to the specimen), stop the timer and report the gel time to the nearest 0.1 minute.

The product shall have a gel time at 325° F, as shown on the Qualified Products List of this specification, unless otherwise specified.

3.4.8 Tack - The product shall exhibit a degree of tackiness to enable easy handling during normal fabrication processes at a temperature range of 65- 80°F, with a humidity not greater than 60% anytime during the defined shelf life. Both sides of the fabric shall exhibit a degree of tackiness so that the fabric, when folded 180°, will adhere lightly to itself. It shall also be capable of being removed, after light hand pressure during lay-up, without disturbing the previously positioned mating ply.

3.4.9 Colour - For all products, the material shall be supplied in the natural colour of the resin fiber system.

3.4.10 Marking - The warp direction of the woven impregnated fabric shall be marked in a manner that is acceptable to Materials Technology,de Havilland. The warp face of the impregnated fabric shall be against the separator film.Acceptable methods include but are not limited to ink arrows, ink lines,

incorporated tracer yarns.

3.4.11 Dimensions

Width - Unless otherwise specified, the overall width of the product, shall be 38" or 50" inclusive of the selvedge for Type 3. Width tolerance shall be ±0.50 inch. Type 6 material shall be 12" wide, with a tolerance of ± 0.25".

Length - Unless otherwise specified, the overall length of the product, shall be 25 ± 1 yard, 50, 100 or 150 yards ± 5 yards.

3.4.12 Workmanship - The impregnated aramid fabric and tape shall be evenly impregnated, uniform in quality, and free from gaps, holes, resin pockets, cured resin particles, foreign materials, creases and other similar defects which would render the product unsuitable for its intended purpose.

3.4.13 Bias or Bowed Filling - The filling strands of Type 3 shall not be distorted from the horizontal by more than 3 inches for 38 inch widths and proportionally for all other widths.

3.5 Properties and Test Methods of Cured Impregnated Fabric

Unless otherwise specified, tests shall be conducted at 70°F ± 10°F and a relative humidity of maximum 60%. Specimens tested at room temperature shall be conditioned for a minimum of 24 hours at 70 ± 10°F and maximum 60% relative humidity immediately prior to the test At least five specimens shall be used per test , and the results averaged. All test pieces shall be cut with the longer dimension parallel to the warp direction of the fabric unless noted otherwise.

3.6 Laminate Mechanical Properties

3.6.1 Tensile Tests - The ultimate tensile strength and the tensile modulus of each specimen shall be calculated and recorded and shall be not less than values given in **Table 3**. For Type 3, five tensile test specimens shall be tested in accordance with ASTM D3039 with a cross head speed of 0.05"/ minute, except that the specimens shall conform to **Figure 1**. For Type 6, five tensile test specimens shall be tested in accordance with ASTM D3039.

3.6.2 Flexural Tests - The flexural strength (modulus of rupture) and flexural modulus (tangent modulus of elasticity) shall be calculated and recorded and shall be not less than the values given in **Table 3**. Five flexural specimens, 3" warp x 1" fill, with the long dimension parallel to the warp direction shall be conditioned as specified in **Table 3** and shall be tested in accordance with ASTM D6272, 4pt. bend and test with a crosshead speed of 0.06"/minute, support span of 2", load span of 0.67". Load/support diameter rods of 0.25 inch shall be used.Test with load applied at the tool side (smooth side) of the specimen.

