BOMBARDIER

de Havilland
Material Specification

TITLE:	**DECORATIVE INTERIOR PAINT SYSTEM**
SPECIFICATION NUMBER:	**DHMS C 4.22**
ISSUE:	**C**
AMENDMENT:	**1**
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PAGE:	**1 of 14**

Prepared by: Approved by:

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REVISION RECORD

Issue	Page	Description and Reason for Change
NC	All	This is a new specification.
A		Add Type V and Type VI. Add new supplier MANKIEWICZ, Germany
B		Re classified Type I, added Type VII.
	3	Clarified viscosity and Pot life.
	4	Table 1: Added note for drying condition
	10	Added Viscosity to Type VI product.
Amd.1		Removed Sherwin Williams product POLANE
	QPL	Added MANKIEWICZ to Type VII
Amd. 2	4	Table 1 correction: Was: ". 30 minutes Minimum." Now: ".30 minutes Maximum."
C		This is a complete revised issue. Added new type IX Updated Flammability requirement FAR 25.853 designation. Removed OSU, NBS and replaced with Heat Release, Optical Smoke Density.
	3	4.1.4: Shelf life Was; 2 years, Now; 12 months. 4.2.4: pot life of catalyzed material: 3 hrs minimum.
	4	Table 1: Updated drying time. 4.3.5: Updated gloss unit: Was: 8- 12 for low gloss, Now: 4 to 8 Was: 20-30 for semi gloss, Now: 12-30.
	6	Table 2: Clarified thickness requirement for thermoplastic test panel. Revised Composite test panel requirement in Note 1 Table 2.

REVISION RECORD

Issue	Page	Description and Reason for Change
C	8-9	Revised section 7, standardized with other specifications.
	10	Table 3: Clarified batch acceptance testing for Supplier and User.
		Added note for curing time and temperature.
	13-14	QPL: Added MAPAERO products to Type VI, VII.
		QPL: Added MAPAERO product to Type IX Primer.
Amd. 1	13-14	QPL: Added Mankiewicz product FST 343-57/FST 345-57 to IX Primer
	14	Corrected MAPAERO product designation. Was: "557XXX" Now: "559XXX"
	13	QPL: Removed Product AERODEX WB 9001W100, as product no longer available.

1 SCOPE

This specification establishes the requirements for decorative interior paint system (primer/filler-topcoat), Bombardier Aerospace Toronto designation F42.

2 CLASSIFICATION

Type I - A waterborne white primer for solvent sensitive thermoplastic.

Type II - A semi-gloss interior decorative top coat

Type III - A low gloss interior decorative top coat.

Type IV - A white primer for solvent resistant thermoplastic and composites parts.

Type V - A flat interior decorative top coat.

Type VI - A waterborne (Semi-gloss) interior decorative topcoat. (This coating is not compatible with Type I primer on Polycarbonate)

Type VII - A waterborne (Low gloss) interior decorative top coat (This coating is not compatible with Type I primer on Polycarbonate)

Type IX - A waterborne primer for solvent resistant thermoplastic and composite parts for use with DHMS C4.22 top coats.

3 APPLICABLE DOCUMENTS

The following documents form part of this specification, to the extent defined herein. In the event of conflicting requirements between this specification and those listed below, the requirements of this specification shall govern. Where a specific issue of a document is not stated, the current issue shall be used.

3.1 U.S. Government Specifications

QQ-A-250/5 - Aluminum Alloy, Alclad 2024, Plate and Sheet

MIL-C-5541 - Chemical Conversion Coatings for Aluminum Alloys

3.2 Federal Specifications

FAR25.853(a) App. F Part I(a)(1)(i) & FAR 25.853(d) App. F Part IV & V Amd. 25-86 - Flammability Requirements

3.3 American Society for Testing & Materials

ASTM D523 - Specular Gloss

ASTM D2197 - Adhesion of Organic Coatings by Scrape Adhesion

ASTM D2369 - Volatile Content of Coatings

ASTM D2794 - Resistance of Organic Coatings to the Effect of Rapid Deformation (Impact)

ASTM D3359 - Measuring Adhesion by Tape Test

ASTM D3363 - Film Hardness by Pencil Test

ASTM D4060 - Abrasion Resistance of Organic Coatings by the Taber Abraser

3.4 Bombardier Aerospace Toronto Specifications

DHMS C4.01 - Primer, Fluid Resistant, Epoxy

DHMS C4.04 - Enamel, Polyurethane

DHMS P1.01 - Polycarbonate Sheet Materials

DHMS P1.59 - Glass-Graphite fabric, Fire Resistant Phenolic Resin Impregnated.

