DE HAVILLAND AIRCRAFT OF CANADA LIMITED

BOMBARDIER

De Havilland
Material Specification

TITLE:	**COMPOUND, WATER DISPLACING, CORROSION INHIBITING**
SPECIFICATION NUMBER:	**DHMS C 4.12**
ISSUE:	**D**
AMENDMENT:	**--**
DATE:	**June 30, 2021**
PAGE:	**1 of 14**

SIGNED ORIGINAL ON FILE

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De Havilland

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REVISION RECORD

Iss.	Page	Description and Reason for Change
Org.	9	Dinitrol AV5B-2 manufactured by Dinol International Inc. added to QPL.
Amd.2	10	LPS-3 changed from Type II to Type I.
Amd.3	9 & 10	From Dinol International, qualified product Type I - AVSB-2 was replaced by Type II - AV8.
Amd. 4	11	Protector 100 (GR.3) and Protector 1500 (GR.4) manufactured by CRC Industries Inc. added to QPL.
A	_	This is a complete revision. Changes have not been noted.
B	QPL	Added Zip-Chem product COR-BAN 35 to Type II Grade 3 and 4
Amd. 1	QPL	Trade name , Manufacturer, Distributor changed: Dinitrol AV8 to ARDROX AV8
Amd. 2	QPL	Added Cor-ban 23 to Type II Grade 3 and 4. Manufacturer names and address changed.
Amd. 3	QPL	Added ARDROX AV15 to Type II Grade 4
Amd. 4	QPL	Removed Zip-Chem Products ZC 023 and ZC D 5023NS. Products no longer available.
Amd.5	QPL	Removed Cor-Ban 35 from Type II Grade 3 and Cor-Ban 23 from Type II Grade 4.
C		This is a complete revision.
	8,9	Updated section 6, 7, Standardized with other specifications
	10	Table 2, Clarified Acceptance tests for supplier, user.
	3	3.2.1 Clarifed colour requirement.
Amd. 1	10	Table 2, Removed Odour Test for Acceptance (Supplier/User)

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REVISION RECORD

Iss.	Page	Description and Reason for Change
D		This is completed revision
	12	Revised section 10 Health and Safety , standardized with other specifications
	QPL	Added Product SOCAPAC 65H to Type II Grade 4.

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1 SCOPE

This specification covers the requirements for a solvent dispersed, water displacing, organic corrosion inhibiting compound. Bombardier Aerospace Toronto finish code for corrosion inhibiting compound is F13.

1.1 Classification

This coating shall be one of the following types and grades:

Type I - Clear, colourless film, detectable by ultraviolet light

Type II - Coloured film, detectable by unaided eye under visible light

Grade 3 - Light film (0.0003 - 0.0005 inch thickness)

Grade 4 - Heavy film (0.0012 - 0.0016 inch thickness)

2 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. If a specific issue of a document is not stated, the current issue shall be used.

2.1 U.S. Government Specifications

QQ-A-250/4 - Aluminum Alloy 2024, Plate and Sheet
QQ-A-250/5 - Aluminum Alloy, Alclad 2024 Plate and Sheet,
MIL-C-5541 - Chemical Conversion Coating on Aluminum and Aluminum Alloys
MIL-C-16173 - Corrosion Prevention Compound, Solvent Cutback, Cold Application

2.2 Test Standards

ASTM G34 - Exfoliation Corrosion in 2XXX and 7XXX Series Aluminum Alloys
ASTM D93 - Flash Point by Pensky-Martens Closed Tester
ASTM B117 - Salt Spray (Fog) Testing
ASTM D445 - Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D522 - Mandrel Bend Test of Attached Organic Coatings
ASTM D1331 - Surface and Interfacial Tensions of Solutions of Surface-Active Agents
ASTM D1400 - Dry Film Thickness of Non-Conductive Coating, Applied to Non-Ferrous Base
ASTM D1644 - Nonvolatile Content of Varnishes

2.3 De Havilland Specifications

DHMS C4.01 - Primer, Fluid Resistant, Epoxy
DHMS C4.04 - Enamel, Polyurethane For Aircraft Exterior Paint System
DHMS C4.11 - Enamel, Epoxy
DHMS P1.24 - Aramid Fiber, High Modulus, 250^{o}F Cure, Epoxy Resin Impregnated
DHMS S5.01 - Slow Evaporating, Manual Wipe, Degreasing and Cleaning Compound

3 REQUIREMENTS

3.1 Material 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 components used in formulating this corrosion inhibiting compound shall consist of non-volatile base materials dispersed in a solvent blend so as to form a sprayable solution.