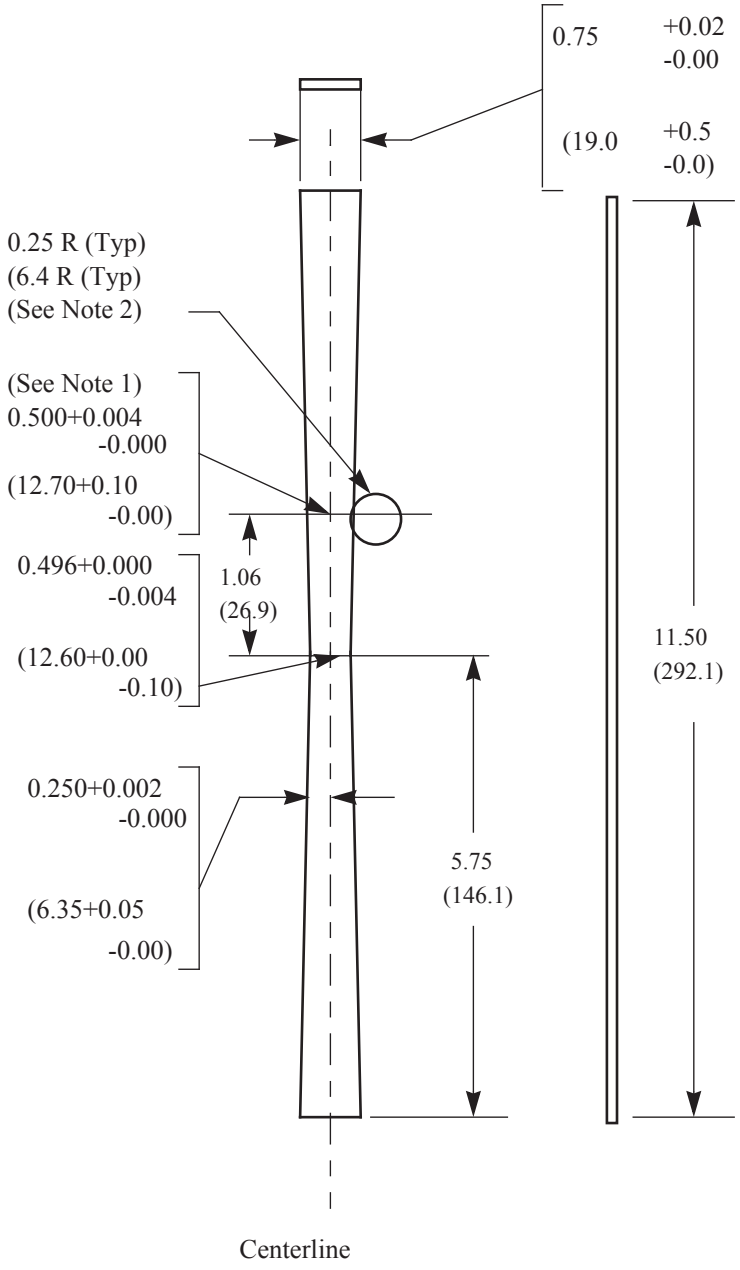
3.6.3 Compressive Tests - The ultimate compressive strength of each specimen shall be not less than the value given in **Table 3**. Five specimens conform to **Figure 2** shall be conditioned as specified in **Table 3** and shall be tested in accordance with ASTM D3410.

3.6.4 Horizontal Shear Strength Test - The Horizontal Shear strength shall be calculated and recorded and shall be not less than the value given in **Table 3**. Five test specimens 1.125" long (parallel to fill) by 0.25" wide (parallel to warp), for Type 3 material, for Type 6 material the fibre direction must be in the 1.125" long direction; shall be conditioned as specified in **Table 3** and shall be tested in according to ASTM D2344 with a crosshead speed of 0.05"/minute and a support span as follows:

0.50"- for specimen thicknesses up to 0.130";

0.65" - for specimen thicknesses greater than 0.130".

Test with load applied at the tool side (smooth side) of the specimens.



Dimensions are in inches (milli meters)

Notes:
1. The width outward from 0.496 (12.60) shall be increased gradually and equally on each side up to 0.500 (12.70) so that no abrupt change in dimensions results.

2. Transition from straight sided center section to tapered section shall be smoothly joined in the area of the 0.250 (6.35) rad.

