de Havilland Inc.

Material Specification

TITLE:	**ENAMEL, CLEAR OR PIGMENTED, PROTECTIVE COATING, POLYURETHANE**
SPECIFICATION NUMBER:	**DHMS C 4.05**
ISSUE:	**ORIGINAL**
AMENDMENT:	**2**
DATE:	**March 4, 1983**
PAGE:	**1 of 13**

Prepared by:

SIGNED ORIGINAL ON FILE

D. Cheng
Materials Technology

Approved by:

D.S. Binnington

J. Thorne

1 SCOPE

This specification covers the requirements for clear or pigmented fluid and weather resistant urethane protective coatings. It is to be used as a protective coating on aircraft walkways, floors, landing gear legs, etc. This enamel is applied as a topcoat on epoxy primed (DHMS C4.01) parts. No intermediate primer is required.

2 APPLICABLE DOCUMENTS

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

2.1 Specifications

QQ-A-250/5	Aluminum Alloy Alclad 2024, Plate and Sheet
MIL-H-5606	Hydraulic Fluid, Petroleum B3se, Aircraft
TT-S-735	Standard Test Fluids: hydrocarbon
MIL-L-7808	Lubricating Oil Aircraft Turbine Engine Synthetic Base
DHMS - F7.01	Hydraulic Fluid, Phosphate Ester Type
DHMS - C4.01	Primer, Fluid Resistant, Epoxy

2.2 Standards

Federal Test Method	Paint, Varnish, lacquer and Related
Std. No. 141	Materials: Methods of Inspection, Sampling and Testing

3 REQUIREMENTS

3.1 Paint Requirements

3.1.1 Materials - Materials used in the manufacture of this product shall be of the highest quality and suitable for the intended purpose.

3.1.2 Components - The enamel topcoat shall be a two-component system, consisting of a base component and a catalyst. The components shall be packaged in separate containers and supplied in kit form. The catalyst shall not be batch oriented to the base component.

3.1.3 Mixing Ratio - The enamel topcoat shall be so formulated so as to have mixing ratios within the following limits:

1 to 10 parts by volume of base component; 1 part by volume of catalyst.

When mixed according to the manufacturer's directions, the enamel top coat shall conform to the requirements of this specification.

3.2 Requirements for As Received Enamel Base and Catalyst (Not Catalyzed)

3.2.1 Condition in Container - The base component and the catalyst in the container shall be free from skins, lumps and grit, and shall be capable of being easily mixed to a smooth, homogeneous condition. The component containing the pigment shall show no separation of the pigment.

3.2.2 Storage Stability - The base component and the catalyst, when stored in separate, tightly closed containers for 12 months (min.) at a temperature range of 65^{o} to 90^{o}F, shall be capable of meeting the requirements of this specification.

3.3 Requirements for Catalyzed Enamel (Not Thinned)

3.3.1 Solids Content - When tested as specified in Para. 4.3, the solids content of the catalyzed enamel shall be as follows:

Solids by Weight - High Pigment 45% min; Low Pigment 35% min.

The minimum solids content of other pigment enamels shall lie within the above minimum limits, and a specific pigment enamel shall not vary more than ± 2% from batch to batch.

3.3.2 Fineness of Grind - The fineness of grind value of the non-volatile (solids) content of the catalyzed enamel shall not be less than 7, when tested as specified in Para. 4.3.

3.3.3 Coarse Partic1es and Skins - Coarse particles and skins of the catalyzed enamel retained on a #325 sieve shall not exceed 0.05%, by weight, of the total non-volatile content, when tested as specified in Para. 4.3.

3.3.4 Weight - The weight of the catalyzed enamel, per Imperial gallon, shall be as follows:

High Pigment Content - 12.0 lbs. min.

Low Pigment Content - 10.2 lbs. min.

The minimum weight of other pigment enamels shall lie within the above minimum limits and a specific pigment enamel shall not vary more than 0.2 lbs. per Imperial gallon from batch to batch.

3.3.5 Colour - The colour of the catalyzed enamel shall be as specified on the Purchase Order. When tested as specified in Para. 4.3, the colour shall acceptably match the colour chip standards agreed upon by the Purchaser and Vendor.

