DE HAVILLAND AIRCRAFT OF CANADA LIMITED

De Havilland
Material Specification

TITLE:	**SEALING COMPOUND, TEMPERATURE RESISTANT, INEGRAL FUEL TANKS, HIGH ADHESION**
SPECIFICATION NUMBER:	**DHMS S3.01**
ISSUE:	**F**
AMENDMENT:	**1**
DATE:	**November 13, 2020**
PAGE:	**1 of 11**

Prepared by: Approved by:

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REVISION RECORD

Issue	Page	Description and Reason for Change
A		This is a complete revised specification.
Amd. 1	8	Bedell International Corporation added to QPL as an alternative supplier in Republic of Korea.
B		This is a complete revision and detail changes have not been noted. Type classification added: I - normal weight, II - low weight Addition of a low weight sealant, Type II (PR 1776).
C		This is a complete revised issue. Detail changes have not been noted.
Amd. 1	8	QPL: The supplier's address has been changed.
Amd. 2	2	Para. 3.1.1 - Storage Life requirements changed from 14 days to 21 days @ -10°F, and from 30 days to 45 days @ -40°F.
D		This is a complete revision. Detail changes have not been noted.
Amd. 1	5	Table 1: Changed tensile load for #10 caps to 30 lbs Para 3.5: Removed minimum "*k*" requirement
	6	Para 3.5.2: Added "Within 2 hours" Para 3.5.4: Changed 2"/min to 5"/min Para 3.6.2: Removed "the two" Table 2: removed minimum "*k*" requirement
	11	Added PRC-DeSoto to QPL for Form D
Amd. 2	4	Changed "date of mixing" to "date of shipping" for storage life of Form D.
	4	Included -40°F storage life requirement for Form D.
	5, 6	Adhesion Test procedure has been modified.
	9, 10	Added "For Form D the supplier must include 2 separately packed and labelled specimens from each tray that was tested by the supplier."
Amd. 3	8	AMS 3281 requirements added for Type II sealant.
	QPL	Product PR-1776 is replaced with PR-1776M. Manufacture site changed to Mojave, CA.

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REVISION RECORD

Issue	Page	Description and Reason for Change
D		
Amd. 4	QPL	Added note – Adhesion test not required for batch size of less than 250 caps.
E		This is a complete revised issue. Detail changes have not been noted.
	6 – 7	Updated sections 4, 5 standardize with other specifications.
	8	Table 3: Clarified acceptance test requirements for both supplier and user.
	12	QPL: Added 3M products AC370 B1/2 and B2 to Type II, Class B for bulk sealant only.
Amd. 1	3	Para. 3.3.1: Revised
	6	Para. 4.5.2: Revised
	7	Para. 4.5.3: Revised
		Para. 5.3.1: Revised
	8	Table 3: Clarified adhesion test is for supplier only.
	9	Para. 7.2: Clarified requirements for date of mixing, date of manufacture.
	11	QPL: Supplier name changed. Was: “PRC Desoto Intl”, Now: “PPG Aerospace”
		Removed flag note “**”
		Added PCD #7 to product PR1776M B2 Form D. Clarified adhesion test batch acceptance is not required for PPG (based on supplier statistical data).
F		Updated Company Name
	9	Added Section 8.1 Environmental Compliance
	11	Updated manufacturer’s address to Springfield MO.
Amd. 1	10	QPL, Added note “PPG Products will have suffix “F” in their lot number indicating OPPE free”

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1. SCOPE

This specification covers the requirements for temperature resistant (-65 to +250°F), two component synthetic rubber compounds for sealing and repairing integral fuel tanks and fuel cell cavities.

1.1 Classification

The sealing compound shall be supplied in one of the following classes, types and forms:

1.1.1 Class A - Sealing material, suitable for brush application

Class B - Sealing material, suitable for application by extrusion gun and spatula

The dash numbers shall be used to designate the minimum application time in hours.

1.1.2 Type I - Regular weight sealant

Type II - Low weight sealant

1.1.3 Form D - Sealant caps, suitable for Dome sealing application

2. APPLICABLE DOCUMENTS

The following document shall form the specification of the sealant defined herein.

2.1 Aerospace Materials Specifications

SAE-AMS-S-8802	Sealing Compound, Temperature - Resistant, Integral Fuel Tanks and Fuel Cell Cavities, High Adhesion.
SAE-AMS 3281	Sealing Compound, Polysulphide (T) Synthetic Rubber for Integral Fuel Tank and Fuel Cell Cavities.