3. Test at crosshead speed of 0.15”/min.

FIGURE 1. TENSILE STRENGTH SPECIMEN

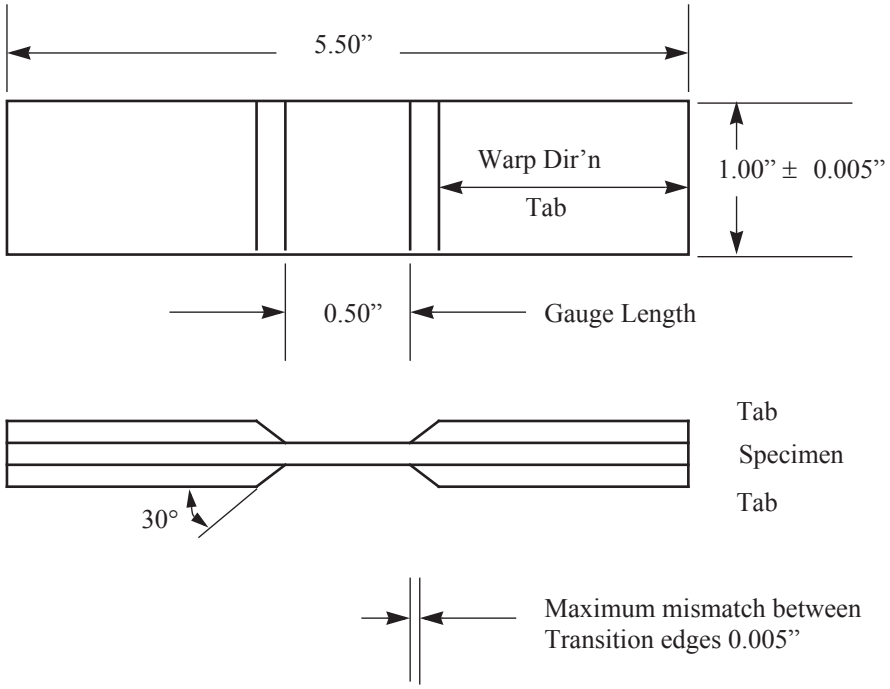


FIGURE 2. COMPRESSIVE TEST SPECIMEN

Notes:

1. Specimen thickness shall be 10 plies.
2. Tabs to be manufactured from 10 plies DHMS P1.22 Type 1 glass fabric and cured at 260° ± 10° F, 35 ± 5 psi for one hour.
3. Use Frekote 44NC or 700NC on caul plate (0.032 - 0.060 thick) on upper surface. Do not use Tooltec.
4. Tab face which is to be bonded to specimen shall be cured with peel ply to DSC-234 12 to provide adequate bond surface.
5. Tab thickness is 0.100 ± 0.010" but all 4 tabs on a specimen must be within 0.002" of each other.
6. Maximum mismatch between tab transition edges is 0.005".
7. Tab lay up may be done in panels and cut to size; no tab may be cut from material within 1/2 inch of the edge of the panel. Bond surface is surface which was cured with peel ply on it.
8. Bond tabs to specimen using 3M, 2 part adhesive EC 2216 or DHMS A6.09 liquid shim. Lightly abrade specimen surface (320 grit abrasive) only where tabs are to be bonded on. Use a fixture to maintain warp direction of tab during lay up. Peel ply must be removed from tab before bonding commences. Wipe bond surfaces with MEK immediately before bonding.
9. 125√ edge finish is required in accordance with ANSI B46.1-78.

Table 3: Laminate Mechanical Properties

Tests	Reference	Minimum Average Values (psi)	
		Type 3	Type 6
Tensile Strength at RT	ASTM D3039		
Condition 1		50 000	140 000
Condition 2		50 000	133 000
Condition 3		50 000	126 000
Tensile Modulus at RT Condition 1 Condition 2 Condition 3	ASTM D3039	3.0×10^6	7.8×10^6
Tensile Strength at 300°F	ASTM D3039	50 000	140 000
Tensile Modulus at 300°F	ASTM D3039	3.0×10^6	7.8×10^6
Flexural Strength at RT	ASTM D6272		
Condition 1		40 000	72 500
Condition 2		38 000	68 900
Condition 3		36 000	65 250
Flexural Modulus at RT Condition 1 Condition 2 Condition 3	ASTM D6272	3.0×10^6	N/A
Flexural Strength at 300°F	ASTM D6272	24 000	43 500
Flexural Modulus at 300°F	ASTM D6272	3.0×10^6	N/A
Compressive Strength at RT	ASTM D3410		
Condition 1		20 000	20 000
Condition 2		18 000	18 000
Condition 3		18 000	18 000
Compressive Modulus at RT Condition 1 Condition 2 Condition 3	ASTM D3410	3.0×10^6	N/A
Compressive Strength at 300°F	ASTM D3410	10,000	N/A

Table 3: Laminate Mechanical Properties

Tests	Reference	Minimum Average Values (psi)	
		Type 3	Type 6
Compressive Modulus at 300°F	ASTM D3410	2.0×10^6	N/A
Short Beam Shear Strength	ASTM D2344		
Condition 1		4 000	7 500
Condition 2		3 600	6 000
Condition 3		3 600	5 600

Condition 1 - Conditioned at 70°± 5°F,60% maximum relative humidity for a minimum of 24 hrs. Test specimens at room temperature.