3.3.6 Pigment - The basic hiding pigments shall be chemically pure and free from extenders.

3.4 Viscosity Requirements of Catalyzed enamel

3.4.1 Viscosity - The viscosity of the catalyzed enamel (without addition of thinners), after suitable mixing agitation and a 30 minutes waiting period, shall be such that the mixed enamel may be sprayed (up to 8 hours after mixing) using standard shop equipment, and shall meet the requirements of Para. 3.5.2.

3.4.2 Pot Life - A one-quart sample of catalyzed enamel, mixed as specified in Para. 3.5.2, shall be stored in a closed container for a period of 8 hours at a temperature of 70^{o} 5^{o}F. At the end of the 8 hour period, the catalyzed enamel shall show no signs of lumping, seeding and separation and shall be capable of meeting the requirements of Para's 3.4.1, 3.5.1, 3.5.2, and all paragraphs of Sections 3.6 and 3.7.

3.5 Requirements of Applied, Uncured Coatings

3.5.1 Drying Time - The topcoat enamel, when applied over an epoxy primed metal surface to a dry film thickness per Para. 4.2, shall have the following drying characteristics:

3.5.1 Continued

- set to touch in 20 minutes
- dry dust-free within 45 minutes
- dry tack free within 1 and 1/2 hours
- dry through within 4 hours
- be recoatable within 3 hours

The above drying times apply for a temperature of $70^{o} \pm 5^{o}$F and a relative humidity of 50 ± 10%.

3.5.2 Spraying Properties - When the pigmented enamel base component is mixed with the catalyst according to manufacturer's instructions, the mixed enamel shall exhibit satisfactory spraying characteristics with acceptable leveling properties, when tested in accordance with Para. 4.3.

3.5.3 Surface Appearance - The catalyzed enamel, when applied by spraying, shall show no sagging, running or streaking and shall dry to a hard, smooth finish. The dried film shall be free from seeds, blisters, blushing, and other surface irregularities.

3.6 Fluid Resistance Requirements of Applied and Cured Coatings

3.6.1 Adhesion (Wet) Tape Test - Three scored test panels, prepared per Para. 4.2, shall be immersed in distilled water at $73^{o} \pm 3^{o}$F for a period of 24 hours. Upon removal, the panel shall be tape tested per Para. 4.3, using one-inch masking tape, Scotch No. 250, or equivalent. The test shall not exhibit any removal of the top coat from the primer coat or removal of the paint system from the panel.

3.6.2 Corrosion Resistance (Salt Spray Test) - Two scored test panels, prepared per Para. 4.2, shall be exposed to 5% salt spray test, per Para. 4.3, for a period of 240 hours. The test panel shall be without visible corrosion of the metal and without evidence of blistering, flaking or underscoring. Disregard corrosion due to "edge effect".

3.6.3 Hydrocarbon Resistance - Two scored test panels, prepared per Para. 4.2, shall be tasted for hydrocarbon resistance, as specified in Para. 4.3. The panel shall be immersed in a hydrocarbon fluid conforming to TT-S-735, Type III, at $73^{o} \pm 3^{o}$F for 7 days (168 hours). Upon removal from the test fluid, the paint system shall show no blistering, wrinkling, and no more than a slight whitening or softening. After 24 hours air drying the immersed portion of the paint system shall have recovered its pretest hardness.

3.6.4 Synthetic Fluid Resistance - Two scored test panels, prepared as specified in Para. 4.2, shall be immersed in a synthetic lubricating oil conforming to MIL-L-7808 at $73^{o} \pm 3^{o}$F for a period of 7 days (168 hours) per Para. 4.3. The paint system shall show no blistering, wrinkling or other visible defects and no more than a slight softening immediately after removal from the test fluid. After 24 hours air drying the immersed portion of the paint system shall have recovered its pretest hardness.

3.6.5 Hydraulic Fluid Resistance - Two scored test panels, prepared per Para. 4.2, shall be tested for resistance to hydraulic fluid per Para. 4.3. The panel shall be immersed in hydraulic fluid conforming to MIL-H-5606 at $73^{o} \pm 3^{o}$ for 7 days (168 hours). The paint system shall show no wrinkling or blistering and no more than slight softening upon removal from the fluid. After 24 hours air drying, the immersed portion of the paint system shall have regained its pretest hardness.

