

**de Havilland Inc.**

# **Material Specification**

|                                  |   |
|----------------------------------|---|
| <b>TITLE:</b>                    | <b>GLASS-GRAPHITE FABRIC, FIRE<br/>RESISTANT PHENOLIC RESIN<br/>IMPREGNATED FOR INTERIOR<br/>SANDWICH AND LAMINATE PANELS</b> |
| <b>SPECIFICATION<br/>NUMBER:</b> | <b>DHMS P 1.44</b>  |
| <b>ISSUE:</b>                    | <b>D</b>  |
| <b>AMENDMENT:</b>                | <b>--</b>   |
| <b>DATE:</b>                     | <b>April 16, 2002</b>   |
| <b>PAGE:</b>                     | <b>1 of 21</b>  |

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#### REVISION RECORD

| Issue  | Page | Description and Reason for Change  |
|--------|------|--|
| A      |      | This specification has been completely revised and changes have been noted   |
| Amd. 1 | 11   | Table 3 - Peel Torque changed from 8 in.lb/3in. width to 6 in.lb/3 in. width.  |
|        | 16   | Table 4 - All mechanical values added.   |
|        | 23   | QPL Type 1 material:<br>Resin Flow changed from 4 - 10% to 9 - 16%.<br>Gel Time changes from 4 - min. to 4 - 10 min. |
|        |      | Type 2 material:<br>Resin Flow changed from 15 - 25% to 22 - 32%.<br>Gel Time changed from 4 - 8 min. to 6 - 11 min. |
| Amd. 2 | 16   | Table 4 - Tensile Strength changed to 55 KSI.<br>Compressive Strength changed to 25 KSI.                             |
| Amd. 3 | 4    | Table 2 - Construction and basic weight of the fabric added.   |
|        | 6    | Para. 3.4.3.2.1 and 3.4.3.3.1 - data added for heat release and smoke density.                                       |
|        | 11   | Table 3 - data added for heat release and smoke density.   |
| Amd. 4 | 11   | Table 3 - Peel Torque corrected to 6 in. lb./ 3 in. width.   |
|        | 23   | Cycom 799/108 and Cycom 799/70G30C manufactured by Cyanamid added to QPL.  |
| B      |      | This is complete revised issue. Detail changes have not been noted.  |
| Amd.1  | 5-10 | Resin Content test method has been changed.  |

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#### REVISION RECORD

| Issue       | Page   | Description and Reason for Change  |
|-------------|--------|--|
| B<br>Amd. 2 | 8      | Figure 1 has been corrected.   |
| Amd. 3      | 21     | QPL: Type 1 material:<br>Resin Flow changed to 9 - 16%.  |
|             | 22     | Gel Time changed to 4 - 10 min.<br>QPL: Type 2 material:<br>Resin Flow changed to 22 - 32%.  |
|             |        | Gel Time changed to 6 - 11 min.  |
| Amd. 4      | 21, 22 | QPL: Cytec deleted from QPL.<br>Brochier address changed.  |
| Amd. 5      | 14     | Figure 4: Bagging procedure changed  |
| C           | 5      | Specified Volatile test specimens can be 100cm <sup>2</sup> round.<br>Resin Content test method, Dry resin content (volatiles excluded)=41%,<br>Wet Resin Content (volatiles included)= 47%. |
|             | 14     | Figure 4: Removed release film Wrightlon 4500 from bagging procedure.  |
|             | 15     | Figure 5: Clarified release vacuum for pressure cured laminate only.   |
|             | 17     | Table 6: Removed Formability test from acceptance test.  |
|             | QPL    | Supplier name and address changed.   |
| D           |        | This is complete revised issue. Detail changes have not been noted.  |

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## 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.**

| Type | Style | Resin Content<br>% by Weight | Cured Ply Thickness<br>(Nominal) |
|------|-------|------------------------------|----------------------------------|
| 1    | 108   | 44 ± 3                       | 0.0025 in/0.0635 mm              |
| 2    | G874  | 41 ± 3                       | 0.008 in/0.2032mm                |

## 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

#### 2.1.2 Military Specifications

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

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### 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 D3039 - Tensile Properties of Oriented Fiber Composites

ASTM E906 - Heat Release and Test Apparatus

ASTM F814-83 - Specific Optical Density of Smoke Generated by Solid Materials for Aerospace Applications.