Condition 2 - Conditioned at 170°± 5°F, 98± 5% relative humidity until a moisture content level of 3-5% by weight (relative to the condition 1 specimens) has been achieved. Test specimens at room temperature within an hour after conditioning.

Condition 3 - Immersed specimens in BMS 3-11 Type IV, Class 1, Grade A fluid at 160° ± 5°F for 7 days. Tested specimens at room temperature within an hour after conditioning.

3.7 Sandwich Mechanical Properties

3.7.1 Flatwise Tensile - Five specimens, each 2" x 2", shall be tested in accordance with ASTM C297. The Tensile strength shall be calculated and recorded and shall be not less than the value given in Table 4.

3.7.2 Peel Torque - Five specimens for each configuration 3" x 12", shall be tested in accordance with ASTM D1781. The Peel Torque shall be calculated and recorded and shall be not less than the value given in Table 4.

Table 4: Sandwich Mechanical Properties

Test	Reference	Minimum Average Values	
		Class 1	Class 2
Flatwise Tensile	ASTM C297	300 psi	300 psi
Climbing Drum Peel Torque (Type 3)	ASTM D1781	30 in.lb/3 in. width	20 in.lb/3 in. width

Note: Peel strength test panels shall be laid up with the fabric warp face against the core. Peel strength testing shall be performed on both tool side and bag side surfaces, tested parallel and transverse to the warp direction.

4 TEST PANEL FABRICATION

4.1 Laminate Specimen

Test laminate typically 18" warp x 12" fill shall be laid up with number of plies specified in Table 5 with the long dimension parallel to the fiber direction or warp direction. Laminate shall be vacuum bagged per the applicable Figure 4 and Figure 5 and cured per Figure 6.

Table 5: Test Panel Layup

Test Specimen	# of Plies for Type 3	# of Plies for Type 6
Flexural	10	10
Horizontal Shear	10	10
Tensile	10	6
Compression	10	10

4.2 Sandwich Panel

Test panel 32" warp x 36" fill shall be laid up according to Figure 3, vacuum bag per Figure 4 and Figure 5 and cured per Figure 6.

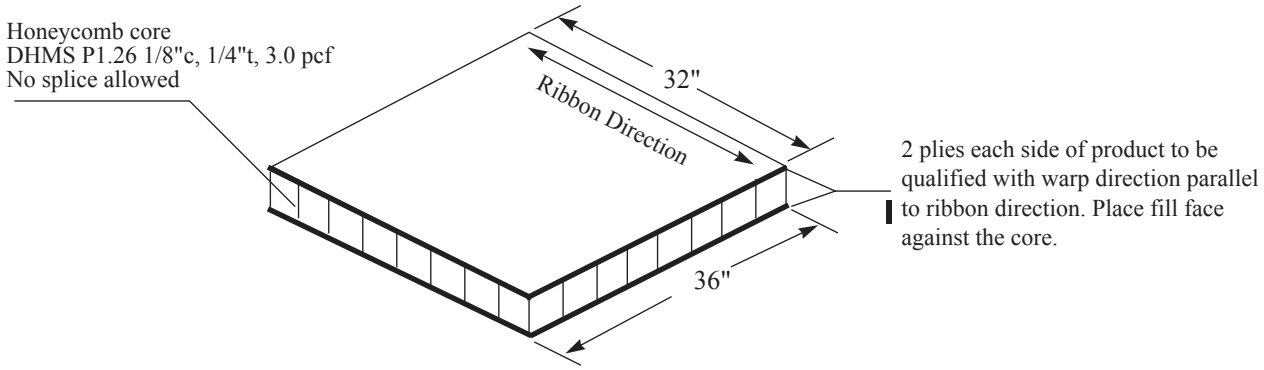
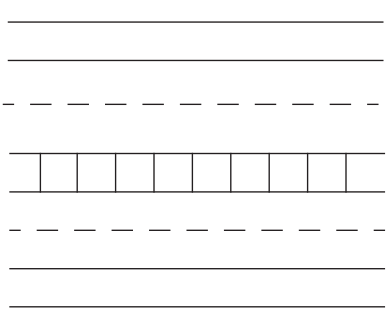