DHMS S5.01 - Slow Evaporating, Manual Wipe, Degreasing and Cleaning Compound. Grade A

4 REQUIREMENTS

4.1 Component Requirements

4.1.1 Materials - Materials used in the manufacture of this product shall be of high quality and suitable for the purpose.

4.1.2 Components - The primer and topcoat shall each consist of two or three components, packaged separately, and supplied in kit form. The components shall not be batch oriented. Thinner can also be supplied as a part of the kit.

4.1.3 Condition in Container - The base component shall be free from lumps, skins, grit and coarse particles and shall show no more settling or caking than can be easily dispersed with a paddle to a smooth, homogeneous condition. The catalyst component shall be clear and clean.

4.1.4 Shelf Life - The previously unopened, packaged product shall meet all the requirements specified herein after a period of at least 12 months from the date of manufacture when stored at 16 to 30^{o}C.

4.1.5 Non-Volatile Content - The non-volatile content of the base and catalyst components (for both primer and topcoat) shall not vary by more than ± 2% from the value established on the material qualification report when tested per ASTM D2369. These values shall be kept by Materials Technology Engineering.

4.2 Mixed Material Requirements

4.2.1 Mixing Ratio - The base and catalyst shall be mixed according to the manufacturer's instructions.

4.2.2 Spraying Properties - The mixed enamel shall exhibit satisfactory spraying characteristics with acceptable leveling properties. The catalysed material shall spray satisfactorily with no sagging, running or streaking.

4.2.3 Viscosity - The viscosities of the mixed primer and topcoat, determined 30 minutes after mixing using a Zahn #2 cup, shall be such that the primer and topcoat can be sprayed with or without the addition of a thinner. Each viscosity shall vary by no more than 4 seconds from the value established during qualification. For type VI and VII, the viscosity shall be measured to ASTM D2196 using spindle LV#4 at 100 rpm to the requirements of QPL.

4.2.4 Pot Life - A sample of catalyzed material shall show no lumping, gelling or separation after being stored in a closed container for 3 hours minimum at 10 to 30^{o}C, and shall meet all the requirements of this

specification.

4.3 Film Properties

4.3.1 Coating Thickness - When applied according to the manufacturer's instructions, the total dry film thickness of the topcoat (dry through as per **Table 1**) shall be 0.0014 to 0.0020 inch, and 0.001 to 0.0011 inch for primer.

4.3.2 Drying Time - Drying times for the primer-topcoat system shall be per **Table 1** under ambient conditions (25°C and 50% relative humidity).

Table 1: Drying Times for Decorative Interior Paint System

Drying Condition	Primer/Filler	Topcoat
dry to touch (tack-dry) *	30 minutes	60 minutes
dry to handle	3 hrs	8 hrs @ RT or 1 hr @60°C
dry through	12 hrs.@ 60°C	4-24 hrs @RT or 1/2-4 hrs @60°C
* Note: Type VI and Type VII - 30 minutes maximum		

4.3.3 Surface Appearance - The dried primer and primer-topcoat film shall be free of grit, seeds, craters, blisters, or any other surface irregularities.

4.3.4 Colour - The colour of the primer shall be white. Upon qualification, the colour of the topcoat shall be established and the colour chip provided (minimum size is 3 inches x 3 inches).

4.3.5 Gloss - The specular gloss, measured according to ASTM D523, 48 hours after application shall be 4 to 8 units for low gloss and 12 to 30 units for semi-gloss.

4.3.6 Hardness - Two test specimens A per **para. 5.1** shall be tested according to ASTM D3363. The primer-topcoat system shall have a pencil hardness of 2H minimum.

4.3.7 Fluid Resistance - Before immersion, test specimens shall undergo pencil hardness testing. Three test specimens A per **para. 5.1** shall be immersed in tap water for 24 hours. The cured primer-topcoat system shall show no blistering, loss of adhesion or other deleterious effects when tested to ASTM D3359 Method B within 15 minutes of removal from the test fluid. After a 24 hour recovery period, the primer-topcoat system shall regain its pre-test pencil hardness.