## 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

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### 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 Amd.25-86 & FAR 25.853(d) APP. F, Part 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<br>Ends/Inch<br>(Denier) | Weave | Basic Weight,<br>oz./sq.yd.<br>(g/sq.m) | Thickness,<br>Nominal,<br>in (mm) |
|------|-------|---------------------------------------|-------|---|-----------------------------------|
| 1    | 108   | 60 x 47                               | Plain | 1.5 ± 0.3<br>(50.9 ± 10.2)              | 0.0025 ± 0.005<br>(0.063 ± 0.127) |
| 2    | G874  | 14 x 14                               |       | 5.1 ± 0.5<br>(172.9 ± 17)               | 0.008 ± 0.001<br>(0.2032 ± 0.025) |

#### 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.

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### 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 270 days from the date of receipt, up to 360 days from the date of manufacture, when stored at a temperature of 10°F or below, or 90 days when stored at a temperature of 40° F to 50° F in the original packaging.
- 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 70%, for a continuous period of up to 60 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 inch (3.8 mm) 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 inch (10 x 10 cm) or 100 cm<sup>2</sup> round 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:

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

W1 = Original Weight

W2 = 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 x4 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.

Alternatively, the wet resin content (volatile content must be performed on different samples) can be calculated as below and shall meet the requirement of 47± 3 %

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, 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. Dry the fibers at 210° ± 10° 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:

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

W1 = Original Weight

W2 = Weight After Extraction

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### 3.4.6 Resin Flow by Weight

#### 3.4.6.1 (Types 1 & 2)

Three specimens, each 4 in. x 4 in. (10 cm. x 10 cm.) 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 2 plies of perforated release film A4000P3 and placed individually in a press, preheated to  $280^{\circ}\text{F} \pm 10^{\circ}\text{F}$  at  $50 \text{ psi} \pm 5 \text{ psi}$  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 in. (6.35 mm.) square, shall be cut from the uncured material. A hot plate shall be preheated to  $280^{\circ}\text{F} \pm 10^{\circ}\text{F}$  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  $280^{\circ}\text{F} \pm 10^{\circ}\text{F}$  of the specified temperature.
2. Insert a 1/4 in. (6.35 mm.) square 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.