FIGURE 3. Sandwich Test Panel

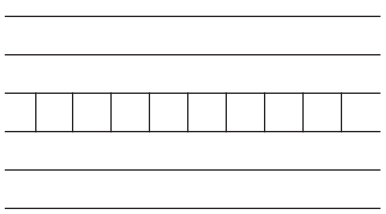
4.3 Sandwich Panel Construction

Class 1

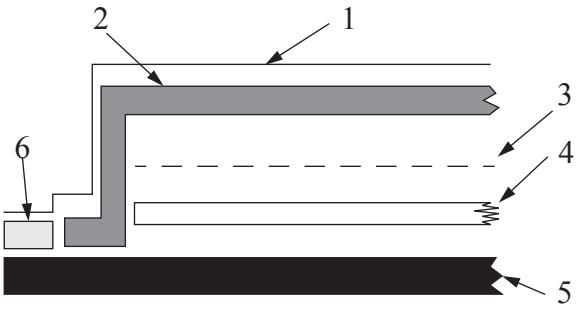


DHMS P1.39 Type 3
DHMS P1.39 Type 3
DHMS A6.08 Class 2 Type 2
DHMS P1.26 1/4"t, 1/8"c, 3.0 pcf
DHMS A6.08 Class 2 Type 2
DHMS P1.39 Type 3
DHMS P1.39 Type 3

Class 2



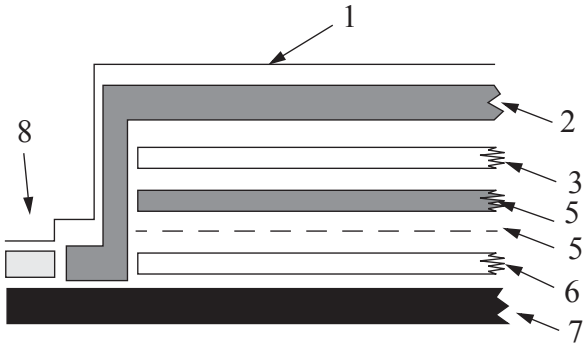
DHMS P1.39 Type 3
DHMS P1.39 Type 3
DHMS P1.26 1/4"t, 1/8"c, 3.0 pcf
DHMS P1.39 Type 3
DHMS P1.39 Type 3



Use DSC 234 expendable materials

1. Nylon Vacuum Bag
2. Airweave SS-FR Breather
3. Perforated Release Film A4000P3
4. PART
5. Tool (coated with mould release Frekote 44 NC or 700NC)
6. GS 43 MR Vacuum Sealant Tape

FIGURE 4. BAGGING PROCEDURE FOR TYPE 3 LAMINATE AND SANDWICH PANELS



Use DSC 234 expendable materials

1. Nylon Vacuum Bag
2. Airweave SS-FR Breather
3. Intensifier (0.32" to 0.060" Al. Plate coated with mould release Frekote 44 NC or 700NC)
4. Airweave SS-FR Breather
5. Perforated Release Film A4000P3
6. PART
7. Tool (coated with mould release Frekote 44 NC or 700NC)
8. GS 43 MR Vacuum Sealant Tape

FIGURE 5. BAGGING PROCEDURE FOR TYPE 6 LAMINATE

APPROVED EXPENDABLE MATERIALS TO DSC 234

Wrightlon 8400	(DSC 234-2-54)	Airtech International Inc., 2542 East Del Amo Blvd.,
Perforated Release Film A4000P3	(DSC 234-5-48)	P.O. Box 6207 Carson, CA 90749
Airweave SS-FR Breather	(DSC 234-11)	(213) 603-9683
Mould Release, Frekote 44NC or 700NC	(DSC 234-13)	Frekote Inc., 170 W. Spanish River Blvd.,
Vacuum Sealant Tape, GS-43MR	(DSC 234-17-1)	Boca Raton, FL 33431 (305) 395-3082

NOTE: Additional sources are listed in DSC 234.

