

## De Havilland Material Specification

<b>TITLE:</b>	<b>POLYCARBONATE SHEET MATERIAL</b>
<b>SPECIFICATION NUMBER:</b>	<b>DHMS P1.01</b>
<b>ISSUE:</b>	<b>L</b>
<b>AMENDMENT:</b>	<b>--</b>
<b>DATE:</b>	<b>September 30, 2019</b>
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## REVISION RECORD

Issue	Page	Description and Reason for Change
G	11a	A new page 11a was added. HYZOD AC-1000 Para. 3.1.3 - Aluminum content revised Polycarbonate sheet manufactured by Sheffield Plastics added to the QPL.
H		This is a complete revised issue. Detail changes have not been noted.
Amd. 1	9 – 11 & 13	QPL: references to G.E. Plastics Canada and Canadian General Electric have been deleted. Merlon (Genesta) has been deleted from QPL.
Amd. 2	9	QPL: Rohm & Haas has been changed to Atofina Chemicals.
J	12 All	QPL: Sheffield Plastics has been deleted. Products no longer exist. Specification reduced from 13 to 12 pages. All page numbers changed.
K	9 – 12 All	QPL: General Electric has been changed to SABIC Innovative Plastics. This is a complete revised issue. Detail changes have not been noted.
Amd. 1	2	<u>Para. 1.1.4:</u> Example part number revised and clarified.
L	4 7-8 9 10 15	<p>This is a complete revised issue.</p> <p>Updated Company Name</p> <p>Edited 3.1 Material Requirement</p> <p>Revised sections 4, 5 standardize with other specifications</p> <p>Table 2 revised to specify acceptance tests required for supplier and purchaser/user</p> <p>Added Section 7 Health and Safety Data and Section 7.1 Environmental Compliance</p> <p>Product code changed for 0.125”-0.5” thick Lexan MR</p> <p>Clear : WAS: MR5-T-112, IS: MR10/MRT-112</p> <p>Bronze: WAS: MR5-T-5109, IS: MR10/MRT-5109</p>



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## 1. SCOPE

This specification covers the requirements of ultra-violet stabilized, flame-resistant and self-extinguishing, low smoke emission, and mar resistant grades of polycarbonate sheet material.

### 1.1 Classification

The polycarbonate sheeting shall be supplied in one of the following grades and types.

#### 1.1.1 Grades

- DHMS P1.01/1 - Ultra-Violet Stabilized
- DHMS P1.01/2 - Self-Extinguishing
- DHMS P1.01/3 - Self-Extinguishing and Low Smoke Emission
- DHMS P1.01/4 - Mar Resistant

#### 1.1.2 Types

- A\* - Smooth Both Sides
- B - Haircell Finish One Side
- C - Suede Finish One Side
- D - Matte Finish One Side

\* - Suffix "A" is not necessary for DHMS P1.01/4 since mar resistant polycarbonate is available only smooth both sides.

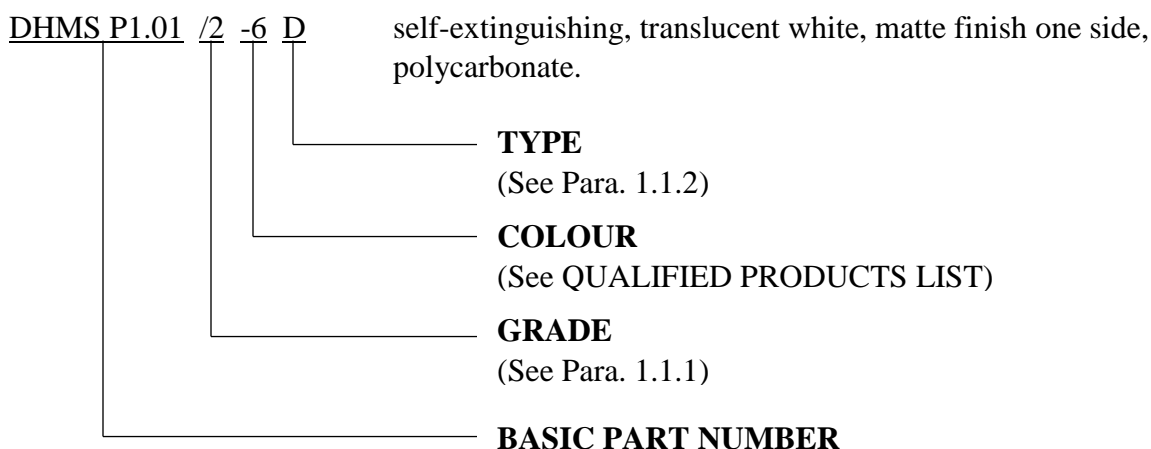
#### 1.1.3 Colours

Colours used by De Havilland Aircraft of Canada Limited are listed in the Qualified Product List (QPL) and they are identified by dash numbers.