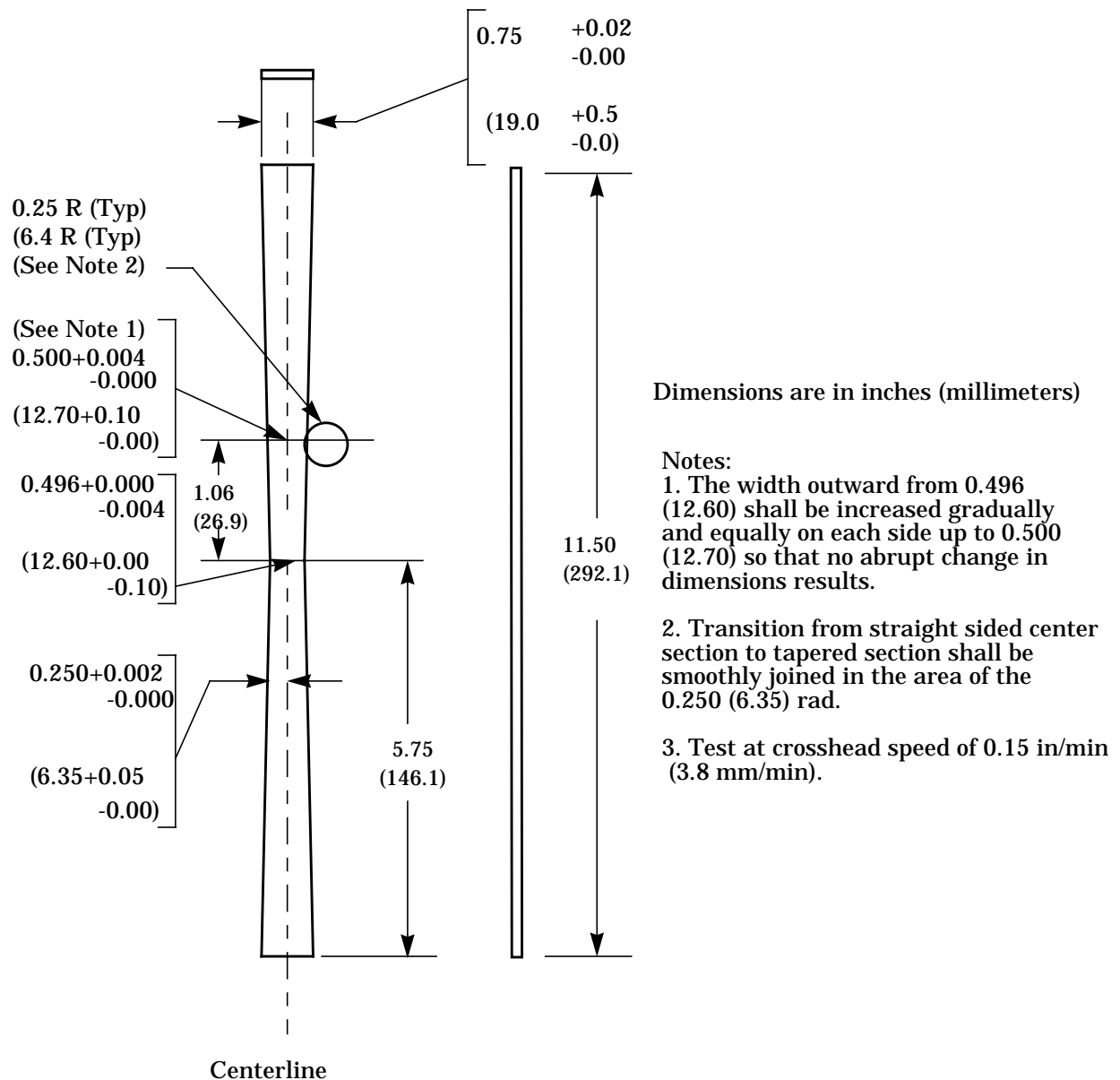
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- 3.4.8 Tack - The product shall exhibit a degree of tackiness for 10 days at a temperature of 77°F, with a humidity not greater than 70%. Both sides of the fabric shall exhibit a degree of tackiness so that the fabric, when folded 180°, will adhere lightly to itself. It shall also be capable of being removed, after light hand pressure during layup, 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 de Havilland Inc.
- 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 +0.50 in. (12.7 mm.) to -0.25 in. (6.35 mm.).  
Length - Unless otherwise specified, the overall length of the product, shall be 25 ± 1 yards (22.85 ± 0.9 m.), 50 yards (45.7 m.), 100 yards (91.4 m.) or 150 yards (137.2 m.) ± 5 yards (4.6 m.).
- 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 1 and 2 fabric shall not be distorted from the horizontal by more than 5 in. (127 mm.) for 50 in. (1270 mm.) widths.

### 3.5 Properties and Test Methods of Cured Impregnated Fabric

- 3.5.1 Flammability Testing  
Fabricate two sandwich panels in accordance with **Para.4.3**. Completed test panels shall be tested in accordance with FAR 25.853(a) APP. F, Part I(a)(1) (i) Amd.25-86, Amd.25-86, FAR 25.853(d) APP. F, Part IV Amd.25-86, and FAR 25.853(d) APP. F, Part V Amd.25-86. Tested panels shall exhibit a 2 minute total heat release of less than 50 kilowatt-minutes/m<sup>2</sup>, a peak heat release rate of 50 kilowatts/m<sup>2</sup> and specific optical density of less than 100DS.
- 3.5.2 Laminate Mechanical Properties  
Fabricate test panels in accordance with **Section 4**. Specimens tested at room temperature shall be conditioned for 40 hours at 70 ± 5°F and 50 ± 5% relative humidity immediately prior to the test.
- 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**.