4.3.8 Hiding Properties - The applied system shall not permit the differentiation of substrate colours when tested according to **para. 6.1**.

4.3.9 Stain Resistance - The applied system shall not be stained when tested according to **para. 6.2**.

4.3.10 Abrasion Resistance - The average weight loss of the applied system shall not exceed 5 mg per 100 cycles when tested according to **para. 6.3**.

4.3.11 Scratch Resistance - A 5 kg weight shall not scratch the applied system when tested to **para. 6.4**.

4.3.12 Impact Resistance - The primer-topcoat system shall not exhibit flaking or cracking when subjected to 40 in.lbs impact from direct side and 10 in.lbs from reverse side. Two test specimens A per **para. 5.1** shall be tested per ASTM D2794.

4.3.13 Effect on Solvent Sensitive Materials - The primer-topcoat system shall not craze or crack test specimens

when tested according to **para. 6.5**.

4.3.14 Repairability - The primer and topcoat shall show no blistering, loss of adhesion, or other deleterious effects when tested according to **para. 6.6**.

4.3.15 Flammability - Three test specimens each of C, D, E, F, G, H, and I per **para. 5.1** conditioned for 24 hours at 21 ± 2°C (70 ± 5°F) and 45 to 55% relative humidity shall meet:

- Flammability requirements of FAR 25.853(a), App. F Part I(a)(1)(i) Amd. 25-86 (60 sec. vertical)
-Heat Release to FAR 25.853(d), App. F Part IV Amd. 25-83, and
- Optical Smoke Density to FAR 25.853(d), App. F Part V Amd. 25-86.

4.3.16 Dry Tape Adhesion - Three test specimens A per **para. 5.1** shall be tested per ASTM D3359 Method B. The cured primer-topcoat system shall show no evidence of loss of adhesion.

5 PREPARATION OF TEST SPECIMENS

5.1 Preparation of Test Specimens (and equivalent LAB drawing test specimens)

5.1.1 Before application of the primer and topcoat, prepare the required test specimens to **Table 2**.

5.1.2 The primer shall be prepared by thoroughly mixing each of the components separately before being mixed together and thinner (if applicable) according to the manufacturer's instructions. Allow the primer to stand for 30 minutes before spraying. Spray the panels with one cross coat of the primer. The dry film thickness shall be 1.0 - 1.1 Mils. After allowing the primer to dry tack-free, apply the topcoat to meet the requirements of **para. 4.3.1**.

Table 2: Test Panels

Panel	LAB Dwg.	Material	Size	Pre-Treatment
A	062-1C	2024-T3 clad QQ-A-250/5	3" x 6" x 0.032"	Chromate conversion coating to MIL-C-5541 Class 1A
B	062-1C	2024-T3 clad QQ-A-250/5	3" x 6" x 0.032"	Chromate conversion coating to MIL-C-5541 Class 1A (Note 2)
C	N/A	DHMS P1.47	0.060" thk Note 3	Clean with naptha
D	N/A	Note 1	Note 3	Clean with MEK
E	N/A	2024-T3 clad QQ-A-250/5	Note 3	Clean with MEK
F	N/A	DHMS P1.01/2	0.060" thk Notes 3, 6	Clean with naptha
G	N/A	DHMS P1.46	0.060" thk Note 3	Clean with naptha

Table 2: Test Panels

Panel	LAB Dwg.	Material	Size	Pre-Treatment
H	N/A	BMS 8-319 (Declar™)	0.060" thk Note 3	Clean with naptha
I	N/A	2024-T3 clad QQ-A-250/5	3" x 6" x 0.032"	Chromate conversion coating to MIL-C-5541 Class 1A (Note 4)

1. Thin Composite Sandwich panel as acceptable to Materials Technology.
2. Substitute DHMS C4.01 Type 2 primer instead of the primer to be qualified. Continue with application of topcoat.
3. 60 sec. vertical 12" x 3", Heat Release 5.94"+0,-0.06"x5.94"+0,-0.06", Smoke Density 2.90"± 0.06" x 2.90"± 0.06"
4. Substitute DHMS C4.01 Type 3 primer instead of the primer to be qualified. Continue with application of topcoat.
5. For Type VI coating, no primer required.