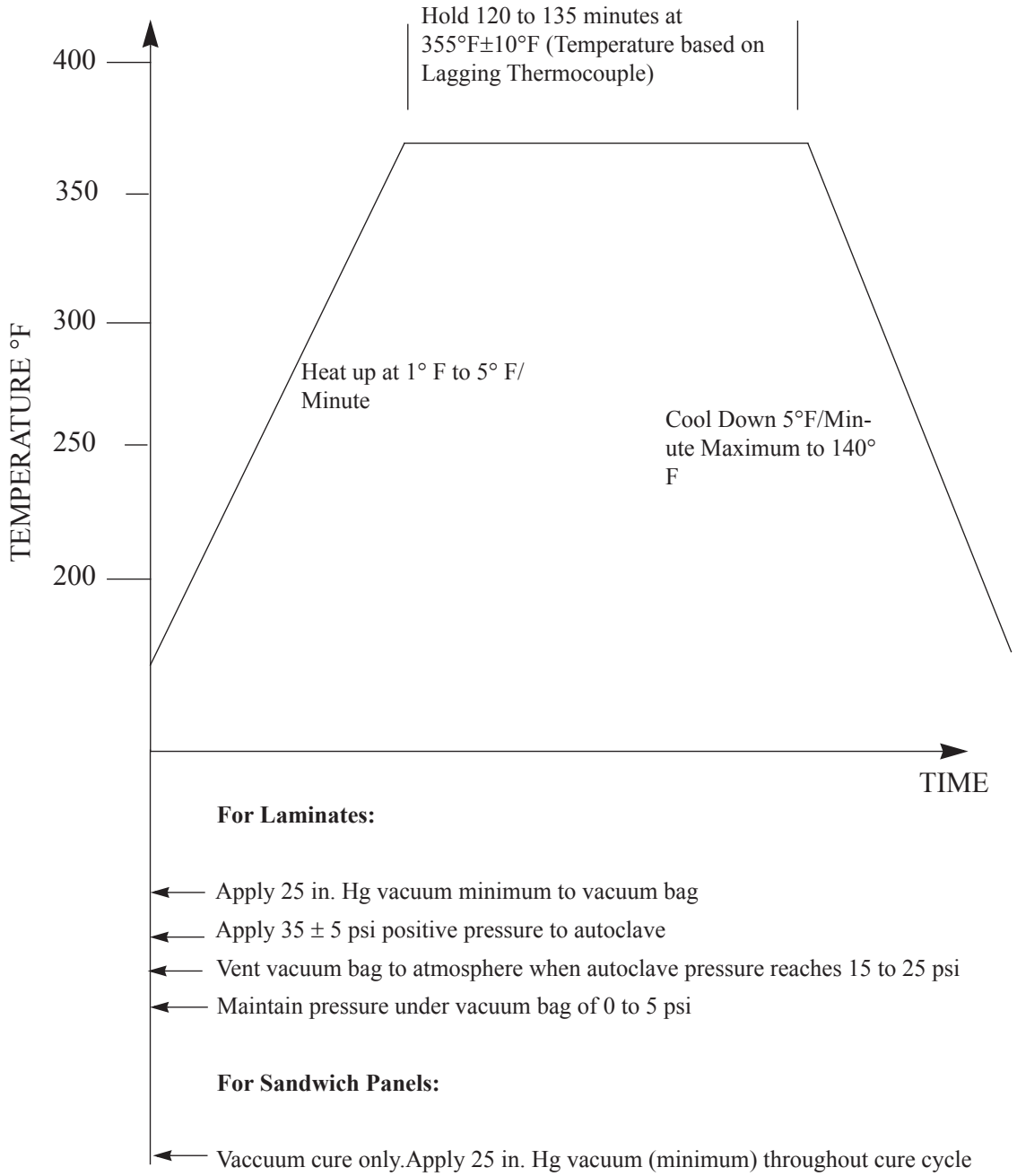


FIGURE 6. Cure Cycle

5 MATERIAL QUALIFICATION REQUIREMENTS

5.1 Request For Qualification

All requests for qualification to this specification shall be addressed to Bombardier Aerospace Materials Technology Engineering department for approval.

All material qualification shall be site specific.

An audit of the manufacturers and/or test facilities by Materials Technology Engineering may be necessary prior to approval.

5.2 Qualification testing

Potential suppliers shall submit a written qualification test report based on 3 batches/lots of materials showing compliance with the requirements contained in section 3. The test report shall contain actual numerical test values, average test results as well as failure modes where applicable.