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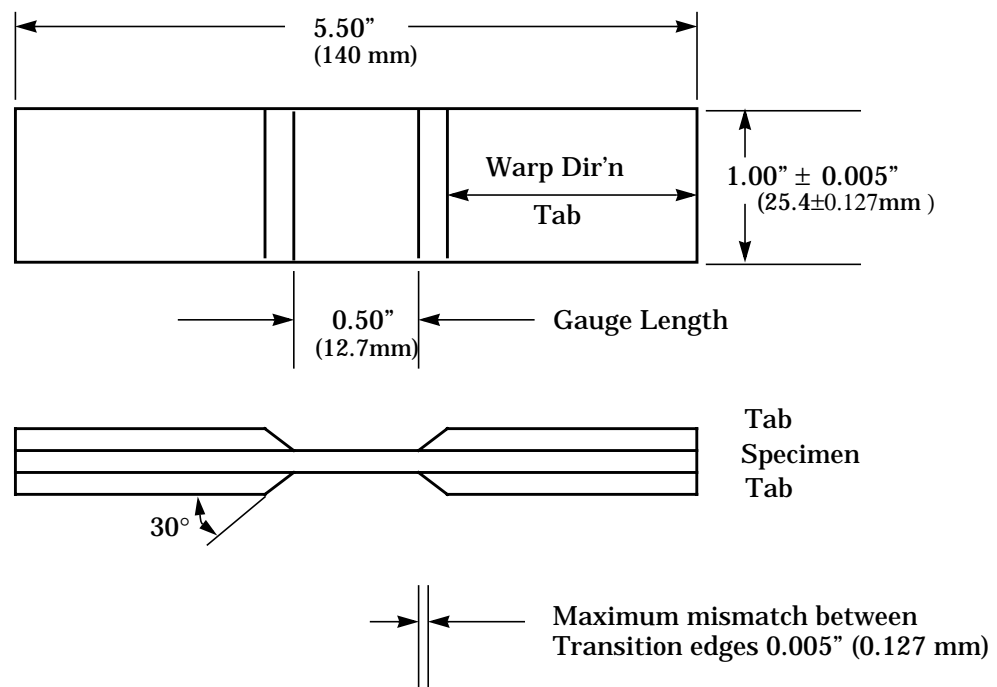
**FIGURE 1. Tensile Strength Specimen**

- 3.5.2.2 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, 4" (101.6 mm) warp x 1" (25.4 mm) fill, with the long dimension parallel to the warp direction shall be tested in accordance with ASTM D6272,

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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.

- 3.5.2.3 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 tested in accordance with ASTM D3410.



**FIGURE 2. Compressive Test Specimen**

**Notes:**

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 (0.813mm) - 0.060 (1.524mm) 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" (2.54 ± 0.254 mm) but all 4 tabs on a specimen must be within 0.002" (0.051mm) of each other.
6. Maximum mismatch between tab transition edges is 0.005" (0.127 mm).
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 1/2 inch (12.7 mm) of the edge of the panel. Bond surface is surface which was cured with peel ply on it.

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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. Wipe bond surfaces with MEK immediately before bonding.

10. 125√ edge finish is required in accordance with ANSI B46.1-78.

3.5.2.4 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" (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 (psi) |         |
|---------------------------|------------------------------|---------|
| Test                      | Reference                    | Type 2  |
| Tensile Strength          | ASTM D3039                   | 55 KSI  |
| Tensile Modulus           | ASTM D3039                   | 4.4 MSI |
| Flexural Strength         | ASTM D790                    | 45 KSI  |
| Flexural Modulus          | ASTM D790                    | 5.5 MSI |
| Compressive Strength      | ASTM D695                    | 25 KSI  |
| Horizontal Shear Strength | ASTM D2344                   | 5.0 KSI |

### 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<br>(8.9 mm.N/mm) |

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

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## 4 TEST PANEL FABRICATION

### 4.1 General

Unless otherwise specified, tests shall be conducted at  $70 \pm 5^\circ \text{F}$  and a relative humidity of  $50\% \pm 5\%$ . 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. All test pieces shall be cut with the longer dimension parallel to the warp direction of the applicable test panel.