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#### 1.1.4 Example of Part Number



## 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 Specification**

FAR 25.853(a), APP. F,      - Flammability Requirements

PART I (1)(i) & (ii)

Amd. 25-86

U.S. National Bureau      - Technical Note 708  
Of Standards

### 2.2 **American Society for Testing and Materials**

ASTM D256      - Impact Resistance of Plastics

ASTM D638      - Tensile Properties of Plastics

ASTM D648      - Deflection Temperature of Plastics Under Flexural Load

ASTM D673      - Mar Resistance of Plastics



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ASTM D792	- Specific Gravity of Plastics
ASTM D1003	- Haze and Luminous Transmittance of Transparent Plastics
ASTM D1044	- Resistance of Transparent Plastics to Surface Abrasion
ASTM D1499	- Recommended Practice for Operating Light-and Water-Exposure Apparatus for Exposure of Plastics
ASTM D2240	- Rubber Property-Durometer Hardness
ASTM E308	- Method for Computing the colors of Objects by using the CIE System

### 3. REQUIREMENTS

#### 3.1 Material

The polycarbonate sheets shall be manufactured from high quality polycarbonate resin that is suitable for the intended purpose.

#### 3.2 Preproduction Samples

For qualification purposes, the vendor shall submit five 6.5" x 10.5" samples of the initial batch of material manufactured to this specification, for approval of design, colour and texture. One sample shall be designated as the Master Standard; the remaining four samples shall be used as Working Standards. DHC will assign a DHC Standard Number to these samples.

#### 3.3 Mechanical Properties

The sheet material shall conform to the mechanical properties specified in **Table 1** and the following physical properties specified herein.

#### 3.4 Physical Properties

##### 3.4.1 Workmanship

Unless otherwise specified, the polycarbonate sheets shall be supplied in one of the grades, types specified herein. The finished sheets shall be free from warp, twist, cracks, chipped edges, surface blisters, visual bubbles, foreign inclusions and scratches which make definite indentations in the surface. Smooth finishes shall be uniform and flat with no objectionable surface imperfections.



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**Table 1: Mechanical Properties**

Test	Units	Thickness	Values	ASTM Test Method No.
Specific Gravity			120 to 1.25	D792
Flexural Distortion (264 psi)	°F*	1/8" min.	270 (min.)	D648
Ultimate Tensile Strength	psi*		8500 (min.)	D638
Elongation	%*		60 (min.)	
Impact Strength Notched Izod	ft.lb/in of notch	1/8"	12 (min.)	D256
Light Transmission % *** Grade P1.01/1 Clear Grade P1.01/2 Clear Grade P1.01/4-3 Bronze			85 80 50	D1003 Procedure "A", CIE Source C
Mar Resistance (1600)**	%		4 (max.)	D673
Haze ***	%		2 (max.)	D1003 Procedure "A" CIE Source C
Abrasion Resistance Taber Abrasion 100 Cycles CS10F Grade P1.01/1 Grade P1.01/2 Grade P1.01/3 Grade P1.01/4	%		35.0 1 - 3	D1044 Z26.1

\* Average of results in longitudinal direction

\*\* Applicable to mar resistant finishes only

\*\*\* Applicable to transparent materials only

### 3.4.2 Sheet Thickness

The sheet thickness of polycarbonate shall be within  $\pm 10$  percent of the specified dimension for 0.060 inches, and above, and  $\pm 15$  percent for 0.040 inches, and thinner.

### 3.4.3 Moisture Content

Polycarbonate resin used to produce clear and coloured sheet material shall contain not more than 0.35% moisture.



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#### 3.4.4 Colour

The sheets shall have an even colour density and shall match the master sample noted in **Para. 3.2**. Comparison shall be made by placing the sample side by side with the control sample in a Macbeth industrial colour matching unit, or equivalent. The direction of illumination shall be normal to the surfaces being compared. Both "North Sky Daylight" (7500K) and "Horizon Sunlight" (2300K) shall be used to compare colours.

#### 3.4.5 Ultra-Violet Resistance

Transparent polycarbonate sheet material shall show only slight discolouration when exposed to ultra-violet radiation for 336 hours and shall not be more than 5% decrease in the tensile properties. The test apparatus shall be the same as described in ASTM D1499, except the use of a water spray shall be deleted.