3.1.3 Storage Stability - The compound shall be capable of meeting all the requirements of this specification when tested at any time up to two years from the date of manufacture.

3.1.4 Flash Point - When tested per ASTM D93, the flash point of the compound shall not be less than 100^{o}F.

3.1.5 Sprayability - When tested per MIL-C-16173, the compound shall be sprayable at a temperature of $40^{o} \pm 2^{o}$ F to form an uniform coating free of any surface defects (runs, craters, etc.).

3.1.6 Nonvolatile Content - When tested per ASTM D1644, the nonvolatile content of the compound shall not vary more than -5%, +10% from the value established during qualification.

3.1.7 Odour - Material shall not be nauseating or irritating to personnel at any application stage.

3.1.8 Surface Tension - When tested per ASTM D1331, the surface tension of the compound shall not exceed 31 dynes/ centimeter at room temperature.

3.2 Film Properties

3.2.1 Colour - The colour of the compound, when sprayed and cured, shall be as per manufacturers Technical Data Sheet.

3.2.2 Transparency - The coating shall be transparent when tested per para. 5.1.

3.2.3 Water Displacement - The compound shall displace water and the test surface shall show no evidence of pitting, mottling or other abnormal surface stains or defects when tested per MIL-C-16173.

3.2.4 Drying Time - The corrosion preventive compound shall dry to handle within 3 hours and it shall meet all requirements of this specification, after drying for a period of 24 hours at room temperature.

3.2.5 Penetrability - Penetrability shall be determined by capillary height of rise. When tested per para. 5.2, the compound shall rise a minimum of 0.6 inches in a 0.020 inch diameter precision bore glass capillary at room temperature.

3.2.6 Functional Penetration - The test specimens shall be wetted an average 85% after 1 hour when tested per para. 5.3. No faying surface area shall be wetted less than 80%.

3.2.7 Corrosion Resistance - The test specimens shall not have more that 5 corrosion pits per specimen with no pit greater than 1 mm in diameter when tested for 336 hours for Grade 3 and 1500 hours for Grade 4 per ASTM B117 using 3 test specimens A per Table 1.

3.2.8 Weight Change Corrosion - Average weight change when tested per para. 5.4 shall comply with the following limits:

Cadmium A-A-51126	± 5.0 mg/cm^2
Magnesium AMS 4375	± 0.5 mg/cm^2
Aluminum QQ-A-250/4	± 0.2 mg/cm^2
Steel ASTM A109	± 0.2 mg/cm^2

3.2.9 Temperature Resistance - After exposure to temperatures of -40^{o}C and 160^{o}C, the coating shall retain its adhesion and flexibility characteristics when tested per para. 5.5.

3.2.10 High Temperature Flow - When tested per section 5.6, the flow of the coating shall not be greater than 0.05 inch.

3.2.11 Combustion Resistance - The compound shall not support combustion for more than 15 seconds after the flame source is removed when tested per para. 5.7.

3.2.12 Effect on Painted Surfaces - There shall be no evidence of streaking, discoloration, or other surface defects when tested per para. 5.8.

3.2.13 Detectability - Type I coating shall be detectable under UV light and Type II coating shall be detectable under visible light.

3.2.14 Removability - The corrosion preventive compound shall be completely removable at any time with Mineral Spirits or Aliphatic Naptha type solvents.