### 4.2 Laminate Specimen

Test laminate 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 the applicable **Figure 4** and cured per **Figure 5**. The tolerance for lay up shall be  $\pm 5^\circ$ . The tolerance for cutting the cured test specimens shall be within  $\pm 1^\circ$  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.**

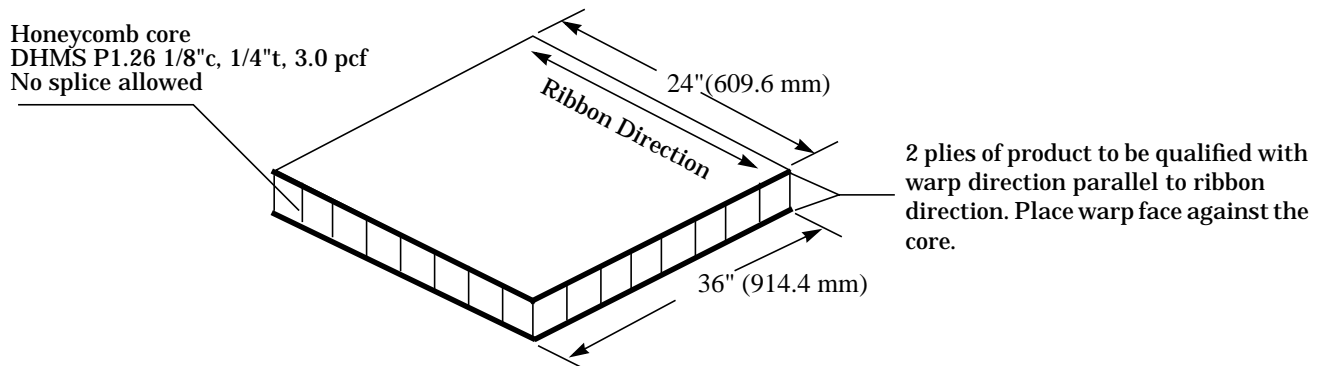
| Test Specimen    | # Plies |
|------------------|---------|
| Flexural         | 10      |
| Horizontal Shear | 10      |
| Tensile          | 10      |
| Compression      | 10      |

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

### 4.3 Sandwich Panel

The test panels 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**.

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**FIGURE 3. Sandwich Test Panel**

- 4.3.1 For Flammability - Panel size shall be 24" x 36" (609.6x914.4 mm), the constructions are shown as per **Para.4.3.2**.
- For Heat Release and Smoke Density tests - Panels shall be 14" x 20" (355.6x508 mm), the constructions are shown as per **Para.4.3.2** for each specimen listed.
- 4.3.2 Sandwich Panel Constructions for Flammability

|       |                                       |
|-------|---------------------------------------|
| _____ | DHMS P1.44 Type 2, warp 45° to ribbon |
| _____ | DHMS P1.44 Type 2, warp 45° to ribbon |
| _____ | DHMS P1.44 Type 2, warp 45° to ribbon |

|   |  |  |  |  |  |  |  |  |  |  |                                  |
|---|--|--|--|--|--|--|--|--|--|--|----------------------------------|
| <table border="1"> <tr> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table> |  |  |  |  |  |  |  |  |  |  | DHMS P1.26 3/4"t, 1/8"c, 4.0 pcf |
|   |  |  |  |  |  |  |  |  |  |  |                                  |

|       |                                       |
|-------|---------------------------------------|
| _____ | DHMS P1.44 Type 2, warp 45° to ribbon |
| _____ | DHMS P1.44 Type 2, warp 45° to ribbon |
| _____ | DHMS P1.44 Type 2, warp 45° to ribbon |

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

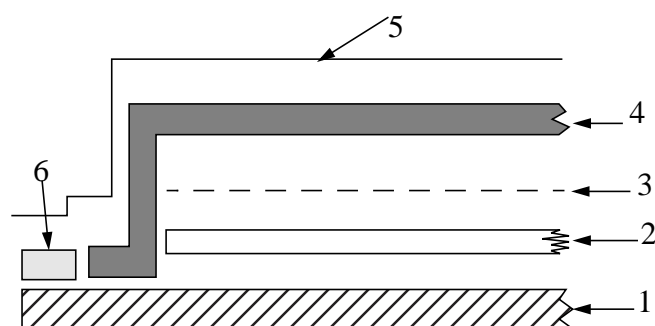
|       |  |
|-------|--|
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |

|   |  |  |  |  |  |  |  |  |  |  |                                  |
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|   |  |  |  |  |  |  |  |  |  |  |                                  |

|       |  |
|-------|--|
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |
| _____ | DHMS P1.44 Type 2, warp parallel to ribbon |