6 TEST METHODS

Unless otherwise specified, tests shall be conducted at 18 to 25°C and 30 to 80% relative humidity.

6.1 Hiding

Prepare two test specimens B per **para. 5.1**, except without topcoat. Evenly divide each panel in half. One part shall be coated with a white topcoat to DHMS C4.04 or equivalent. The other part shall be coated with a black topcoat to DHMS C4.04 or equivalent. After seven days cure, the test specimens shall be lightly abraded using 220 grit sand paper and cleaned with DHMS S5.01 Class 2 solvent. The decorative interior paint system shall be applied. The total dry film thickness shall not exceed 0.002 inch. For the purpose of this test, the colour of the topcoat to be qualified shall be white.

6.2 Stain Resistance

Six test specimens A per **para. 5.1** shall be soiled with the following items, allowed to dry for 2 hours minimum, and then evaluated after cleaning by scrubbing with common household alkaline cleaner diluted in warm water. Each of the following items shall be used to soil an area of approximately 5 in^2.

Butter	Lipstick (dark red)
Mayonnaise	Tomato Juice or Ketchup
Mustard	Coffee

6.3 Abrasion Resistance

Three test specimens B per **para. 5.1** shall be tested to ASTM D4060 using a CS-10 wheel and 500g weight. Test until the DHMS C4.01 Type 2 primer begins to show or to 700 cycles, whichever occurs first.

6.4 Scratch Resistance

Three test specimens B per **para. 5.1** shall be tested according to ASTM D2197 except that a loop stylus shall be pulled across the test area and the first sign of visible damage to the topcoat shall be reported as a failure.

6.5 Effect on Solvent Sensitive Materials

Clamp bare test specimens C over a 7.0 inch radius curve. The specimens are to be clamped at both ends only. Using a brush, apply the primer-topcoat system onto the test specimens. After 24 hours total stress time, the specimens are to be inspected for breakage, cracking, swelling, or softening.

6.6 Repairability

The test specimens used in the **para. 4.3.7** shall be air dried for 24 hours, sanded using 220 grit aluminum oxide abrasive paper and solvent cleaned using DHMS S5.01 Class 2. The primer-topcoat shall be re-applied and air dried for 7 days.

The test specimens shall be immersed for 7 days in tap water. Test per ASTM D3359 Method B within 30 minutes of removal from the test fluid.

7 MATERIAL QUALIFICATION REQUIREMENTS

7.1 Request For Qualification

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

All material qualification shall be site specific.

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

7.2 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.

7.2.1 A sample shall be submitted for testing at the discretion of Bombardier Aerospace Materials Technology for evaluation.

7.3 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 aerospace specifications where the requirements are similar to this specification.

7.4 Process Control Document

7.4.1 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.

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

7.4.3 The PCD and all production data shall be available to any Bombardier Aerospace auditors when requested.

7.5 Qualification

7.5.1 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.

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

7.5.3 Re-qualification of the product may be requested by the Bombardier Materials Technology if there any

changes in the method of manufacture and/or formulation.

8 QUALITY ASSURANCE REQUIREMENTS

8.1 Supplier Batch/Lot Acceptance Tests

8.1.1 The manufacturer/supplier is responsible for the performance of all sampling, inspection and testing of each batch/lot as specified in Table 3.

8.1.2 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.

8.1.3 Bombardier Aerospace 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.

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

8.2 Purchaser Batch/Lot acceptance tests

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

Table 3: Qualification, Batch Acceptance and Shelf Life Extension Tests

Test	Paragraph	Qualification (Manufacturer/ Supplier)	Acceptance	
			Manuf./Supplier	Purchaser/User
Condition in Container	para. 4.1.3	x	x	x
Non-Volatile Content	para. 4.1.5	x	x	
Viscosity	para. 4.2.3	x	x	
Pot Life	para. 4.2.4	x	x	x
Drying Time	para. 4.3.2	x		
Surface Appearance	para. 4.3.3	x	x	x
Colour	para. 4.3.4	x	x	
Gloss	para. 4.3.5	x	x	
Hardness	para. 4.3.6	x		
Fluid Resistance	para. 4.3.7	x		
Hiding	para. 4.3.8	x		

