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Material Specification

TITLE:	**GLASS-GRAPHITE FABRIC, FIRE RESISTANT PHENOLIC RESIN IMPREGNATED FOR INTERIOR SANDWICH AND LAMINATE PANELS (1990 FLAMMABILITY RULE)**
SPECIFICATION NUMBER:	**DHMS P 1.59**
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Prepared by: Approved by:

SIGNED ORIGINAL ON FILE

Hai Yen Tran
Materials Technology

Emma Jane Donlin
Manager Functional Engineering &Governance

GLASS-GRAPHITE FABRIC, FIRE RESISTANT PHENOLIC RESIN IMPREGNATED FOR INTERIOR SANDWICH AND LAMINATE PANELS (1990 FLAMMABILITY RULE)

REVISION RECORD

Issue	Page	Description and Reason for Change
ORG		This is a new specification.
A	2	Para. 2.1.1 -Adm.25-61 deleted.
	4	Para. 3.0 -Amd.25-61 deleted.
		Table 2 -Construction of fabric added.
	6	Para.3.4.3.2.1 -Amd.25-61 deleted.
	11	Table 3 -Peel Torque changed from 8 to 6 in.lb/3 in. width.
		-Amd.25-61 deleted.
		Para.4.2.4.1 -Amd.25-61 deleted.
	13	Para.4.3.6.1 -Amd.26-61 deleted.
	17	Table 4 -Missing data added.
		-Amd.25-61 deleted.
	19	Para.5.1.2 -Amd.25-61 deleted.
	24	New page added for QPL.
Amd. 1	17	Table 4 -Horizontal Shear Strength changed from 6.0 to 5.0 ksi minimum.
Amd.2	2	Table 1 - Style 1080 added.
	4	Table 2 - Style 1080 added.
		Para. 3.1- Style 1080 added.
	20	Table 5 - Acceptance Test for Horizontal Shear Strength and Flexural Strength deleted.
B		This is a complete revised issue. Detail changes have not been noted.
C		This is a complete revised issue. Detail changes have not been noted.
C Amd. 1	10	Table 3: Typing mistake has been corrected. Tensile Modulus requirement is 4.4 Msi not 44.4.

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REVISION RECORD

Issue	Page	Description and Reason for Change
C Amd. 2	8	Figure 1 has been changed.
D		This is a complete revision and detailed changes have not been noted.
Amd. 1	7	Para. 3.4.6, clarified, the specimens is positioned between aluminum foil.
	14	Para. 4.3.2, correct material desingation in the flammability test specimens.
	16	Figure 5, Specified laminate panel is to be cured at 35 psi and sandwich panel is to be cured at 25 in. Hg (minimum) vacuum .
	17	Added requirement for PCD.
E	All	Updated specification format. Corrected ASTM call out for Flex and Compressive testing in table 3.
	Table 6	Clarified acceptance testing is required for both supplier and purchaser.
F	All	Updated section 5
	3	Deleted reference to ASTM E906,ASTM F814-83
	4	Table 2. Corrected Fabric Yarn construction Was: 14x14 Is: 25 x 25
	6	Para. 3.4.8, Requirement for tack Was: 10 days, Is: 5 days
	7	3.5 Conditioning of test specimen Was : 40 hrs, Is: minimum 24 hrs.
	17	Table 6. Removed requirement for Acceptance testing of Tack test.
	21	QPL, Based on Cytec SPC chart, adjusted % Flow requirement Was: 22-32%, Is: 15-27%
G	3	Revised mechanical properties requirements based on test data and fatique test resutlts.
	6	Revised definition of tack test Added Poisson ratio and Shear Modulus testing for qualification

GLASS-GRAPHITE FABRIC, FIRE RESISTANT PHENOLIC RESIN IMPREGNATED FOR INTERIOR SANDWICH AND LAMINATE PANELS (1990 FLAMMABILITY RULE)

REVISION RECORD

Issue	Page	Description and Reason for Change
H		This is a completed revised issue.
	3	2.2 : Added Reference to ASTM D2584
	4	3.4.1 : Specified store temperature Is: 10°F, Was: 0°F. Removed storing temperature of 40°F to 50°F.
	5	3.4.5 : Added Dioxalane for resin content test method. Added Alternative test method for type 1. Update calculation formulation, dry the fiber at 280F, same temperature as volatile testing.
	6	3.4.11: Revised Width and Length requirements.
	7	3.4.13: Clarified fabric distortion requirement is for type 2 fabric.
		3.5: Revised temperature for testing and conditioning
		Is: 65-80° F, Was: 70 ± 5° F
		3.5.2.3: Clarified Flex test is 4 point bending, 1/3 loading.
	9	Added note for alternative tab bonding preparation as per MT agreement.
	10	Table 3: Revised mechanical Flex, Poisson, In-plane shear properties require ments based on qualification test data.
		Table 4: Clarified test note, Is: "Ribbon", Was: "Warp".
	11	4.1, 4.2: Clarified the specimen size is typical size.
		Figure 3: Clarified 2 plies each side for sandwich panel.
	13	Figure 4: Added notes specifying use of nonperforate release film is for Cycom 799H system only.
	14	Figure 5: Added note to hold vaccuum through out cure cycle for laminate.
	17	Table 6 : Updated Table to standardize with other specs.
	18	6.3.2: Revised Batch Definition.
	21	QPL: Added new approved product Cycom 2400-1M/70G30C.