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

|   |   |
|---|---|
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1. Tool (coated with mould release Frekote 44NC or 700NC)
- Use DSC 234 expendable materials
2. PART
3. Perforated Release Film A4000P3
4. Airweave SS-FR Breather
5. Nylon Vacuum Bag
6. GS 43 MR Vacuum Sealant Tape

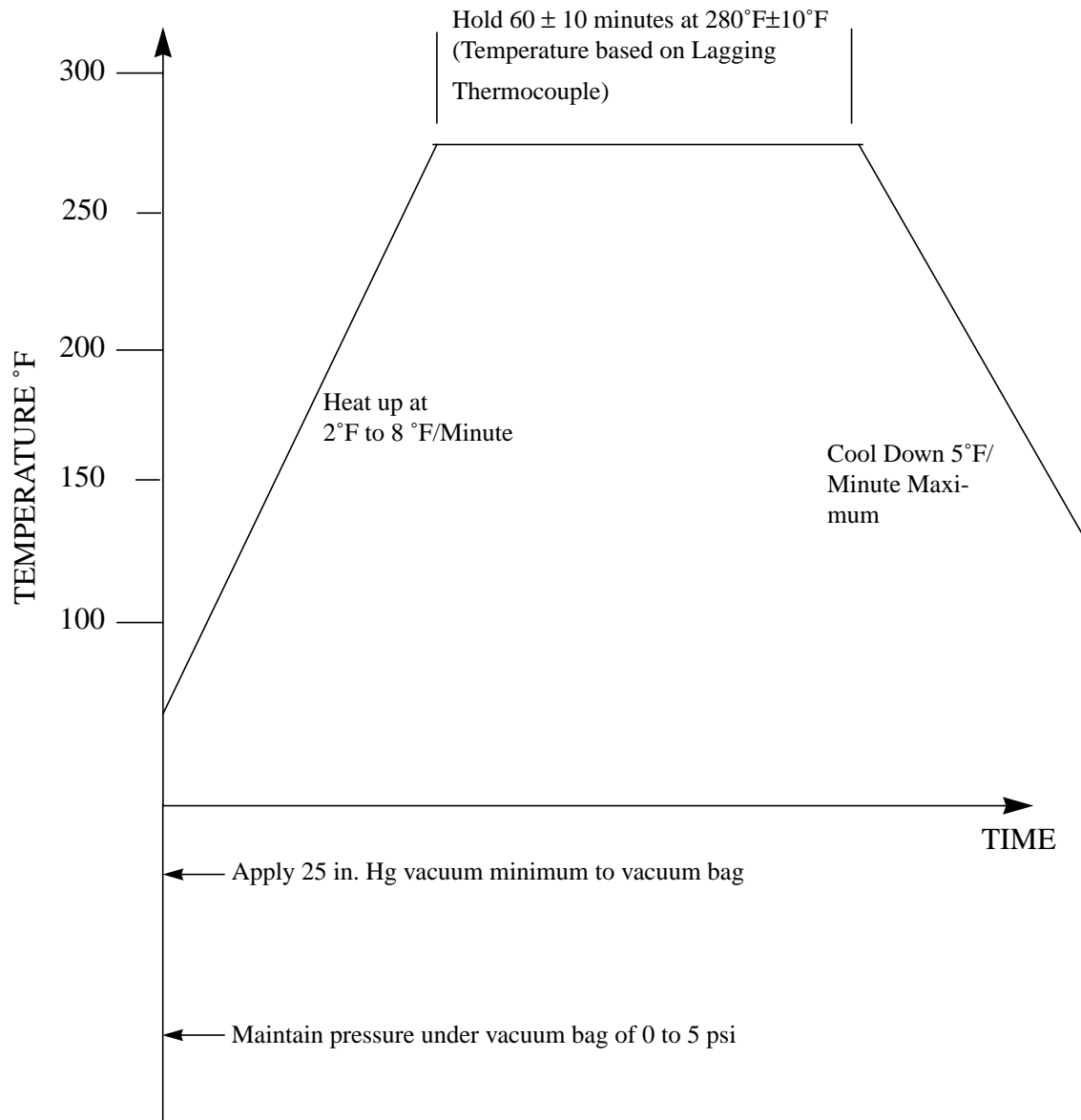
**FIGURE 4. Bagging Procedure for Laminate And Sandwich Panels**