4 PREPARATION OF TEST SPECIMENS

4.1 Preparation of Test Specimens

Table 1: Test Specimens

Panel	LAB Dwg	Material	Dimensions	Pre-Treatment
A	062-11	2024-T3 bare (QQ-A-250/4)	3" x 6" x 0.032”	None
B	062-1C2	2024-T3 clad (QQ-A-250/5)	3" x 6" x 0.032”	Chromate conversion coating to MIL-C-5541 Class 1A + F19 to DHMS C4.01 Type 2
C	062-13C2	2024-T3 clad (QQ-A-250/5)	3" x 6" x 0.125”	Chromate conversion coating to MIL-C-5541 Class 1A + F19 to DHMS C4.01 Type 2
D	062-9	DHMS P1.24	3" x 6" x 0.032"	None

4.1.1 Test specimens A and D shall be manually cleaned with DHMS S5.01 Class 2 and wiped dry.

4.1.2 Test specimens B and C shall be primed with epoxy primer to DHMS C4.01 Type 2 to a dry film thickness of 0.0004 to 0.0006 inches and cured for 7 days minimum at room temperature. Immediately prior to application of corrosion preventive compound, the test specimens shall be manually cleaned with a solvent per DHMS S5.01 Class 2.

4.1.3 Immediately after cleaning, test specimens shall be coated with corrosion preventive compound and air dried for 24 hours. The dry film thickness for Grade 3 shall be 0.0003 to 0.0005 inches, and for Grade 4, 0.0012 to 0.0016 inches. The corrosion preventive compound can be applied by the spray or dip method.

5 TEST METHODS

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

5.1 Transparency - Two test specimens B per Table 1 shall be coated with epoxy enamel to DHMS C4.11 colour white to DSC 302-0930. On both specimens, mark two 1/6" diameter dots, 0.5" apart, at the approximate center of each panel using aluminized epoxy enamel to DHMS C4.11 and allow to air dry for 7 days. Apply corrosion preventive compound per para. 4.1.3. Inspect each panel with the unaided eye and determine whether the dots (simulated corrosion spots) are visible through the coating.

5.2 Penetrability - The ability to penetrate is measured by the capillary height of rise method. Using an aerosol spray can equipped with a 6" extension tube, spray sufficient material into a graduated cylinder. Lightly cover with aluminum foil and let stand 25 to 35 minutes for the propellant to dissipate at room temperature. If testing bulk materials, pour approximately 10 mL of compound into a 20 mL beaker and ensure that the compound is free of entrapped air. Cover the cylinder or beaker with aluminum foil, leaving a hole of just sufficient size to accommodate a 0.020" diameter precision bore glass capillary. Lower the clean capillary vertically until it contacts the surface of the compound. Allow 25 minutes for the capillary rise to reach its maximum, then remove it from the cylinder or beaker and measure the capillary rise.

5.3 Functional Penetration -Lap joint test specimens used to determine functional penetration shall be prepared per Figure 1. Three assemblies shall be made using test specimens C per Table 1, Hi-Lok bolts (HL-20-8-4), and Kaynar nuts (KFN600-8-4). Bolts and nuts shall be installed per PPS 2.67.