2.2 American Society for Testing and Materials

ASTM D412	Test Methods for Rubber Properties in Tension

2.3 Boeing Material Specifications

BMS 3-11	Hydraulic Fluid, Fire Resistant

2.4 Military Specifications

MIL-STD-1916	Department of Defense Test Method Standard

3. REQUIREMENTS

The sealing compounds noted shall meet all the requirements specified in **Table 3**.

3.1 Process Control Document

The manufacture of Form D caps shall be defined by a Process Control Document (PCD). The PCD, which will be listed on the QPL of this specification, will have a Number, Title, Date and Revision #.

3.2 Storage Life

3.2.1 The storage life of the Pre-Mixed Frozen (PMF) sealant shall be 21 days from the date of mixing when stored at a temperature of -10°F. Alternatively, the storage life of the pre-mixed frozen sealant shall be 45 days from the date of mixing when stored at a temperature of -40°F or lower.

3.2.2 The storage life of the unmixed sealant shall be 9 months maximum from the date of packaging and must occur within 90 days maximum from date of manufacture, when stored at temperatures between 40°F and 80°F.

3.2.3 The storage life of Form D caps containing pre-mixed frozen sealant shall be 14 days from the date of shipment when stored at -10°F or 30 days from date of shipment when stored at -40°F.

3.3 Accelerated Cure Test

The mixing process for pre-mixed and frozen sealant shall be monitored. In the case of pre-mixed and frozen sealant cartridges samples are taken from sequenced cartridges as they are filled. A small amount of sealant (a button) is removed from each cartridge and placed on a button board in the square corresponding to the number of the cartridge.

3.3.1 Accelerated Cure

Button boards or caps are left at ambient conditions for at least one hour following application of the last button sample. Specimens are cured as necessary for up to 18±2 hours at 120±5oF, and then allowed to stabilize at 77±5oF for 30 minutes before examination.

3.3.2 Visual Examination

The buttons or caps are cut through with a knife and visually examined as follows:

The cured sealant shall be of a uniform colour and consistency with no evidence of streaks of base component or accelerator.

The cured sealant shall be smooth and uniform in texture with no evidence of coarse particles, flakes or bubbles.

The maximum acceptable number of air bubbles between 0.020" and 0.062" in diameter shall be 6 and the maximum acceptable size of any single bubble shall be 0.062". Air bubbles smaller than 0.020" in diameter shall not be cause for rejection.

3.3.3 Hardness Test

The minimum acceptable hardness shall be 35 Durometer A.

3.4 Resistance to Hydraulic Fluid (Type II only)

The cured sealant shall be immersed in hydraulic fluid to BMS 3-11 Type IV, Class I, Grade A at 77±5°F for 7 days. After immersion cut 3 specimens into 0.25" by 4" dumbbell specimens conforming to ASTM D 412, Die C. Then pull each specimen in a tensile testing machine at a rate of 2" per minute. The minimum tensile strength and elongation 60 psi and 200% respectively.

3.5 Adhesion Test for Form D Sealant Caps

The pre-filled cured sealant caps shall be pulled to failure and all values shall be reported. Sealant caps at 77±5°F shall meet the minimum tensile load requirement specified in **Table 1**. Furthermore there shall be no evidence of an interface between the pre-cured cap and the filling.

Table 1: Minimum Tensile Load and Nail Dimensions

Cap Size	Tensile Load (lbs.)	Nail Dimensions		
		Length	Head Diameter	Shank Diameter
6	20	3”	0.275”	0.135”
8	20	1.25”	0.4”	0.15”
10	30	1.25”	0.4”	0.15”

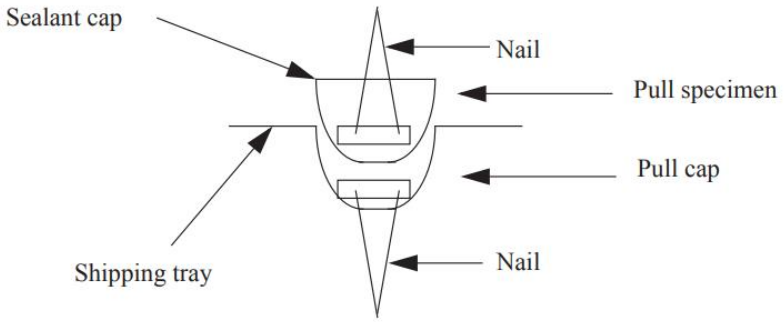

Figure 1: Adhesion Test Assembly

Frozen Form D caps are thawed for a minimum of 15 minutes at ambient conditions. Within 2 hours, a pull specimen is prepared by embedding a cleaned nail head into the wet sealant (care is taken to twist the nail as it is inserted into the sealant to ensure complete coating of the head with sealant, minimizing air pockets, and complete insertion of the head into the dome cap). Pull caps are prepared by drilling a hole slightly smaller than the diameter of the nail shaft (see **Table 1**) through the bottom of the molded shipping tray and pushing a nail through the hole. The interior of the pull cap is coated with epoxy so that the nail can be sealed in place and the pull specimen is embedded into the epoxy. The assembly is then allowed to cure per the accelerated cure in **Para.3.3.1** (see **Figure 1**). The assembly is clamped in place on Scott tester or equivalent, subject to De Havilland Engineering approval. Tester is activated and assembly is pulled at 5"/min. to failure.