5.2.1 A sample shall be submitted for testing at the discretion of Bombardier Aerospace Materials Technology for evaluation.

5.3 Qualification by Similarity

Where a product has been qualified to another similar specification, the supplier may submit the qualification data applicable to this specification for consideration. The similar specification may be a government, company, or other aerospace specifications where the requirements are similar to this specification.

5.4 Process Control Document

5.4.1 The manufacturer shall develop and maintain a Process Control Document (PCD).

5.4.2 The PCD shall define the manufacturing and quality control requirements and procedures for assuring consistent, uniform and compliant products. The PCD shall identify baseline chemical constituents, in-process test procedures and requirements, and manufacturing procedures. All specifications and test procedures employed during the process shall also be listed and issue/date controlled.

5.4.3 When qualification has been granted, the PCD shall be signed by the supplier and Bombardier Aerospace Materials Technology Engineering and shall not be changed without prior written approval.

5.4.4 The PCD and all production data shall be available to Bombardier Aerospace auditors when requested.

5.5 Qualification Approval

5.5.1 Upon review of supplier's data, PCD and de Havilland tests, the supplier will be advised either of product qualification or reasons for not qualifying the product.Products that are qualified will be listed in the Qualified Products List of this specification.

5.5.2 No changes in the method of manufacture and/or formulation, shall be made without notification and prior written approval of Materials Technology Department.

5.5.3 Re-qualification of the product may be requested by the Bombardier Materials Technology if there are any changes in the method of manufacture and/or formulation.

6 QUALITY ASSURANCE REQUIREMENTS

6.1 Manufacturer/Supplier Batch/Lot Acceptance Tests

6.1.1 The manufacturer/supplier is responsible for the performance of all sampling, inspection and testing of each batch/lot as specified in **Table 6.**

6.1.2 The manufacturer/supplier shall issue with each batch of product one copy of an Acceptance Test report showing actual test data conformance to the acceptance tests specified in **Table 6** The report shall include the supplier's batch identification, materials specification and date of testing.

6.1.3 Bombardier Aerospace Materials Technology Engineering reserves the right to perform any or all of the tests set forth in this specification to ensure that the product continues to meet specification requirements. Any product not meeting the requirements of this specification will be returned to the supplier at the supplier's expense.

6.1.4 The manufacturer/supplier shall certify with a Certificate Conformance that each batch of each shipment meets the requirements of this specification

6.2 Purchaser/User Batch/Lot acceptance tests

6.2.1 The purchaser/user is required to perform of all sampling, inspection and testing of each batch/lot as specified in **Table 6.**

TABLE 6. Qualification and Batch Acceptance Tests

Property	Requirement	Qualification (Manfacturer/ Supplier)	Acceptance	
			Manufacturer/ Supplier	Purchaser/User
Fabric Weight	Para.3.4.5	x	x	
Storage Life	Para.3.4.1	x		
Working Life	Para.3.4.2	x		
Formability	Para.3.4.3	x	x	
Volatile Content	Para.3.4.4	x	x	
Resin Content	Para.3.4.5	x	x	x
Resin Flow	Para.3.4.6	x	x	x
Gel Time	Para.3.4.7	x	x	x
Tack	Para.3.4.8	x	x	x
Colour	Para.3.4.9	x		
Dimensions	Para.3.4.10	x		
Workmanship	Para.3.4.12	x	x	
Bias or Bowed Filling	Para.3.4.13	x		
Cure Cycle	Figure 6	x		
Tensile Strength	Table 3	x		
Tensile Modulus	Table 3	x		
Flexural Strength at 75°F	Table 3	x	x	x
Flexural Strength at 300°F	Table 3	x		
Flexural Modulus	Table 3	x		
Compressive Strength	Table 3	x		
Horizontal Shear Strength	Table 3	x	x*	x*
Flatwise Tensile	Table 4	x		
Peel Torque	Table 4	x	x**	x**

TABLE 6. Qualification and Batch Acceptance Tests

Property	Requirement	Qualification (Manfacturer/ Supplier)	Acceptance	
			Manufacturer/ Supplier	Purchaser/User
* 1. Applicable for Type 6 and Condition 1 of Table 3 only. ** 2. Applicable for Class 2 type 3 only. For acceptance, peel testing parallel to ribbon direction on both tool side and bag side is required. 3. For all mechanical acceptance test ,test at condition 1 only: condition at 70°± 5°F, 60% max relative humidity for a minimum of 24hrs. Test specimens at room temperature.				

