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de Havilland
Material Specification

TITLE:	**CARGO COMPARTMENT LINERS (ARAMID OR GLASS FABRIC, RESIN IMPREGNATED)**
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CARGO COMPARTMENT LINERS (ARAMID OR GLASS FABRIC, RESIN IMPREGNATED)

REVISION RECORD

Issue	Page	Description and Reason for Change
Org.		
Amd. 4	5	Table 2 - Edge bearing requirement added for Class B material
A		This is a complete revised issue. Detailed changes have not been noted.
Amd.1	9	QPL has been corrected.
B		This is a complete revised issue. Detailed changes have not been noted.
Amd. 1	10	QPL, product Gilliner 1366T deleted due to presence of Penta and Octa BDE chemicals.
Amd. 2	10	QPL, product Gilliner 1366T reinstated due to Re- confirmation from MCGILL.
C	7	Table 3, removed the FAR 25.855 as lot/ batch acceptance test. Added Certification Statement for Flammability is required.
	6	Added PCD requirement.
	QPL	Removed the product Gillfab 1566 as it is no longer available.

CARGO COMPARTMENT LINERS (ARAMID OR GLASS FABRIC, RESIN IMPREGNATED)

1 SCOPE

This specification covers the requirements for semi-rigid, high impact, self-extinguishing, thermoset, resin impregnated, aramid or glass fabric reinforced laminates, in sheet form, for use as cargo compartment liners and cargo/cabin combinations.

1.1 Classification

The liner shall be one of the following classes and thicknesses as shown in **Table 1**.

Class A - Aramid fabric reinforced laminate.

Class B - Glass fabric reinforced laminate.

Class C - High impact resistant woven glass fabric with phenolic resin. This material shall meet the FAR 25.853(a), Amd. 25-83,APP. F, PART I (1)(i) & (ii) and FAR 25.853(d), APP. F, PART IV & V requirements.

Grade 1 - Bare (without polyvinyl fluride film).

Grade 2 - With a 0.001 in. thick white polyvinyl fluride film (Tedlar) on one side.

Table 1:

Class	Grade	Thickness - inches			
A	2	0.016 ± 0.002	0.020 ± 0.002	0.033 ± 0.003	0.040 ± 0.004
B	1	0.020 ± 0.002	0.030 ± 0.003	0.040 ± 0.004	0.050 ± 0.005
B	2	0.020 ± 0.002	0.030 ± 0.003	0.040 ± 0.004	0.050 ± 0.005
C	2	0.020 ± 0.003	0.030 0.003	-	-

2 APPLICABLE DOCUMENTS

The following documents shall form a part of this specification to the extent specified herein. In the event of conflicting requirements between these documents and the specification listed below, the requirements of this specification shall govern.

2.1 Federal Aviation Administration

FAR 25.853(a), Amd. 25-83 APP. F, PART I (1)(i) & (ii)- Flammability Requirements

FAR 25.853(d), APP.F, PART IV & V - Heat Release and Smoke Density Requirements

FAR 25.855, Amd. 25-72 APP. F, PART III - Flame Penetration Resistance

2.2 American Society for Testing and Materials

ASTM D953 - Bearing Strength of Plastics

3 MATERIAL REQUIREMENTS

3.1 Quality

3.1.1 The aramid or glass fabric reinforced sheeting as received shall be of a durable, structural, uniform quality and completely cured. The surfaces shall be free from contamination by foreign materials, and shall be consistent in physical properties. Imperfections such as surface waviness due to fibre pattern surface imprints, handling scuffs or scratches that do not expose broken fibres are acceptable.

3.1.2 The following structural imperfections in the finished product are not allowed: kinks, creases, folds greater than 6 inches in length, waviness in which an individual thickness measurement exceeds the laminate thickness tolerance by more than 0.005", resin starved areas, blisters, internal or edge delamination, scratches which expose broken fibres, pits, gouges or severe surface indentations.

3.1.3 For Grade 2 material, the adhesion of the P.V.F. film to the surface shall be such that the adhesive bond is greater than the tensile strength of the P.V.F. film. Occasional pin hole type resin bleed through spots on the Tedlar surface is acceptable.

3.2 Definitions

3.2.1 Kink - A cracking of one or both surfaces of the material that indicates a fracture of the fibres, usually caused by rough handling and/or bending (over a protection).

3.2.2 Crease - A condition of the surface of the material where the thickness is not appreciably changed, but the material is permanently formed into a ridge.

3.2.3 Fold - A condition in which the fibres are laid back over themselves and laminated into the sheet, causing a permanent ridge of increased thickness.

3.2.4 Resin Starved - An area with less than normal resin content, sometimes causing delamination or separation between plies due to poor bond.

3.2.5 Blister - A void due to entrapped air between plies.

3.2.6 Delamination - The separation of plies due to bruises or peeling action such as during trimming operations causing the plies to peel back from one another from the edge of the trimmed laminate.

3.2.7 Lot - A lot shall consist of all sheets of the same class from a given production run and presented for inspection at one time. The vendor shall be responsible for designation of lot numbers.