GLASS-GRAPHITE FABRIC, FIRE RESISTANT PHENOLIC RESIN IMPREGNATED FOR INTERIOR SANDWICH AND LAMINATE PANELS (1990 FLAMMABILITY RULE)

1 SCOPE

This specification establishes the requirements for a 280˚F cure phenolic resin impregnated, glass-graphite fabric, supplied in a "B" stage condition, suitable for vacuum or autoclave pressure laminating of interior composite panels.

1.1 Classification

The materials supplied to this specification shall be one of the following types:

TABLE 1. Materials

TYPE	STYLE	RESIN CONTENT	CURED PLY THICKNESS NOMINAL
1	108 or 1080	44 ± 3 %	0.002"
2	*	41 ± 3 %	0.008"

* Reference QPL for vendor designation

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

FAR 25.853(a), APP. F, PART I(a)(1)(i)-Flammability Requirements

Amd.25-86

FAR 25.853(d), APP. F, PART IV & V-Flammability Requirements

Amd.25-86

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

2.1.2 Military Specifications

MIL-Y-1140H -Yarn, Cord, Sleeving, Cloth, and Tape-Glass

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 Constructions in Flatwise Plane
ASTM C613	-	Resin Content of Carbon and Graphite Prepregs by Solvent Extraction
ASTM 3410	-	Compressive Properties of Unidirectional or Crossply Fiber - Resin Composites
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 D2584	-	Ignition Loss of Cured Reinforced Resin.
ASTM D3039	-	Tensile Properties of Oriented Fiber Composites
ASTM D3518	-	Standard Test Method for In-Plane shear Response of Polymer Matrix Composite Materials by Tensile Test of a $\pm 0.45^{o}$ Laminate.

2.3 de Havilland Specifications & Standards

DHMS P1.26	-	Core, Honeycomb, Fibrous Aramid Base, Phenolic Coated
DHMS A6.09	-	High Temperature Epoxy Adhesive/Liquid Shim Material
DSC 234	-	Composite Manufacture Expendable Materials

2.4 Boeing Specification Support Standards

BSS 7239	-	Toxic Gas Generation by Materials on Combustion, Test Method For

3 REQUIREMENTS

Prior to procurement, for applications requiring OSU heat release and NBS smoke density attributes, materials shall demonstrate compliance to FAR 25.853(d), APP. F, PART IV & V, Amd.25-86. This compliance data shall be consistent with similar data from previously procured materials.

3.1 Fabric

The Style 108 glass fabric shall meet the requirements of MIL-Y-1140H, Form 4, Class 2, Fabric No. 108.

3.1.1 Ends

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

3.1.2 Fabric Weight

The basic weight of the fabric shall meet the requirements given in **Table 2**. For acceptance test, the weight of the fabric shall be determined in accordance with ASTM C613.

TABLE 2. Unimpregnated Fabric

Type	Style	Construction Ends/Inch (Denier)	Weave	Basic Weight oz/ sq.yd.
1	108 or 1080	60 x 47	Plain	1.50 ± 0.30
2	*	25 x 25		5.10 ± 0.30

* Reference QPL for vendor designation

3.2 Preimpregnated, Glass-Graphite Fiber Fabric

The product shall be one of the fabrics noted in **Table 2** of this specification, impregnated with a phenolic 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 the following limits: defects in excess of one in any 5 linear yards of materials or 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 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 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 of Uncured Impregnated Fabric

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 product shall be a minimum of 180 days from the date of receipt, up to 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 50%, 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 and be cured in that position. The product shall be formable over, or into, a 0.15" minimum 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 280˚F ± 10˚F for 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 as follows:

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

W_1 = Original Weight

W_2 = Weight After Heating Cycle

The volatile content, by weight, shall not be greater than 10% for Types 1 and 2.

3.4.5 Resin Content By Weight

The dry resin content (volatile excluded) when tested in accordance with ASTM C613 shall meet the requirements of **Table 1**. Three specimens approximately 4 x 4 in. (100 sq. cm.) 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.