Table 3: Qualification, Batch Acceptance and Shelf Life Extension Tests

Test	Paragraph	Qualification (Manufacturer/ Supplier)	Acceptance	
			Manuf./Supplier	Purchaser/User
Stain Resistance	para. 4.3.9	x		
Abrasion Resistance	para. 4.3.10	x		
Scratch Resistance	para. 4.3.11	x		
Impact Resistance	para. 4.3.12	x		
Effect on Solvent Sensitive Material	para. 4.3.13	x		
Repairability	para. 4.3.14	x		
Flammability	para. 4.3.15	x		
Dry Tape Adhesion	para. 4.3.16		x*	x*
*. Test on Panel A of Table 2. Test to be carried out after curing at - 7 days at 21 ± 3°C (70 ± 5°F) and 50 to 55% relative humidity - Or 12 hours at 60°C				

9 ORDERING DATA

9.1 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.

9.1.1 Procurement documents shall specify the following:

- Title, Number, Issue and Amendment Number of this Specification
- Manufacturer's Name and Product Identification (Trade Name or Code Number)
- Type or Size of Containers, total quantity
- -Acceptance Report
- Material Safety Data Sheets

10 PREPARATION FOR DELIVERY

10.1 Preservation and Packing

The primer-topcoat components shall be packed in such a manner as to ensure that, during shipment and storage, the product will be protected against damage from exposure to hazards which would affect adversely conformance to the properties per Section 4 of this specification.

10.2 Packaging

The primer-topcoat system shall be supplied in a kit packaged as a unit, or as separate components in

bulk form as stated on the Purchase Order, consisting of the base component and the required amount of catalyst and thinner to bring the paint to spraying consistency.

10.3 Marking

Each container shall be legibly marked with the following information:

- Primer/Topcoat (conforms to DHMS C4.22).
- Manufacturer's Name and Product Identification (Trade Name or Code Number)
- Date of Manufacture
- Batch Number
- Net Quantity (Imperial, U.S. or metric measure)

10.4 Shipping Documentation

Shipping documentation shall show:

- Bombardier Aerospace Purchase Order No.
- Specification Number
- Number of Containers
- Batch Number
- Total Quantity (Imperial, U.S. or metric measure)
- Acceptance Test Reports (Certification of Conformance)
- Material Safety Data Sheets

11 HEALTH AND SAFETY DATA

When supplying samples for qualification per **para. 7.2**, 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 DH4339 form, "Application to Introduce a New Material", to the Material Safety Committee.

Upon receipt of DH 4340 form, "Recommendation", that approves the use of the material, it can then be included on the Qualified Products List.

NOTE: Any change in the formulation of the material requires a re-submission of the MSDS.

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
	Type I Primer TBD			
	Type VI (Semi-Gloss)			
Mankiewicz Gebr.&Co.	Base: Alexit-FST-346-57 series Hardener: Alexit-FST-345-57 series Viscosity: 1600 ± 500 cP	3813 3814	PQS #4	August, 2009
MAPAERO 10Avenue dela Rijole 09100 Pamiers France	FR2-55 Base: 559X XXXXB Hardener: 2105 5001D Viscosity: TBD	4027 4028	PQS#5	July, 2016
	Type VII (Low Gloss)			
Mankiewicz Gebr.&Co.	Base: Alexit-FST-346-57 series Hardener: Alexit-FST-345-57 series Viscosity: 1600 ± 500 cP	3813 3814	PQS #4	August, 2009
MAPAERO	FR2-55 Base: 559X XXXXB Hardener: 2105 5001D Viscosity: TBD	4027 4028	PQS#5	July, 2016

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION NO.	MATERIAL SAFETY DATA SHEET NO.	DE HAVILLAND QUALIFICATION SHEET NO.	DATE OF PRODUCT APPROVAL
MAPAERO	**Type IX Primer** FR4-45 Base Cream: 64000300BXXXY Hardener: 64000000DXXXY Viscosity: TBD	4011 4012	PQS#5	July, 2016
Mankiewicz Gebr.&Co	Base: Alexit-FST-343-57 series Hardener: Alexit-FST-345-57 series Viscosity : TBD	4025	PQS#6	June, 2016

Primer, top coat must be used as a system