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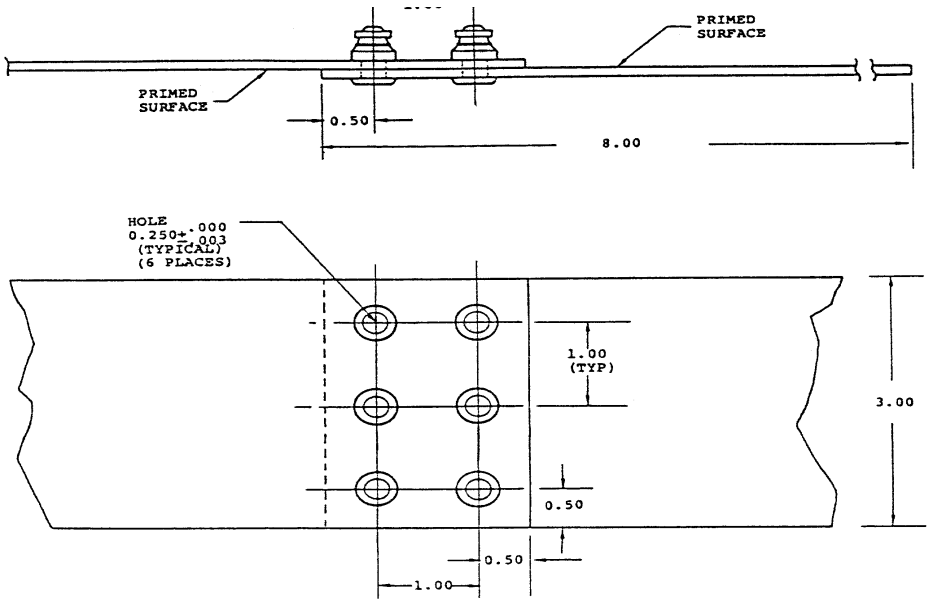

Figure 1.

Apply vacuum bag sealant (e.g. Schnee Morehead Chemicals #5121 or equivalent) to one side of joint to form a containment area for compound per Figure 2. Assemblies per Figure 2 shall be kept at a 10^{o} angle from the horizontal. Pour 1 mL of the corrosion preventive compound into containment area and let stand for 1 hour. After 1 hour, remove residual fluid from containment area with clean, dry cheesecloth. Remove sealing tape. Remove fasteners being careful not to disturb underlying compound. Open each assembly with care and determine the percentage of each faying surface area that has been wetted by the corrosion preventive compound. In order to facilitate evaluation, a transparent grid 3.0 inch by 2.0 inch with 25 squares/in^2 may be used. A square is considered wet if more than 50% of a surface is covered with the corrosion preventive compound.

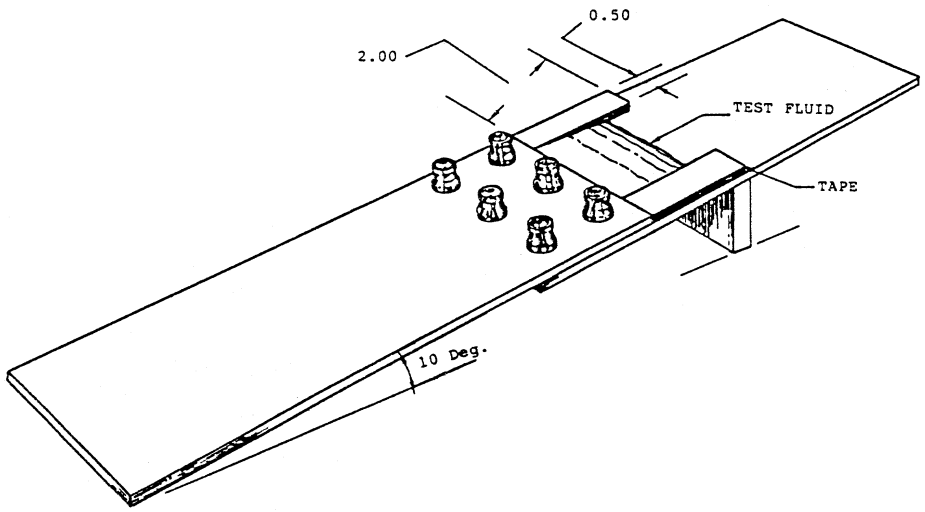

Figure 2.

5.4 Weight Change Corrosion - For each test material, two test specimens made from materials listed in section 3.2.9 and having dimensions 1 inch x 2 inch x 0.25 inch shall be washed with solvent to DHMS S5.01 Class 2 and, if necessary, polished with 240 grit polishing medium to remove pits, burrs and other irregularities. Dry specimens shall be weighed to the nearest 0.1 milligram. Then, the specimens shall be totally immersed in a container containing the corrosion inhibiting compound. The sealed container shall be heated in a convection oven at 130 ± 5° F. At the end of seven days, remove panels from the compound and clean by swabbing with gauze pads moistened with Mineral Spirits or Aliphatic Naptha solvents. Weigh test specimens and determine any weight changes.