The three samples shall be individually weighed on an analytical balance and weights recorded to the nearest 10 mg. Extract the three samples in separate beakers containing 500 ml of Methyl Ethyl Ketone, or Dioxalane for at least 15 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. Dry the fibers at $280^{o} \pm 10^{o}$ F for 15 minutes. The specimens shall then be cooled to room temperature in a desiccator, reweighed, and the resin content weight calculated as follows:

$$\text{Resin Content, \% by weight} = \frac{(W1 - W0) - W2}{W1 - Wo} \times 100$$

W_1 = Wet sample areal weight

W_2 = Dry fiber areal weight after extraction

W_0 = Volatile content by weight

Altenatively, type 1 material can be tested to the requirements of ASTM D2584 .

3.4.6 Resin Flow by Weight (Types 1 & 2)

Three specimens, each 4" x 4" x 4 plies, except for Type 1 material which shall be 8 plies thick, of the uncured material shall be weighed on an analytical balance to the nearest 10 mg. The specimens shall be positioned between 0.0015" aluminum foil which is coated with release agent and placed individually in a press, preheated to 280˚F ± 10˚F at 50 psi ± 5 psi pressure and cured for 15 minutes. The foil shall be removed, the flash broken off, 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

3.4.7.1 Method 1

Three specimens, each being approximately 1/4" square, shall be cut from the uncured material. A hot plate shall be preheated to 280˚F ± 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.

3.4.7.2 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 280˚F ± 10˚F of the specified temperature.
2. Insert a 1/4" 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 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- 77˚F, with a humidity not greater than 70% 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.

3.4.11 Dimensions

Width

Unless otherwise specified, the overall width of the product, shall be as specified in the Qualified Products List. Width tolerance shall be +1.0" to -0.5".

Length

Unless otherwise specified by purchaser, the overall length of the roll, shall not exceed 150 yards .

3.4.12 Workmanship

The impregnated fabric shall be evenly impregnated, uniform in quality and free from gaps, holes, resin pockets, areas lacking resin, excess resin, patches 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 Types 2 fabric shall not be distorted from the horizontal by more than 5" for 50" widths.

3.5 Properties and Test Methods of Cured Impregnated Fabric

General

Unless otherwise specified, tests shall be conducted at 65-80° F and a relative humidity of maximum 60% . Specimens tested at room temperature shall be conditioned for a minimum of 24 hours at 65-80˚F and maximum 60% relative humidity immediately prior to the test. At least five specimens shall be used per test except for flammability testing which requires a minimum of three specimens, and the results averaged. No individual value shall be less than 90% of the value specified; this shall not apply to flammability tests.

Unless otherwise specified, all test pieces shall be cut with the longer dimension parallel to the warp direction of the applicable test panel.

3.5.1 Flammability Testing

Fabricate two sandwich panels in accordance with **Para.4.2**. Completed test panels shall be tested in accordance with FAR 25.853, APP. F, Part I(a)(1) (i) Amd.25-86,FAR 25.853, APP. F, Part IV Amd.25-86, and FAR 25.853, APP. F, Part V Amd.25-86. Tested panels shall exhibit a 2 minute total heat release of less than 50 kilowatt-minutes/m^2, a peak heat release rate of 50 kilowatts/m^2 and specific optical density of less than 100DS.