#### 3.4.6 Flammability Requirements

- DHMS P1.01/1 - Ultra-Violet Stabilized Polycarbonate Sheet - no flammability requirement needed, for exterior use only.
- DHMS P1.01/2 - Self-Extinguishing Polycarbonate Sheet - shall meet the requirements of FAR 25.853(a), APP. F, PART I (1)(i) Amd. 25-86.
- DHMS P1.01/3 - Self-extinguishing and Low Smoke Emission Polycarbonate - shall meet the requirements of FAR 25.853(a), APP. F, PART I (1)(i) Amd. 25-86.
- DHMS P1.01/4 - Mar resistant Polycarbonate Sheet - shall meet the requirements of FAR 25.853(a), APP. F, PART I (1)(ii) Amd. 25-86.

#### 3.4.7 Smoke Emission

DHMS P1.01/3 type polycarbonate shall have a smoke emission rating not greater than 100 D<sub>s</sub> after 4 minutes.

At least three specimens, with the results averaged, shall be tested in accordance with FAR 25.853(d), APP. F, PART V, Amd. 25-86.

Test specimens shall be conditioned prior to testing at 70°F ± 5°F at 50% ± 5% relative humidity until moisture equilibrium is reached, or for 24 hours. Only one specimen at a time may be removed from the conditioning environment immediately before subjecting it to the test.

### 4. MATERIAL QUALIFICATION REQUIREMENTS

#### 4.1 Request for Qualification

- 4.1.1 All requests for qualification to this specification shall be addressed to De Havilland Materials



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Technology Engineering department for approval.

4.1.2 All material qualification shall be site specific.

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

#### **4.2 Qualification Testing**

4.2.1 A supplier is responsible for the performance of all qualification testing, as specified in **Table 2** of this specification.

4.2.2 A supplier desiring qualification shall submit one (1) copy of a report showing actual qualification test data and a sufficient quantity of the product for De Havilland evaluation tests.

4.2.3 Preproduction samples, as noted in **Para. 3.2**, from each new combination of materials (resulting in a new colour, pattern, texture, or other appearance factor), shall be submitted for DHC Engineering approval of construction, appearance, texture, and colourfastness to light, prior to furnishing material to this specification.

#### **4.3 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 specification where the requirements are similar to this specification.

#### **4.4 Qualification Approval**

4.4.1 Upon review of supplier's data and De Havilland tests, the supplier will be advised either of product qualification or reasons for failure.

4.4.2 Products that are qualified will be listed on the Qualified Product List of this specification.

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

4.4.4 Requalification of the product may be requested by the purchaser for any changes in the method of manufacture and/or formulation.

### **5 QUALITY ASSURANCE REQUIREMENTS**

#### **5.1 Supplier Batch/Lot Acceptance Tests**

5.1.1 The manufacturer/supplier is responsible for the performance of all sampling, inspection and testing of each batch/lot as specified in **Table 2** of this specification.





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5.1.2 The manufacturer/supplier, performing Lot Acceptance Tests, as per **Para. 5.1**, shall furnish with each lot of product one copy of a Lot Acceptance Test Report showing actual test data conformance to the acceptance tests specified in **Table 2**. The report shall include the supplier's lot identification.

5.1.3 De Havilland Aircraft of Canada Limited. 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.

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

## **5.2 Purchaser Batch/Lot Acceptance Tests**

5.2.1 The purchaser/user is required to perform of all sampling, inspection and testing of each batch/lot as specified in **Table 2**.

## **5.3 Definitions**

A Lot is defined as the end product of all the raw materials mixed and/or manufactured at the same time and place. The weight or volume may vary, depending upon the capacity of the manufacturer's facilities.



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**Table 2: Qualification and Acceptance Tests**

Test	Requirement	Qualification (Supplier)	Acceptance	
			Supplier	Purchaser/User
Specific Gravity	<u>Table 1</u>	X		
Flexural Distortion	<u>Table 1</u>	X		
Ultimate Tensile Strength	<u>Table 1</u>	X	X	
Elongation	<u>Table 1</u>	X		
Mar Resistance (when specified)	<u>Table 1</u>	X		
Light Transmission (transparent material only)	<u>Table 1</u>	X		
Impact Strength	<u>Table 1</u>	X		
Haze (transparent materials only)	<u>Table 1</u>	X		
Abrasion Resistance	<u>Table 1</u>	X		
Workmanship	<u>Para. 3.4.1</u>	X	X	X
Moisture Content	<u>Para. 3.4.3</u>	X		
Colour	<u>Para. 3.4.4</u>	X	X	
Ultra-Violet Resistance (natural transparent only)	<u>Para. 3.4.5</u>	X		
Flammability	<u>Para. 3.4.6</u>	X	X	
Smoke Emission	<u>Para. 3.4.7</u>	X		

## **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.

Prior to shipment of material, a 6.5" x 10.5" sample, taken from the lot of material to be shipped, shall be forwarded to DHC for lot approval.