3.6 Sample Size and Rejection Criteria

3.6.1 Cartridges

Each cartridge has a small amount removed so that a visual button test can be performed. In addition, a minimum of 5% of the buttons are tested for hardness. Buttons shall be selected so that they are evenly distributed throughout the batch. Cartridges corresponding to buttons that do not meet the cure standard described in **Para.3.3** shall be removed from the lot. Additionally, the cartridge preceding the rejected cartridge and the two following shall be removed from the lot. When a rejection is found the cartridge immediately prior to and immediately following those that have been removed shall be tested. A cartridge can also be rejected based on the visual test, but in this case, only one cartridge following is also removed.

3.6.2 Form D

Sampling size shall be based on batch size and **Table 2**. To ensure a random selection, caps shall be selected from trays that are evenly spaced out during production. Failure of a cap to meet either the accelerated cure or adhesion test requirements specified above shall be cause for the corresponding tray to be removed from the lot. Additionally, the tray preceding the rejected tray and following shall be removed from the lot. When a rejection is found the tray immediately prior to and immediately following those that have been removed shall be tested. If more than 30% of the caps tested are rejected consult De Havilland Materials Technology Engineering for disposition.

Table 2: Sampling Size

Batch Size (# of caps)	Sampling Size (# of caps)
<5000	85
>5000	100

4. MATERIAL QUALIFICATION REQUIREMENTS

4.1 Request for Qualification

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

All material qualification shall be site specific.

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

4.2 Qualification Testing

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

4.2.1 A sample shall be submitted for testing at the discretion of De Havilland Materials Technology Engineering for evaluation.

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 Process Control Document

4.4.1 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.

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

4.4.3 The PCD and all production data shall be available to any De Havilland auditors when requested.

4.5 Qualification

4.5.1 Upon review of supplier's data, PCD and De Havilland tests, the supplier will be advised either of product qualification or reasons for disqualification. Products that are qualified will be listed in the Qualified Products List of this specification.

4.5.2 No significant changes in the method of manufacture and/or formulation that affect form, fit or function shall be made without notification and prior written approval of De Havilland Materials Technology Engineering Department.

4.5.3 Re-qualification of the product may be requested by the De Havilland Materials Technology Engineering if there significant changes in the method of manufacture and/or formulation that affect form, fit, function.

5. QUALITY ASSURANCE REQUIREMENTS

5.1 Manufacturer 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 3**.

5.1.2 The manufacturer/supplier shall issue with each batch of product one copy of an Acceptance Test Report showing actual test data conformance to the acceptance tests specified in **Table 3**. The report shall include the supplier's batch identification, materials specification and date of testing.

5.1.3 De Havilland 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.

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

The purchaser/user is required to perform of all sampling, inspection and testing of each batch/lot as specified in **Table 3**.

5.3 Definition

5.3.1 Batch - A batch shall be the entire product produced in a single production run from the same lot of raw material under the same fixed conditions and submitted for inspection at one time. (For example in the case of sealant caps, change of sealant filler batch number, change of preformed caps batch number etc. is taken as change of fixed condition)

5.3.2 A lot is defined as the total quantity of product in a shipment taken from the same batch.

6. ORDERING DATA

6.1 Prerequisite

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

Table 3: Qualification and Batch Acceptance Tests

Property	Requirements (See Remarks)	Qualification (Manufacturer / Supplier)	Acceptance (Purchaser/ User)
Specific Gravity		x	
Non-Volatile Content		x	
Viscosity		x	
Flow (B)		x	x
Application Time		x	x
Tack Free		x	x
Standard Cure Rate (A and B)		x	x
Fluid Immersed Cure Rate (A1/2 and B1/2)		x	
Resistance to Thermal Rupture		x	
Low Temperature Flexibility		x	
Peel Strength		x	
Corrosion Resistance		x	
Weight Loss and Flexibility		x	
Tensile Strength		x	
Elongation		x	
Chalking		x	
Accelerated Storage Stability		x	
Reparability (A and B)		x	
Storage Life	**Para. 3.2**	x	
Accelerated Cure Test *	**Para. 3.3**	x	x
Resistance to Hydraulic Fluid (Type II only)	**Para. 3.4**	x	
Adhesion Test **	**Para. 3.5**	x	x

REMARKS: Except for Storage Life, Accelerated Cure Test, Resistance to Hydraulic Fluid and Adhesion Test, the requirements for Type I sealants are to SAE AMS-S-8802 and the requirements for Type II sealants are to AMS 3281.