3.5.2 Laminate Mechanical Properties

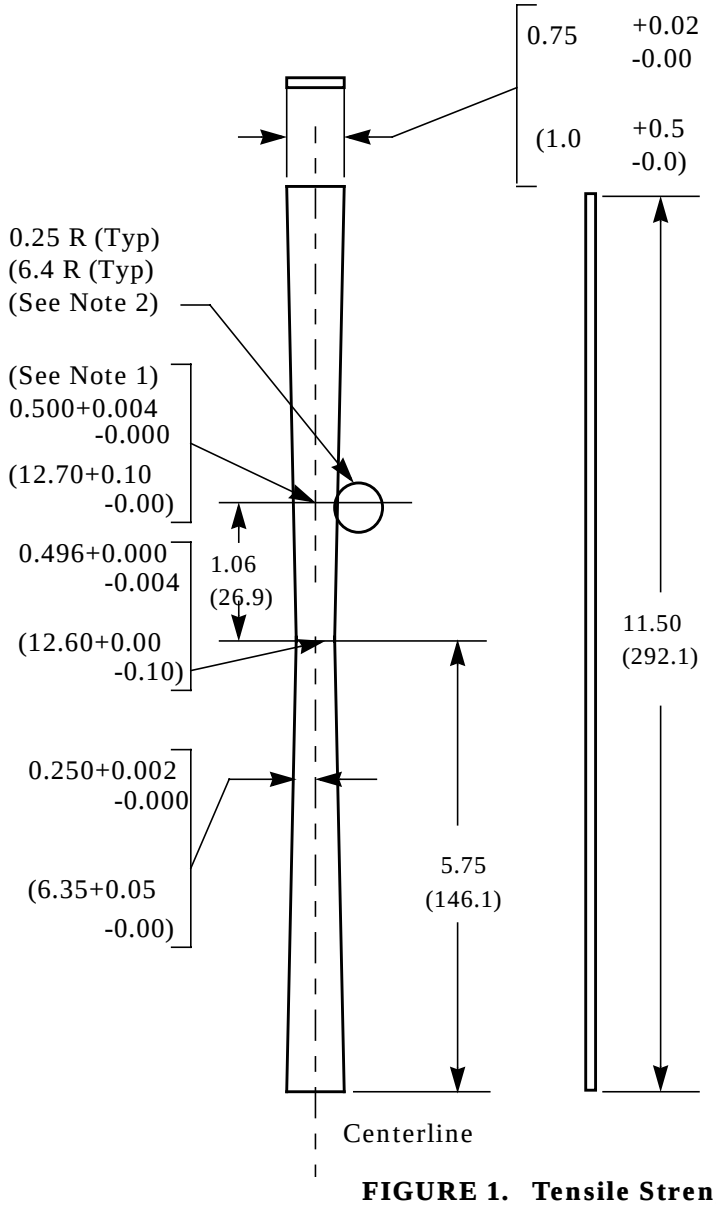
Fabricate test panels in accordance with **Section 4**.

3.5.2.1 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**. Five tensile test specimens shall be tested in accordance with ASTM D3039 except that the specimens shall conform to **Figure 1**.

3.5.2.2 Poisson ratio shall be determined by using bi-axial extensometers or bi-axial strain gauge for the strain measurements.

3.5.2.3 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, 4" (101.6 mm) warp x 1"(25.4 mm) fill, shall be tested in accordance with ASTM D6272, 4 point bend, 1/3 loading, Procedure A, L/d=32 and test with a crosshead speed of 0.06"/minute. Test with load applied at the tool side (smooth side) of the specimen.

3.5.2.4 Shear Modulus: The in-plane shear modulus of elasticity shall be calculated and recored and shall be not less than the values given in Table 3. Five test specimens shall be bested in accordance with ASTM D 3518.



Dimensions are in inches (millimeters)

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

3.5.2.5 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 tested in accordance with ASTM D3410.

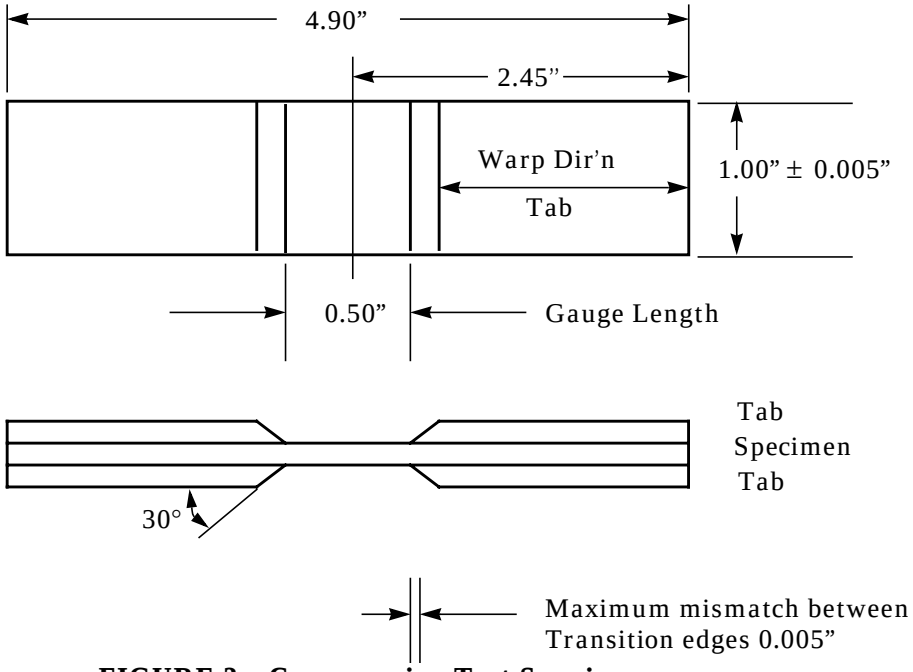


FIGURE 2. Compressive Test Specimen

Notes:

Prepare bonding tab as below. Alternative tab bonding as per agreement with Materials Technology.