3.6.6 Phosphate Ester Fluid Resistance - One scored test panel, prepared per Para. 4.2, shall be tested for resistance to phosphate ester hydraulic fluid conforming to DHMS F7.01. The panel shall be wetted (not immersed) with fluid every 24 hours and exposed in an oven operating at $49^{o} \pm 3^{o}$C ($129^{o} \pm 5^{o}$F) for a period of 72 hours.Upon removal from the oven, the paint system shall show no blistering, wrinkling, and no more than a slight film softening. After 24 hours air drying the wetted portion of the paint system shall have regained its pre-test hardness.

3.6.7 Water Resistance - Three unscored test panels, prepared per Para. 4.2, shall be immersed in distilled water at $73^{o} \pm 3^{o}$F for 7 days (168 hours) and tested per Para 4.3. The paint system shall show no blistering or wrinkling and no more than a slight softening immediately after removal from the water. After 24 hours air drying the immersed portion of the paint system shall have regained its pretest hardness.

3.6.8 Accelerated Weathering (Open Arc Apparatus) - Two unscored test panels, prepared per Para. 4.2, shall be tested for resistance to weathering per Para. 4.3 for a period of 21 days (504 hours). The paint shall show no chalking or loss of colour.

3.7 Physical Property Requirements of Applied and Cured Coatings

3.7.1 60 Degree Specular Gloss - Prepare and test one specimen per requirements of Para 4.3. The specular gloss value of the specimen shall not be less than 80 for high gloss enamel; semi-gloss enamel shall not be less than 35.

3.7.2 Impact Resistance - Three unscored test panels, prepared per Para. 4.2, shall be tested for impact resistance using a Gardner Impact Tester. The paint system shall not show any flaking or cracking at the following impact values:

(a) Negative impact, i.e. the impact is directed against the unpainted or reverse side of the panel.

- 4 in-lbs.

(b) Positive impact, i.e. the impact is directed against the painted or forward side of the panel.

- 25 in-lbs.

3.7.3 Flexibility - Two unscored test panels, prepared per Para. 4.2, shall be subjected to a bend test per Para. 4.3. The paint system shall show no failure when bent over a 0.5 inch diameter mandrel through 180^{o}.

4 QUALITY ASSURANCE

4.1 Qualification and Batch Acceptance Tests

4.1.1 Qualification Tests

a) All requests for source/product qualification shall be directed to the Quality Assurance Department of the de Havilland Inc.

b) A supplier is responsible for the performance of all qualification testing, as specified tn Table 1 of this specification.

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

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

e) Products which are qualified will be listed in the Qualified Products List of this specification.

f) 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 of de Havilland Inc.

4.1.1 Continued

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

4.1.2 Qualification by Similarity - Where a product has been qualified to another similar specification, the supplier may submit this qualification test report in lieu of performing a separate qualification test required by Para. 4.1.1 of this specification. The similar specification may be a government, company or other specification, where the requirements are similar to this specification.

4.1.3 Acceptance Tests

a) Unless otherwise specified in the contract or purchase order, the supplier is responsible for all Batch Acceptance Tests, as specified in Table 1 of this specification.

b) The supplier, performing batch acceptance tests per para. 4.1.3(a), shall furnish with each lot of product one copy of a Batch Acceptance Test Report showing actual test data conformance to the acceptance tests specified in Table 1. The report shall include the supplier's batch identification.

c) De Havilland Aircraft 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.

4.1.4 Definitions

a) Batch 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.

b) Lot is defined as the total quantity of product in a shipment taken from the same batch.

TABLE 1. Qualification and Batch Acceptance Tests

Test	Paragraph	Qualification	Acceptance
Solids Content	3.3.1	x	x
Fineness of Grind	3.3.2	x	
Coarse Particles and Skins	3.3.3	x	
Weight per Gallon	3.3.4	x	
Colour Difference of Opaque Materials (Instrumental Measurement)	3.3.5		x
Viscosity	3.4.1	x	
Pot Life	3.4.2	x	
Drying Time	3.5.1	x	x
Spraying Properties	3.5.2	x	
Adhesion (Wet) Tape Test	3.6.1	x	
Corrosion Resistance (Salt Spray Test)	3.6.2	x	
Hydrocarbon Resistance	3.6.3	x	
Synthetic Fluid Resistance	3.6.4	x	
Hydraulic Fluid Resistance	3.6.5	x	
Phosphate Ester Fluid Resistance	3.6.6	x	
Water Resistance	3.6.7	x	
Accelerated Weathering (Open Arc Apparatus)	3.6.8	x	
60 Degree Specular Gloss	3.7.1	x	
Impact Resistance	3.7.2	x	
Flexibility	3.7.3	x	