3.2.8 Waviness - A condition in the laminate that is characterized by a corrugated appearance.

3.3 Dimensions

The liner material shall be available in 36", 48", 56", 62", and 72" widths, with a length up to 168". Width and length tolerance shall be +1"-0". Warp twist of the liner shall not exceed 3% of the distance measured.

3.4 Flammability

3.4.1 The liner shall meet the requirements of FAR 25.853(a), Amd. 25-83 APP. F, PART I (1)(i) & (ii) and FAR 25.855, Amd. 25-72 APP.F, PART III.

3.4.2 The Class C material used for **cargo/cabin combinations shall also meet the requirements of FAR 25.853(d), Amd. 25-83, APP. F, PART IV & V**.

3.5 Physical Properties

The liner shall meet the requirements of **Table 2**.

Table 2: Physical Properties

Test	Test Method	Minimum Values									
	Para.	Class A				Class B				Class C	
		0.016	0.020	0.033	0.040	0.020	0.030	0.040	0.050	0.020	0.030
Impact Strength, ft -lbs. (Minimum)[1]	Para.4.1	10	18	20	26	6.0	10.0	12.0	20.0	14	16
Weight, lb / ft^2 (Maximum)	N/A	0.10	0.14	0.20	0.28	0.24	0.35	0.46	0.57	0.2	0.3
Edge Bearing Strength, ksi, (Minimum)	Para.4.2	50				30				38	

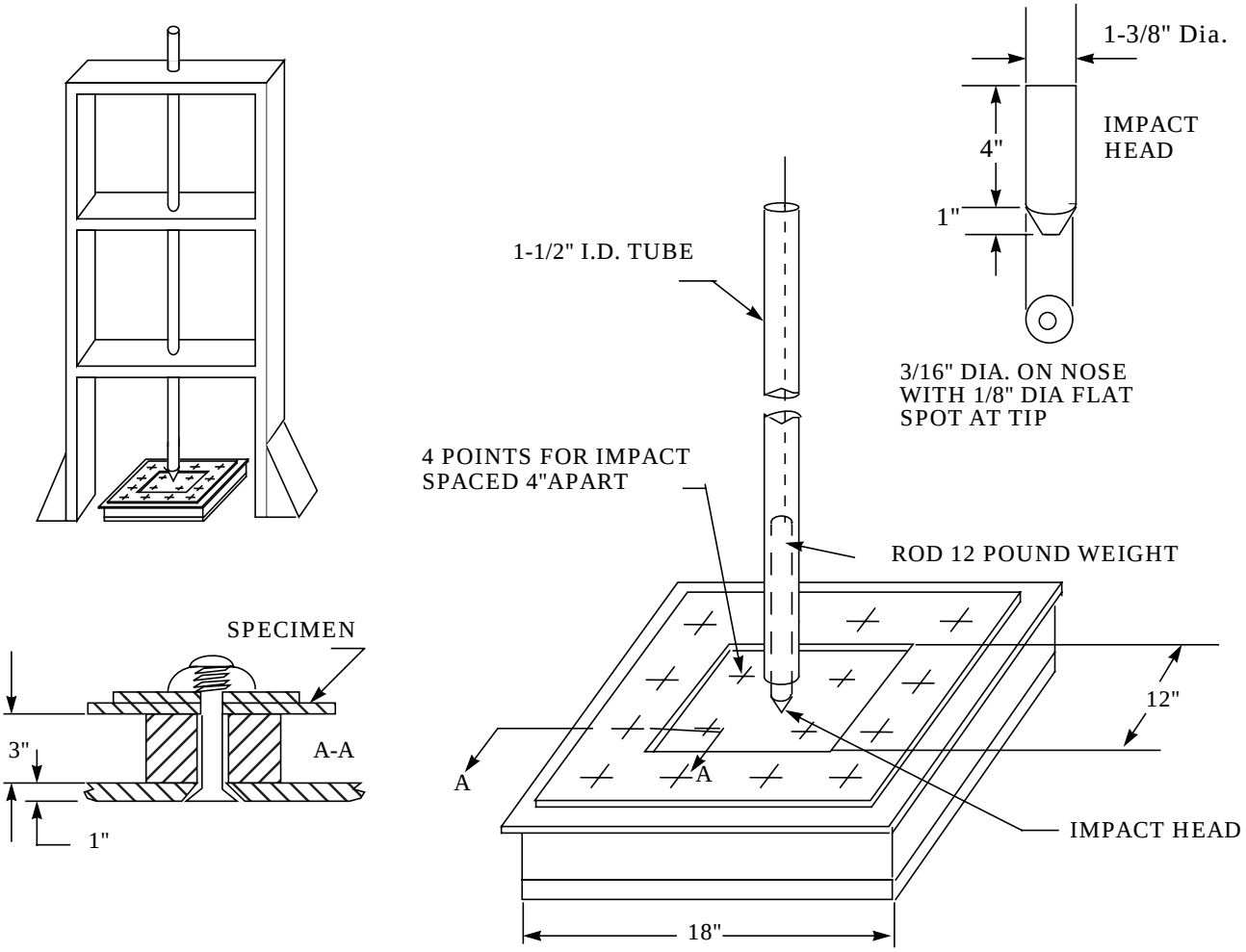
1. The minimum values are determined by the highest value of impact (in foot-pounds) that the material can withstand without penetration.