#### **APPROVED EXPENDABLE MATERIALS TO DSC 234**

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

**NOTE:** Additional sources are listed in DSC 234.

|   |   |
|---|---|
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**FIGURE 5. Cure Cycle**



|  |                               |  |
|--|-------------------------------|--|
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## 5 QUALITY ASSURANCE

### 5.1 Qualification

5.1.1 A supplier is responsible for the performance of all qualification testing, as specified in **Table 6** of this specification. A three lots/batches qualification is required.

5.1.2 A supplier desiring qualification shall submit one copy of a report showing actual qualification test data and a sufficient quantity of product for de Havilland evaluation tests.

**Materials submitted for qualification must demonstrate compliance to FAR 25.853(d) APP. F, Part IV and V Amd. 25-86. Materials to be tested by de Havilland Inc., must exhibit results consistent with those on the suppliers qualification test report of the same material type. The supplier qualification tests and de Havilland Tests shall be conducted at an FAA approved facility. De Havilland tests will be performed at the time of qualification and at any time thereafter, at the discretion of de Havilland Inc. Qualified products will be listed in the Qualified Products List to this specification for each type which qualification is granted.**

5.1.3 Upon review of supplier's data and de Havilland tests, the supplier will be advised either of product qualification or reasons for disqualification.

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

5.1.5 Re-qualification of the product may be requested by the purchaser if there are any changes in the method of manufacture and/or formulation.

### 5.2 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.

### 5.3 Acceptance Tests

5.3.1 Unless otherwise specified in the contract or purchase order, the supplier is responsible for all acceptance tests, as specified in **Table 6** of this specification.

5.3.2 The supplier, performing acceptance tests per **Para.5.3.1** shall furnish 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.

5.3.3 de Havilland Inc. 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.

|   |                               |  |
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**TABLE 6. Qualification and Batch Acceptance Tests**

| Property                  | Paragraph                  | Qualification | Acceptance |
|---------------------------|----------------------------|---------------|------------|
| Fabric Weight             | <b><u>Table 2</u></b>      | X             |            |
|                           | <b><u>Para.3.1.2</u></b>   |               | X          |
| Storage Life              | <b><u>Para.3.4.1</u></b>   | X             |            |
| Working Life              | <b><u>Para.3.4.2</u></b>   | X             |            |
| Formability               | <b><u>Para.3.4.3</u></b>   | X             |            |
| Volatile Content          | <b><u>Para.3.4.4</u></b>   | X             | X          |
| Resin Content             | <b><u>Para.3.4.5</u></b>   | X             | X          |
| Resin Flow                | <b><u>Para.3.4.6</u></b>   | X             | X          |
| Gel Time                  | <b><u>Para.3.4.7</u></b>   | X             | X          |
| Tack                      | <b><u>Para.3.4.8</u></b>   | X             | X          |
| Colour                    | <b><u>Para.3.4.9</u></b>   | X             |            |
| Dimensions                | <b><u>Para.3.4.11</u></b>  |               | X          |
| Workmanship               | <b><u>Para.3.4.12</u></b>  | X             | X          |
| Bias or Bowed Filling     | <b><u>Para.3.4.13</u></b>  | X             | X          |
| Cure Cycle                | <b><u>Figure 5</u></b>     | X             |            |
| Flammability              | <b><u>Para.3.5.1</u></b>   | X             |            |
| Heat Release              | <b><u>Para.3.5.1</u></b>   | X             |            |
| Smoke Density             | <b><u>Para.3.5.1</u></b>   | X             |            |
| Tensile Strength          | <b><u>Para.3.5.2.1</u></b> | X             |            |
| Tensile Modulus           | <b><u>Para.3.5.2.1</u></b> | X             |            |
| Flexural Strength         | <b><u>Para.3.5.2.2</u></b> | X             |            |
| Flexural Modulus          | <b><u>Para.3.5.2.2</u></b> | X             |            |
| Compressive Strength      | <b><u>Para.3.5.2.3</u></b> | X             |            |
| Horizontal Shear Strength | <b><u>Para.3.5.2.4</u></b> | X             |            |
| Flatwise Tensile          | <b><u>Para.3.5.3.1</u></b> | X             |            |
| Peel Torque               | <b><u>Para.3.5.3.2</u></b> | X             | X**        |