1. Specimen thickness for Type 2 shall be 10 plies.
2. Tabs to be manufactured from 10 plies DHMS P1.22 Type 1 and cured at 260˚F ± 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 suitable 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. Warp direction shall be ± 1˚ for specimen and tab layup.
8. Tab layup may be done as panels and cut to size; no tab may be cut from material within 0.5" of the edge of the panel. Bond surface is surface which was cured with peel ply on it.
9. 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 layup. Peel ply must be removed from tab before bonding commences. Clean bond surfaces with MEK and wipe surface before M.E.K. evaporates prior to bonding.
10. 125√ edge finish is required in accordance with ANSI B46.1-78.

3.5.2.6 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" (28.575mm)long (parallel to fill) by 0.25" (6.35mm) wide (parallel to warp) shall be tested in according to ASTM D2344 with a span/thickness ratio of 4 and a crosshead speed of 0.06" (1.524mm)/minute.

TABLE 3. Laminate Mechanical Properties

	Minimum Average Values	
Test	**Reference**	**Type 2**
Tensile Strength	ASTM D3039	45 KSI
Tensile Modulus	ASTM D3039	4.0 MSI
Flexural Strength	ASTM D6272	45 KSI
Flexural Modulus	ASTM D6272	4.5 MSI
Compressive Strength	ASTM D3410	25 KSI
Horizontal Shear Strength	ASTM D2344	4.0 KSI
Poisson ratio (Ref. Only)	ASTM D3039	0.06 (Ave.)
In-Plane Shear Modulus (G_{12})	ASTM D3518	0.42 Msi (Ave.)

3.5.3 Sandwich Mechanical Properties

Fabricate test panels in accordance with **Figure 3**. The sandwich panels shall be vacuum bagged per **Figure 4** and cured per **Figure 5**.

3.5.3.1 Flatwise Tensile - Five specimens, each 2" x 2" (50.8 x 50.8 mm)shall be tested in accordance with ASTM C297. The individual and average values shall meet the requirements given in **Table 4**.

3.5.3.2 Peel Torque - Five specimens for each configuration, 3" x 12" (76.2 x 304.8 mm), shall be tested in accordance with ASTM D1781. The individual and average values shall meet the requirement given in **Table 4**.

TABLE 4. Sandwich Mechanical Properties

Test	Reference	Minimum Values (Type 2)
Flatwise Tensile Strength	ASTM C297	250 psi
Peel Torque *	ASTM D1781	6 in.lb./3 in. width (8.9 mm.N/mm)

* Both toolside and bagside must meet the minimum values. Tested parallel and transverse to ribbon direction.

4 TEST PANEL FABRICATION

4.1 Laminate Panel

Test laminate typically 18"(457.2mm)warp x 12" (304.8mm)fill shall lay 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 **Figure 4** and cured per **Figure 5**. The tolerance for lay up shall be ± 5˚. The tolerance for cutting the cured test specimens shall be within ± 1˚ of the warp or fibre direction. Test pieces shall be finished at the cut edges by wet sanding to a smooth finish, free from fuzz or loose fibres.

TABLE 5.

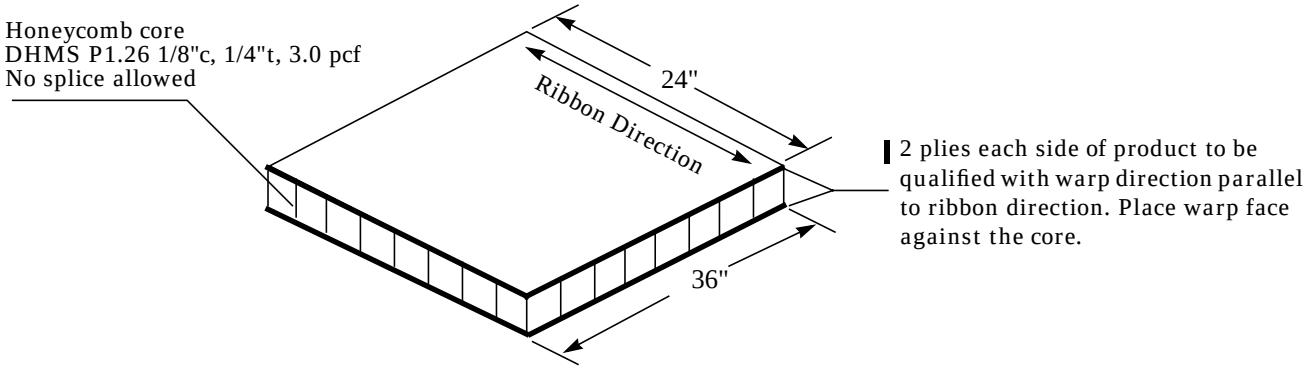
Test Specimen	# Plies
Flexural	10
Horizontal Shear	10
Tensile	10
Compression	10
Poisson ratio (V_{12})	10
In-Plane Shear Modulus (G_{12})	$(-45/+45)_{2s}$

All tests shall be conducted in accordance with the methods listed in **Table 3**.