6.3 Sampling

6.3.1 Sampling Schedule - Sampling shall be in accordance with Table 7.

6.3.2 Batch - A batch shall be defined as a product produced in a single production run from the same lot of raw material under the same condition.

When more than one lot of aramid fibre fabric is used in production of a batch of prepreg to this specification, acceptance test shall be conducted so as to cover all lots of fabric batches utilized.

Table 7: Sampling Schedule

Number of Rolls in Batch	Frequency of Inspection
1 - 10	1 roll
11 - 39	2 rolls
40 and more	3 rolls

7 ORDERING DATA

7.1 Prerequisite

Material furnished under this specification for production use shall be qualified and listed on the Qualified Products List prior to issuing of a Purchase Order.

7.2 Procurement Documents

Procurement documents shall specify the following:

- Title, Number, Issue and Amendment Number of this Specification
- Type and Class of Pre-Impregnated Fabric
- Manufacturer's Material Designation
- Total Quantity

8 PREPARATION FOR DELIVERY

8.1 Identification

8.1.1 Each roll of impregnated fabric shall be identified with a label or marking, securely affixed to the inside of the core or with a removable tag.

8.1.2 The label or removable tag shall use characters of a size such as to be clearly legible and which will not be obliterated by normal handling. Each label or tag shall show the following information:

- Aramid Fiber Fabric, Epoxy Impregnated, 350° F Cure
- DHMS P1.39 Latest Issue & Amendment (Enter Class and Type)
- Manufacturer's Material Designation
- Purchase Order Number
- Lot and Roll Numbers
- Quantity
- Perishable - Store Below 10° F
- Date of Manufacture

8.2 Packaging

8.2.1 The impregnated fiber shall be wound on spools not less than 3 inches in hub diameter and interleaved with a non-adherent film. The non-adherent film must be on the outside to prevent penetration of moisture or loss of impregnating resin solvent.The backing type shall be that is acceptable to Materials Technology.

Winding shall be uniform and shall provide for proper unreeling. Fabric ends shall be secure.

8.2.2 Each roll shall be adequate support at both ends through the center of the core.

8.2.3 Each roll shall be sealed in a bag of suitable non-adherent material to prevent penetration of moisture or loss of impregnating resin solvent.

8.2.4 The roll shall be packed in an exterior shipping container capable of protecting the impregnated materials adequately at 10°F or lower during shipment and storage.

8.3 Shipping Documentation

8.3.1 Each shipping container shall have the exterior legibly marked with the following information in such a manner that the markings shall not smear or be obliterated during normal handling or use:

- Aramid Fiber Fabric, Epoxy Impregnated, 350° F cure
- DHMS P1.39 Latest Issue & Amendment (Enter Class and Type)
- Manufacturer's Material Designation
- Purchase Order Number
- Lot and Package Numbers
- Quantity
- Perishable - Store Below 10° F

8.3.2 Containers shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery.

8.3.3 Each shipment shall contain a copy of the Material Safety Data Sheet.

9 HEALTH AND SAFETY DATA

When supplying samples for qualification per Para.5.1, the supplier shall submit a Material Safety Data Sheet (MSDS) complying with the "Controlled Products Regulations" of the Hazardous Products Act (also known as W.H.M.I.S. Regulations). The document must state all hazardous ingredients, safe-handling procedures, first-aid measures, fire and explosion data, re-activity data, physical properties, preparation information and procedures for storage and disposal.

This (MSDS) must then be supplied with a completed DH 4339 "Application To Introduce A New Material" form to the Material Safety Committee.

Upon receipt of DH 4340 "Recommendation" form that approves the use of the material, it can then be included on the Qualified Products List.

Any changes in the formulation of the material require a re-submission of the Material Safety Data Sheet.

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MSDS #	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
Cytec Solvay 1440 N Kraemer Blvd. Anaheim, CA 92806	**Class 1, Type 3** Cycom 985 K285 50" % Resin Flow: 20-36% Gel Time: 11-21 min. Tack: Med to Heavy (or as per Purchase order) **Class 2, Type 3** N/A	SDS#00093 28	PQS#7	Aug 1, 2017