4.2 Test Panels

Test panels shall be 3" x 6" x 0.032" alclad aluminum alloy to specification QQ-A-250/5. The test panels shall be prepared as follows:

(a) Chromic acid anodize per PPS 32.03.

(b) Spray a coat of chromated epoxy primer to a dry film thickness of 0.0005" - 0.0007" (for both Type I and II primers, per DHMS C4.01). Air dry 1.5 hours.

(c) Spray final topcoat of urethane ename1, per DHMS C4.05 to a dry film thickness of 0.0018" - 0.0025".

(d) Air dry for 7 days (168 hours) at a temperature of $70^{o} \pm 5^{o}$F and a relative humidity of 50 ± 10%.

(e) Test panels are specified in each applicable paragraph as "scored" or "unscored". Scored test panels shall be prepared as follows: one face of the test film shall be scribed with a sharp instrument diagonally from corner to corner through the paint system and anodic coating to the base metal.

4.3 Test Method

Tests shall be conducted in accordance with the specified methods of Federal Test Method Standard No. 141.

TABLE 2.

Test	**Federal Test Method Std. No. 141** Method No
Solids Content	4041
Viscosity (Ford Cup)	4282
Weight Per Gallon	4184
Drying Time	4061
Adhesion (Wet) Tape Test	6301
Flexibility	6221
Salt Spray (Fog) Test	6061
Hydrocarbon Resistance	6011
Synthetic Fluid Resistance	6011

TABLE 2.

Test	Federal Test Method Std. No. 141 Method No
Hydraulic Fluid Resistance	6011
Water Resistance	6011
Fineness of Grind	4411.1
Coarse Particles and Skins in Synthetic Vehicle Enamels, Lacquers and Dopes	4092.1
Spraying Properties	4331.1
60 Degree Specular Gloss	6101
Accelerated Weathering (Open Arc Apparatus)	6151
Colour Difference of Opaque Materials (Instrumental Measurement)	6123

5 ORDERING DATA

5.1 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.

5.2 Procurement Documents

Procurement documents should specify the following:

(a) title, number, issue and amendment number of this specification

(b) type and size of containers (Imperial or U.S. measure)

(c) total quantity (Imperial or U.S. measure)

(d) enamel type: clear or pigmented

(e) colour, colour chip standard number or colour control sample.

6 PREPARATION FOR DELIVERY

6.1 Preservation and Packing

The enamel 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 which would affect adversely the property conformance to Section 3.0 of this specification.

6.2 Packaging

The enamel shall be supplied in a kit packaged as a unit, consisting of either one U.S. gallon or one Imperial gallon base component and the required amount of catalyst and thinners (urethane grade) to bring the topcoat enamel to spraying consistency.

6.3 Marking

Each container shall be legibly marked with the following information :

Enamel - Clear or Pigmented, Protective Coating Polyurethane

(Conforms to DHMS C4.05)

Component 1 (Base}

Component 2 (Catalyst)

Manufacturer's Name and Product Identification

(Trade Name or Code Number)

Date of Manufacture

Batch Number

Net Quantity (Imperial or U.S. Measure)

Colour and Colour Chip Standard Number

6.4 Shipping documentation

Shipping document shall show:

De Havilland Purchase Order No., Specification Number, Number of Containers, Batch Number, Total Quantity (Imperial or U.S. Measure), Enamel Type: Clear or Pigmented

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	DE HAVILLAND QUALIFICATION SHEET NO.	MSDS #	DATE OF PRODUCT APPROVAL
Distributor				
Trebor Industrial Sales, 1724 St. Clair Ave. W., Toronto, Ont.	3401 3403 3405	PQS #2	0025/72	July 9, 1974
Manufacturer				
Tempo Paint & Varnish Co., Div. of Tower Chemicals Co., 69 Howden Rd., Scarborough, Ont. M1R 3C7				