4.2 Sandwich Panel

The test panels typically 24" (609.6mm) warp x 36" (914.4mm) fill shall be laid up according to **Figure 3**, vacuum bag per **Figure 4** and cured per **Figure 5**.

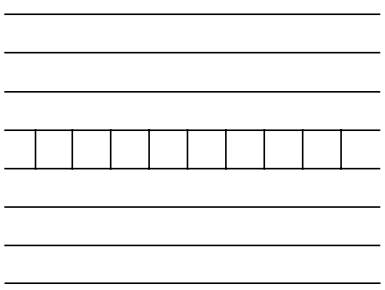
FIGURE 3. Sandwich Mechanical Testing Panel



4.2.1 For Flammability - Panel size shall be 24" x 36"(609.6x914.4 mm), the constructions are shown as per **Para.4.2.2**.

For Heat Release and Smoke Density tests - Panels shall be 14" x 20" (355.6x508 mm), the constructions are shown as per **Para.4.2.2** .

4.2.2 Sandwich Panel Constructions for Flammability

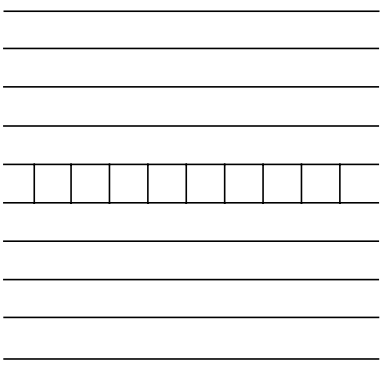


DHMS P1.59 Type 2, warp 45° to ribbon
DHMS P1.59 Type 2, warp 45° to ribbon
DHMS P1.59 Type 2, warp 45° to ribbon

DHMS P1.26 3/4"t, 1/8"c, 4.0 pcf

DHMS P1.59 Type 2, warp 45° to ribbon
DHMS P1.59 Type 2, warp 45° to ribbon
DHMS P1.59 Type 2, warp 45° to ribbon

Specimen 1 - Toolside (Test this side for Heat Release and Smoke Density)

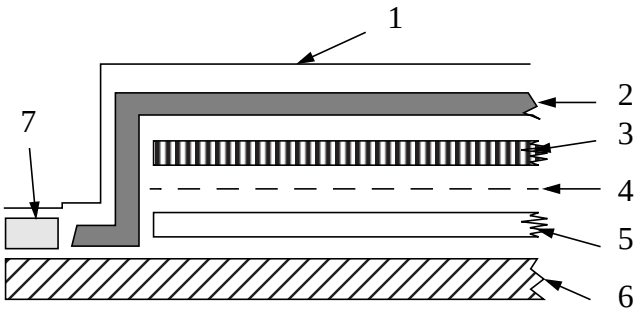


DHMS P1.59 Type 2, warp parallel to ribbon
DHMS P1.59 Type 2, warp parallel to ribbon
DHMS P1.59 Type 2, warp parallel to ribbon
DHMS P1.59 Type 2, warp parallel to ribbon

DHMS P1.26 1/2"t, 1/8"c, 6.0 pcf

DHMS P1.59 Type 2, warp parallel to ribbon
DHMS P1.59 Type 2, warp parallel to ribbon
DHMS P1.59 Type 2, warp parallel to ribbon
DHMS P1.59 Type 2, warp parallel to ribbon

Specimen 2 - Toolside (Test this side for Heat Release and Smoke Density)



Use DSC 234 expendable materials

1. Ipplon DP 1000 Vacuum Bag
2. Wrightlon 4500 Non-perforated Release Film
3. Airweave SS-FR Breather
4. A4000 P3 Perforated Release Film
5. Part
6. Tool (coated with mould release Frekote 44NC or 700NC)
7. GS 43 MR Vacuum Sealant Tape

FIGURE 4. Bagging Procedure for Laminate and Sandwich Panels

APPROVED EXPENDABLE MATERIALS TO DSC 234

Vacuum bag, Ipplon DP1000	(DSC 234-1-54)	Airtech International Inc.,
Non-perforated Release Film, Wrightlon 4500	(DSC 234-19)	2542 East Del Amo Blvd.,
Perforated Release Film A4000P3	(DSC 234-5-48)	P.O. Box 6207
Breather, Airweave SS-FR	(DSC 234-11)	Carson, CA. 90749
Vacuum Sealant Tape, GS-43MR	(DSC 234-17-1)	(213) 603-9683
Mould Release, Frekote 44NC or 700NC	(DSC 234-13)	Frekote Inc., 170 W. Spanish River Blvd., Boca Raton, FL. 33431 (305) 395-3082

NOTE:

- Additional sources are listed in DSC 234.
- Item 2, Non-perforated Release Film is required for curing product Cycom 799H.
- For curing of product Cycom 2400-1M, omit this film.