4 TEST METHODS

4.1 Impact Strength

4.1.1 Impact strength shall be tested using the apparatus and procedures as indicated in **Figure 1**. Four indicated locations per sample shall be tested. Test at least three samples.

4.1.2 Penetration is determined by lightly probing the area of the impacted blow with a sharp pointed instrument (or to a pencil point) to see if the point protrudes entirely through the area of impact. If the point protrudes entirely through with slight pressure, the material is considered to be penetrated. Small local delamination on the surface (front or back), or slight rupture of surface fibres (front or back), without complete penetration of the probe, is considered acceptable.



1. Cut and drill impact specimen to fit frame.
2. Insert specimen as diaphragm in frame and fasten securely.
3. Place frame, with specimen, under the tube and position the impact head (in tube) over spot to be impacted.
4. Lower the rod until it is in contact with the top of the impact head.
5. Raise 12 pound rod by increments of inches.
6. Release rod and record the distance dropped.
7. Each inch of drop represents one foot-pound (i.e. record a 9 inch drop as 9 foot-pounds).

NOTE: Frame shall be placed on a concrete-floor.

FIGURE 1.

4.2 Edge Bearing

A minimum of five test specimens shall be tested in accordance with ASTM D953 Procedure A, with the exception that the ultimate bearing strength shall be calculated using the following formula:

$$S = \frac{L}{D \times T}$$

where S = Ultimate Bearing Strength, psi

L = Ultimate Load, lb

D = Hole Diameter, inches

T = Specimen Thickness, inches.

5 QUALITY ASSURANCE

5.1 Qualification

5.1.1 A supplier is responsible for the performance of all qualification testing, as specified in **Table 3** 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.

5.1.3 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. The PCD shall be approved and signed and be available for inspection by authorized representatives of Bombardier Aerospace.

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

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

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

5.1.7 Requalification 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. 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 3** 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 an Acceptance Test Report showing actual test data conformance to the acceptance tests specified in **Table 3**. The report shall include the supplier's batch identification.

5.3.3 A Certificate of Conformance stating the materials meets the applicable requiments of flammability, per **Para.3.4.1** or **Para.3.4.2** is required.

5.3.4 de Havilland 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, per **Section 3**, will be returned to the supplier at the supplier's expense.

Table 3: Qualification And Batch Acceptance Tests

Test	Paragraph	Qualification	Acceptance
Quality	**Para.3.1**	x	x
Weight	**Table 2**	x	x
Thickness	**Table 1**	x	
Impact	**Table 2**	x	x
Dimensions	**Para.3.3**	x	x
Flammability	**Para.3.4.1**	x	
Heat Release & Smoke Density[1]	**Para.3.4.2**	x	
Bearing Strength	**Table 2**	x	

1. For Class C material only.

6 ORDERING DATA

6.1 Prerequisite

Products 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
- Class, Grade, Thickness
- Width and Length
- Total Square Feet and Number of Sheets
- Manufacturer's Material Designation.

7 PREPARATION FOR DELIVERY

7.1 Identification

7.1.1 Each sheet shall be marked with recurring blocks of letters and symbols as follows:

- Cargo Liner Sheet Material
- DHMS P1.42, Class, Grade, Thickness
- Manufacturer's Material Designation
- Purchase Order Number
- Lot Number
- Date of Manufacture
- Quantity - Number of Sheets and Square Feet.

7.1.2 The blocks shall be pitched at 9" centers in the width and 24" centers in length. Letters and symbols to be 3/8" to 1/2" in height. Blocks shall be staggered to produce a checkerboard effect.

7.1.3 For Grade 2 sheets, the identification shall be made on the fabric surface.

7.1.4 The marking shall be such that it is clearly legible and will not be obliterated by normal handling. It shall not stain through to opposite surface.

7.2 Preservation and Packaging

The cargo liner sheeting shall be packed in such a manner as to assure that, during shipment and storage, the product shall be protected against damage from exposure to hazards which would affect adversely the property conformance of **Section 3** of this specification.

7.3 Shipping Documentation

The shipping document shall show:

- Cargo Liner Sheet Material
- DHMS P1.42, Class, Grade, Thickness
- de Havilland Purchase Order Number
- Manufacturer's Material Designation

- Quantity - Sheets and Square Feet
- Lot Number
- Lot Acceptance Report including Certification statement per **Para.5.3.3**.

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

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 NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIAL SAFETY DATA SHEET NO.	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
Class B, Grade 1				
M.C. Gill Corp.	Gilliner 1366	0991	PQS #1	June 19, 1985
Class B, Grade 2				
M.C. Gill Corp.	Gilliner 1366T	0991	PQS #1	June 19, 1985
Class C, Grade 2				
M.C. Gill Corp.	Gillfab 1367A	0991	PQS #3	January 7, 1998