\*\* For acceptance, peel testing parallel to ribbon direction on both tool side and bag side is required.

|  |                               |  |
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## 5.4 Sampling

5.4.1 Sampling Schedule - Sampling shall be in accordance with **Table 7**.

**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                 |

5.4.2 Batch - A batch shall be all the product produced in a single production run from the same lot of raw materials under the same fixed conditions and submitted for inspection at one time. When more than one lot of unimpregnated 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.

## 6 ORDERING DATA

### 6.1 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.

### 6.2 Procurement Documents

Procurement documents shall specify the following:

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

## 7 PREPARATION FOR DELIVERY

### 7.1 Identification

7.1.1 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.

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|---|---|
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- 7.1.2 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:
- Glass-Graphite Fabric, Phenolic Impregnated
  - DHMS P1.44, latest Issue & Amendment (Enter Type)
  - Manufacturer's Material Designation
  - Purchase Order Number
  - Lot and Roll Numbers
  - Quantity
  - Perishable - Store Below 10°F
  - Date of Manufacture

## 7.2 Packaging

- 7.2.1 The impregnated fabric shall be wound on spools not less than 3 inches (76.2 mm) 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.
- 7.2.2 Each roll shall be sealed in a bag of suitable non-adherent material to prevent penetration of moisture or loss of impregnating resin solvent.
- 7.2.3 The roll shall be packed in an exterior shipping container capable of protecting the impregnated fabric adequately at 10°F or lower during shipment and storage.

## 7.3 Shipping Documentation

- 7.3.1 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 P1.44, latest Issue & Amendment, Enter Type
  - Manufacturer's Material Designation
  - Purchase Order Number
  - Lot and Roll Numbers
  - Quantity
  - Perishable - Store Below 10°F
- 7.3.2 Containers shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery.
- 7.3.3 Each shipment shall contain a copy of the Material Safety Data Sheet.

|   |                               |  |
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## 8 HEALTH AND SAFETY DATA

When supplying samples for qualification per **Para.5.1.2**, 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.

|  |                               |  |
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#### QUALIFIED PRODUCTS LIST

| MANUFACTURER'S<br>NAME AND ADDRESS                                      | MANUFACTURER'S<br>PRODUCT<br>IDENTIFICATION NO.   | MATERIALS<br>SAFETY DATA<br>SHEET NO. | DE HAVILLAND<br>QUALIFICATION<br>SHEET NO. | DATE OF<br>PRODUCT<br>APPROVAL |
|---|---|---------------------------------------|--|--------------------------------|
| <b>Type 1</b>   |   |                                       |  |                                |
| Hexcel Composites SA<br>ZI La Plaine, Dagneux<br>01121 Montluel, France | Vicotex 250/44%/108<br>Resin Flow: 9-16 %<br>Gel Time: 4 - 10 min.<br>Width: 49"+0.5"-0.25"<br>(1244.6mm +12.7mm -<br>6.35 mm) inclusive of<br>selvedge | 288                                   | PQS #2                                     | February 1, 1988               |

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| MANUFACTURER'S<br>NAME AND ADDRESS                                     | MANUFACTURER'S<br>PRODUCT<br>IDENTIFICATION NO.   | MATERIALS<br>SAFETY DATA<br>SHEET NO. | DE HAVILLAND<br>QUALIFICATION<br>SHEET NO. | DATE OF<br>PRODUCT<br>APPROVAL |
|--|---|---------------------------------------|--|--------------------------------|
|  | <b>Type 2</b>   |                                       |  |                                |
| Hexcel Composites SA<br>ZI La Plain, Dagneux<br>01121 Montluel, France | Vicotex 250s/41%/G874<br>Resin Flow: 22-32%<br>Gel Time: 6-11 min.<br>Width: 48"+0.5"-0.25"<br>(1219.2mm +12.7mm -<br>6.35mm)inclusive of sel-<br>vedge | 288                                   | PQS #4                                     | August, 1988                   |