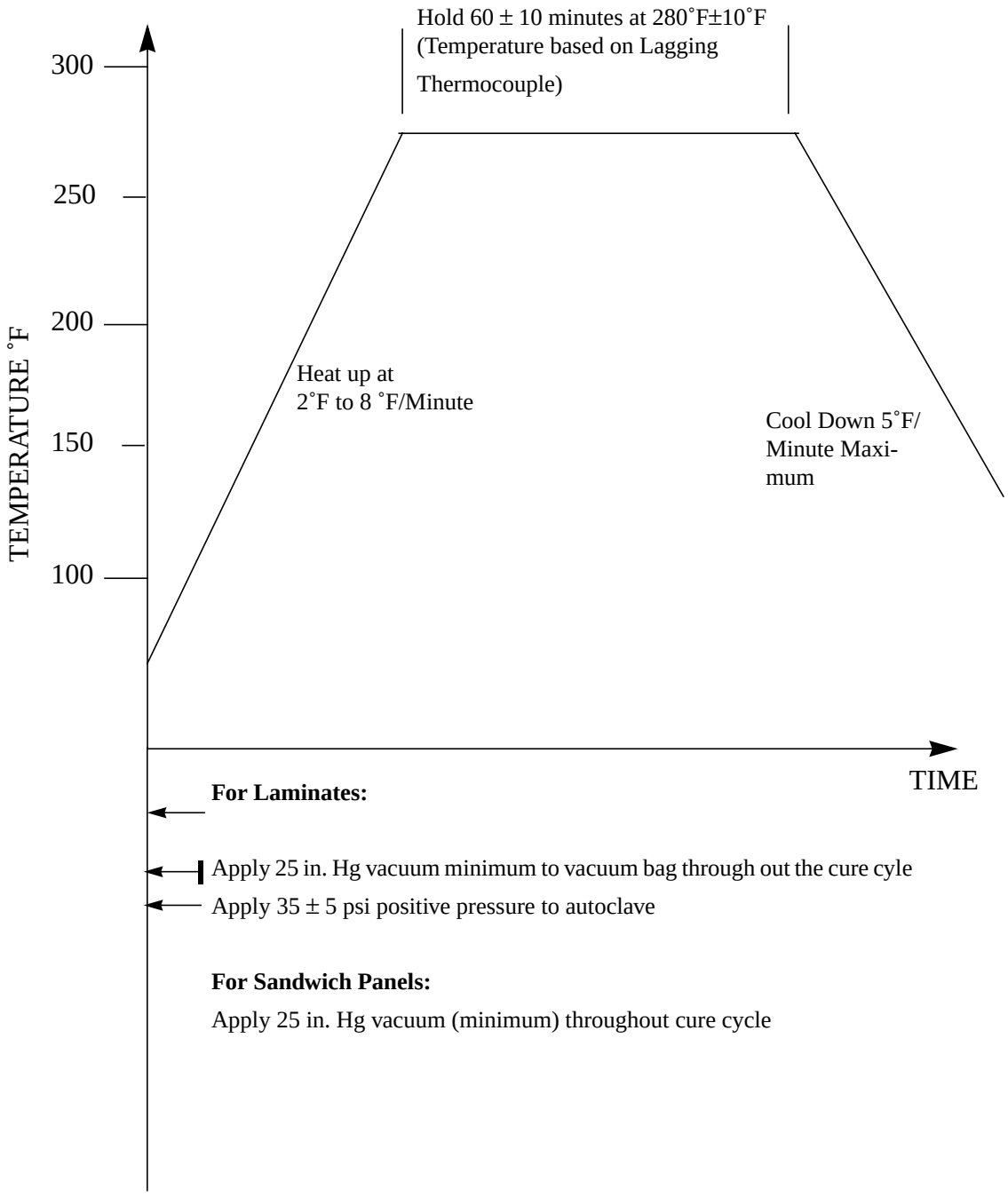


FIGURE 5. Cure Cycle

5 MATERIAL QUALIFICATION REQUIREMENTS

5.1 Request For Qualification

All requests for qualification to this specification shall be addressed to Bombardier Aerospace deHavilland 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

5.2.1 Potential suppliers shall submit a written qualification test report based on 3 batches/lots of materials showing compliance with the requirements as specified in **Table 6** of this specification. The test report shall contain actual numerical test values, average test results as well as failure modes where applicable.