* Applies to pre-mixed frozen sealant supplied in cartridges and Form D sealant only.

** Applies to pre-mixed frozen Form D sealant only. Applicable to supplier only. See QPL.

6.2 Procurement Documents

Procurement documents should specify the following:

- Title, Number Issue and Amendment Number of this specification
- Manufacturer's Name and Product Identification
- Type and Size of Cartridges or Cap
- Type, Class and Form of Material
- Quantity

7. PREPARATION FOR DELIVERY

7.1 Packaging

The sealant shall be packed in such a manner as to assure that during shipment and storage the product will be protected against damage from exposure to hazards that could have adverse effects on conformance to **Section 3** of this specification.

For bulk sealant including injection kits, the temperature should be maintained between 40°F-80°F during transit.

For pre-mixed frozen sealant, the supplier must ensure that the sealant is maintained at a temperature below -10°F during transit.

For Form D the supplier must include 2 separately packed and labelled specimens from each tray that was tested by the supplier.

7.2 Identification

Each container shall be legibly marked with the following information:

- Sealing Compound, Temperature Resistant, Integral Fuel Tank, High Adhesion
- DHMS S3.01 A2, A1/2, B2 or B1/2, Type I or II, Form D
- Manufacturer's Name and Product Identification
- Purchase Order Number
- Batch Number.
- Quantity
- Date of Manufacture (For 2 part kits)
- Date of Mixing (for premixed and Frozen sealant and Form D caps)
- Cartridge Size or Cap size
- Expiry Date
- Perishable - Store Below -10°F (for Premixed and Frozen sealant and Form D caps)

7.3 Shipping Documentation

The shipping document shall show:

- Sealing Compound, Temperature Resistant, Integral Fuel Tank, High Adhesion
- DHMS S3.01 A2, A1/2, B2 or B1/2, Type I or II, Form D
- Manufacturer's Name and Product Identification
- Purchase Order Number
- Batch Number
- Quantity
- Cartridge Size or Cap size
- Certificate of Conformance including Acceptance Test Reports

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

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 not 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.

QUALIFIED PRODUCTS LIST

MANUFACTURER NAME AND ADDRESS	MANUFACTURER PRODUCT IDENTIFICATION NO.	DE HAVILLAND QUALIFICATION SHEET NO.	SAFETY DATA SHEET	DATE OF PRODUCT APPROVAL
	TYPE I			
	Class A			
PRC-Desoto International	PR 1422 A1/2	PQS #1	1810 1811	May 4, 1973
PPG Aerospace	PR 1422 A2	PQS #2	0786 0566	
11601 United Street				
Mojave, CA 93501	**Class B**			
	PR 1422 B1/2	PQS #3	0946 0947	May 4, 1973
	PR 1422 B2	PQS #4	0565 0567	
Distributor:	**TYPE II**			
PPG Canada dba	**Class B**			
PPG AEROSPACE	PR 1776M B1/2	PQS #8	2327 2328	Mar 24, 2003
-ASC Canada*	PR 1776MB2	PQS #9	2243 2244	Mar 24, 2003
5676 Timberlea Blvd.				
Mississauga, Ontario	**Class B**			
L4W 4M6	**Form D**			
Tel: (905) 629-7999	PR 1776M B2	PQS #9 PCD #7**	2243 2244	Mar 24, 2003

As of July 2020, PPG Products will have suffix "F" in their lot number indicating OPPE free. PPG sealants lots without suffix "F" may be used to depletion.

* Location for casting and filling of caps.

** Batch acceptance: adhesion test is not required for PPG.

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QUALIFIED PRODUCTS LIST

MANUFACTURER NAME AND ADDRESS	MANUFACTURER PRODUCT IDENTIFICATION NO.	DE HAVILLAND QUALIFICATION SHEET NO.	SAFETY DATA SHEET	DATE OF PRODUCT APPROVAL
3M 3211E Chestnut Expy. Springfield, MO 65802 USA	**TYPE II** **Class B** AC 370 B1/2 AC 370 B2	PQS #10	4029, 4030	July 26, 2016
Approved to supply Bulk Sealants only. NOT Pre-Mixed Frozen (PMF).				