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## 6.2 Procurement Documents

Procurement documents should specify the following:

- Title, Number, Issue and Amendment Number of this Specification
- Grade, Type and Colour Code
- Manufacturer's Product Identity
- Total Quantity

## 7. PREPARATION FOR DELIVERY

### 7.1 Preservation and Packing

The polycarbonate sheets 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 to **Section 3** of this specification.

### 7.2 Marking

Each container shall be legibly marked with the following information:

- Polycarbonate Sheet Material (Conforms to DHMS P1.01, plus Grade, Type and Colour)
- Manufacturer's Name and Product Identification (Trade Name or Code Number)
- Quantity
- Date of manufacture
- Lot Number

### 7.3 Shipping Documentation

The shipping document shall show:

- De Havilland Purchase Order Number
  - Specification Number, Grade, Type and Colour.
  - Quantity
  - Lot Number
  - Number of Containers or Packages
  - Lot Acceptance Test Report
-



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## **8. HEALTH AND SAFETY DATA**

When supplying samples for qualification per Para. 4.2 the supplier shall submit a Safety Data Sheet (SDS) complying with Workplace Hazardous Material Information System (WHMIS) 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 (SDS) must then be supplied with a completed EHS-FO-025 "Application To Introduce A New Material" form to the Material Safety Review Committee.

Upon receipt of EHS-FO-025 "Recommendation" form that approves the use of the material, it can then be included on the Qualified Products List.

### **8.1 Environmental Compliance**

Materials and ingredients used in manufacturing the product shall comply to environmental regulations such as REACH, EPA, CPA. Prohibited substances or restricted from certain uses under an Environmental Regulation shall now be used for the specified prohibited applications.

Supplier shall notify De Havilland Aircraft of Canada Limited Materials Technology Engineering department if the product contains targeted substances.



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### QUALIFIED PRODUCTS LIST

<b>MANUFACTURER NAME AND ADDRESS</b>	<b>MANUFACTURER PRODUCT IDENTIFICATION NO.</b>	<b>DE HAVILLAND QUALIFICATION SHEET NO.</b>	<b>DATE OF PRODUCT APPROVAL</b>
<b>DHMS P 1.01/1 – Ultraviolet Resistant (Non Fire Retardant, Exterior Use Only)</b>			
SABIC Innovative Plastics One Plastics Ave. Pittsfield, Mass. 01201 413-448-5400	Lexan 9030 Series U.V. Stabilized  0A Clear 9030-112 1A Black 9030-701 2A Grey 9030-5-3001 3A Olive Grey 9030-30095 4A Green 9030-3098 5A Red 9030-62053	PQS #2	Feb 27, 1979
Atofina Chemicals Inc. Atoglas Division 128 Old Brickyard Lane Kensington, CT 06037-1437 860-829-3200	0A Tuffak A UVA Stabilized	PQS #5	Feb 20, 2002



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<b>MANUFACTURER NAME AND ADDRESS</b>	<b>MANUFACTURER PRODUCT IDENTIFICATION NO.</b>	<b>DE HAVILLAND QUALIFICATION SHEET NO.</b>	<b>DATE OF PRODUCT APPROVAL</b>
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**DHMS P 1.01/2 – Self Extinguishing**

SABIC Innovative Plastics One Plastics Ave. Pittsfield, Mass. 01201 413-448-5400	Lexan 9600 Series  0A    Natural    9600-116 1A    Bronze    9604-5109 6A    Translucent White matte One Side    9605-82067	PQS #1	Nov 23, 1973
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**DHMS P 1.01/3 – Self Extinguishing & Low Smoke Emission Content**

SABIC Innovative Plastics One Plastics Ave. Pittsfield, Mass. 01201 413-448-5400	Lexan	F-6000	PQS #4	Feb 27, 1979
	1B Black	F60011-701		
	2B Grey	F60011-70342		
	3B White	F60011-80044		
	4B Cream	F60011-50032		
	5B Beige	F60011-50461		
	6B Blue	F60011-20168		
	1C Black	F6006-701		
	2C Grey	F6006-70342		
	3C White	F6006-80044		
	4C Cream	F6006-50032		
	5C Beige	F6006-50461		
	6C Blue	F6006-21068		



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**DHMS P 1.01/4 – Mar Resistant**

SABIC Innovative Plastics One Plastics Ave. Pittsfield, Mass. 01201 413-448-5400	Lexan MR  0.060” and 0.080” Thickness -2 Clear FMR604-112 -3 Bronze FMR604-5109  0.093” Thickness (Coated Thin Gauge) -2 Clear CTG-112 -3 Bronze CTG-5109  0.125” and 0.500” Thickness -2 Clear MR10/MRT-112 -3 Bronze MR10/MRT-5109	PQS #3	July 3, 1980
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