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

5.2.3 **Materials submitted for qualification must demonstrate compliance to FAR 25.853(d) APP. F, Part IV and V Amd. 25-86. The supplier qualification tests shall be conducted at an FAA approved facility and witness by Materials Technology and/or Flam DAD. At the descretion of Bombarider Materials Technology, tests will be performed at the time of qualification and at any time thereafter, .**

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 (Not applicable for flammability testing). The similar specification may be a government, company, or other specification 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). 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.

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

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

5.5 Qualification Approval

5.5.1 Upon review of supplier's data, PCD and BA tests, the supplier will be advised either of product qualification or reasons for not qualifying the product.

5.5.2 Products that are qualified will be listed in the Qualified Products List of this specification.

5.5.3 Re-qualification of the product may be requested by the Bombardier deHavilland 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

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

6.1.1 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.

6.1.2 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.

6.1.3 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

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

TABLE 6. Qualification and Batch Acceptance Tests

Property	Paragraph	Qualification (Supplier)	Acceptance	
			Supplier/Manf.	Purchaser/User
Fabric Weight	Table 2 Para.3.1.2	x	x	
Storage Life	Para.3.4.1	x		
Working Life	Para.3.4.2	x		
Formability	Para.3.4.3	x		
Volatile Content	Para.3.4.4	x	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		
Colour	Para.3.4.9	x		
Dimensions	Para.3.4.11	x		
Workmanship	Para.3.4.12	x		
Bias or Bowed Filling	Para.3.4.13	x		
Cure Cycle	Figure 5	x		
Flammability **	Para.3.5.1	x		x**
Heat Release **	Para.3.5.1	x		x**
Smoke Density **	Para.3.5.1	x		x**
Tensile Strength	Para.3.5.2.1	x		
Tensile Modulus	Para.3.5.2.1	x		
Flexural Strength	Para.3.5.2.3	x	x	x
Flexural Modulus	Para.3.5.2.3	x		
Compressive Strength	Para.3.5.2.5	x		
Horizontal Shear Strength	Para.3.5.2.6	x		
Poisson Ratio	Para.3.5.2.2	x		
Shear Modulus	Para.3.5.2.4	x		
Flatwise Tensile	Para.3.5.3.1	x		
Peel Torque *	Para.3.5.3.2	x	x*	x*

* For acceptance, peel testing parallel and transverse to ribbon direction on both tool side and bag side is required.
**Purchaser acceptance test as per QAMTR 033 as applicable.

6.3 Sampling

6.3.1 Sampling Schedule

Sampling shall be in accordance with Table 7.

TABLE 7.

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

6.3.2 Batch

Prepreg containing reinforcement material (fabric, fiber or otherwise) which has been impregnated with a resin in one continuous operation with traceability to all individual component lots.

7 ORDERING DATA

7.1 Pre-requisite

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 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.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:

- Glass-Graphite Fabric, Phenolic Impregnated
- DHMS P1.59, Type, latest Issue & Amendment,
- 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 fabric shall be wound on spools not less than 3 " in hub diameter and interleaved with a non-adherent film. Winding shall be uniform and shall provide for proper unreeling. Fabric ends shall be secure.

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

8.2.3 The roll shall be support at both ends through the core and packed in an exterior shipping container capable of protecting the impregnated fabric 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:

- Glass-Graphite Fabric, Phenolic Impregnated
- DHMS P1.59, latest Issue & Amendment, Enter Type
- Manufacturer's Material Designation
- Purchase Order Number
- Lot and Roll 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.5.2.1**, 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.

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

GLASS-GRAPHITE FABRIC, FIRE RESISTANT PHENOLIC RESIN IMPREGNATED FOR INTERIOR SANDWICH AND LAMINATE PANELS (1990 FLAMMABILITY RULE)

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIAL SAFETY DATA SHEET NO.	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
	Type 1			
Cytec Aerospace Limited, Abenbury Way Wrexham Clwyd, LL13 9UZ, U.K (01978) 665200	Cycom 799 / 108 Resin Flow: 9-16% Gel Time: 2-10 min. Width: 49" +0.5" -0.25" inclusive of selvedge Working Life : 10 days	1734	PQS #1	May 6, 1991
	Type 2			
	Cycom 799 / 70G30C Resin Flow: 15-27% Gel Time: 2-11 min. Width: 48" +0.5" -0.25" inclusive of selvedge	1734	PQS #3	May 6, 1991
Cytec Industries Inc. 645 N Cypress St. Orange, CA 92867	Cycom 2400-1M/70G30C Resin Flow: 15-30% Gel Time: 60 sec-350 sec Width: nominal 48" +1" -0.5" exnclusive of selvedge	--	PQS #4	November 30, 2015