5.5 Temperature Resistance - Four test specimens B per Table 1 shall be conditioned at -65 ± 5°F for seven days. Two specimens shall be rapidly bent over a 0.5 inch diameter mandrel that has been conditioned at the same temperature and time as the test panels per ASTM D522 Method B. The film of corrosion preventive film shall not crack. The other two specimens shall be scribed with four parallel scratches approximately 1/8 inch apart and 1 inch long. Four similar scratches shall be made perpendicular to the first four. Unsatisfactory adhesion is characterized by flaking of the film within the areas bounded by the scratches. Chipping of the film more than 0.05 inch from the scribes shall be considered flaking.

Four additional test specimens B per Table 1 shall be conditioned at 160 ± 5°F for seven days. Two specimens shall be rapidly bent over a 0.5 inch diameter mandrel conditioned at the same temperature and time as the test panels per ASTM D522 Method B. The corrosion preventive film shall not crack. The other two specimens shall be scribed with four parallel scratches approximately
1/8 inch apart and 1 inch long. Four similar scratches shall be made perpendicular to the first. Unsatisfactory adhesion is characterized by flaking of the film within the areas bounded by the scratches. Chipping of the film more than 0.05 inch from the scribes shall be considered flaking.

5.6 High Temperature Flow - Using a sharp blade, remove a 1 inch strip of corrosion preventive film from one long side on one side only on each of two test panels B per Table 1. Suspend the panels vertically with the bare surface down for 22 hours in an oven maintained at 200 ± 5°F. Remove the test specimens from the oven and cool to room temperature. Determine the distance of material flow on the bare surface toward the edge.

5.7 Combustion Resistance - Three test specimens B per Table 1 shall be individually suspended vertically in the flame of a Bunsen burner having a 10 ± 1 mm internal diameter, air supply shut off and flame regulated to 2 inches. Each specimen shall be in the flame at a depth of one inch. Allow the flame to remain under the test panel for 20 seconds. After the flame is withdrawn, observe and record the time that flaming continues. The result will be reported as the average of the three test panels.

5.8 Effect on Painted Surfaces - Two test panels B per Table 1, two test panels B per Table 1 coated with F22 epoxy enamel per DHMS C4.11 colour white per DSC 302-0930, and two test panels B per Table 1 coated with F24 polyurethane enamel per DHMS C4.04 colour white per DSC 302-0930 shall have an approx. 1" wide strip in the lengthwise centre of each panel coated with the corrosion inhibiting compound. After thirty days exposure, the coating shall be completely removed with Mineral Spirits or Aliphatic Naptha solvents. The surfaces of the test panels shall not show any discernible difference in colour between the centre and the edges when viewed at a distance of 24" under natural light conditions.

6 MATERIAL QUALIFICATION REQUIREMENTS

6.1 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.

6.2 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.

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

6.3 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.

6.4 Qualification Approval

6.4.1 Upon review of supplier's data, and De Havilland tests, the supplier will be advised either of product qualification or reasons for not qualifying the product.

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

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

Re-qualification of the product may be requested by the De Havilland Materials Technology if there are any changes in the method of manufacture and/or formulation

7 QUALITY ASSURANCE REQUIREMENTS

7.1 Supplier Batch/Lot Acceptance Tests

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

7.1.2 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 2** The report shall include the supplier's batch identification, materials specification and date of testing.

7.1.3 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.

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

7.2 Purchaser Batch/Lot acceptance tests

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

Table 2: Qualification, Batch Acceptance Tests

Test	Paragraph	Qualification (Supplier)	Acceptance (Supplier/User)
Flash Point	3.1.4	x	
Sprayability	3.1.5	x	
Nonvolatile Content	3.1.6	x	x
Odour	3.1.7	x	
Surface Tension	3.1.8	x	
Colour	3.2.1	x	x
Transparency	3.2.2	x	
Water Displacement	3.2.3	x	
Drying Time	3.2.4	x	
Penetrability	3.2.5	x	
Functional Penetration	3.2.6	x	
Corrosion Resistance	3.2.7	x	
Weight Change Corrosion	3.2.8	x	
Temperature Resistance	3.2.9	x	
High Temperature Flow	3.2.10	x	
Combustion Resistance	3.2.11	x	
Effect on Painted Surfaces	3.2.12	x	
Detectability	3.2.13	x	
Removability	3.2.14	x	

8 ORDERING DATA

8.1 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.

8.2 Documentation

8.2.1 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

- Compound Type and Grade
- Material Data Safety Sheets

9 PREPARATION FOR DELIVERY

9.1 Preservation and Packing

The corrosion preventive compound 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 the property conformance to Section 3 of this specification.

9.2 Marking

Each container shall be legibly marked with the following information:

- Corrosion Preventive Compound, DHMS C4.12 Type and Grade
- Manufacturer's Name and Product Identification (Trade Name or Code Number)
- Date of Manufacture
- Batch Number
- Net Quantity (Imperial, U.S. or metric measure)

9.3 Shipping Documentation

Shipping document shall show:

- De Havilland Purchase Order No.
- Specification Number (DHMS C4.12)
- Number of Containers
- Batch Number
- Total Quantity (Imperial, U.S. or metric measure)
- Compound Type and Grade
- Material Safety Data Sheets

10 HEALTH AND SAFETY DATA

When supplying samples for qualification per **Para. 6.2.1**, 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.

10.1 Environmental Compliance

Materials and ingredients use in manufacturing the product shall comply to environmental regulations such as REACH, EPA, CEPA. 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 Materials Technology if the product contains targeted substances.

QUALIFIED PRODUCTS LIST

TYPE & GRADE	MANUFACTURER	PRODUCT IDENTIFICATION	PRODUCT QUALIFCATION SHEET NO.	MSDS #	DATE OF PRODUCT APPROVAL
Type I, Grade 3	PMS Products Inc., 76 Veterans Dr. #110, Holland, Michigan 49423	Boeshield T-9	PQS #2	--	Jul. 12, 1977
	LPS Laboratories Inc. 4647 Hugh Howel Rd., Tucker, Georgia 30085-5052	LPS-3	PQS #1	107	Jul. 12, 1977
Type I, Grade 4	CRC Industries Inc. 885 Louis Dr. Warmister, PA 18974 (215) 674-4300	Protector 1500	PQS #6	--	Dec. 1998
Type II, Grade 3	PMS Products Inc. (see above address)	Boesshield T-9 Coloured	PQS #2	--	Jul. 12, 1977
	Zip-Chem Products 1860 Dobbin Dr. San Jose, CA 95133	Cor-Ban 23	PQS #14	3768 3769	Aug. 6, 2007
Type II Grade 3	LPS Laboratories Inc. (see above address),	LPS HardCoat	PQS #9	2646	Sep. 21, 1999
	CRC Industries Inc. (same address as above)	Protector 100	PQS #5	--	Dec. 1998
	Chemetall TS S.A.S 280 Jean-Baptise Godin Z-I. Villeneuve, France F-02200 Soissons, France	ARDROX AV-8	PQS #4	1855	Apr. 21, 1992

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Type II, Grade 4	Zip-Chem Products 1860 Dobbin Dr. San Jose, CA 95133	ZC 029 ZC D-5029NS	PQS #8 PQS #11	2645 --	Sep. 21, 1999 Sep. 21, 1999
		Cor-Ban 35	PQS #13	3711 3712	Feb. 22, 2006
	LPS Laboratories Inc. 4647 Hugh Howel Rd., Tucker, Georgia 30085-5052	Procyon (Formula 13-100-1)	PQS #12	2647	Sep. 21, 1999
	SOCOMORE S.A.S LE PRAT-RP 3707 Vannes CX,56,FR, 56037	SOCAPAC 65H	PQS #16		June 30, 2021