de Havilland Inc.

Material Specification

TITLE:	**ELECTROLESS NICKEL-BORON PLATING**
SPECIFICATION NUMBER:	**DHMS C 4.15**
ISSUE:	**B**
AMENDMENT:	**---**
DATE:	**November 4, 1999**
PAGE:	**1 of 8**

Prepared by: Reviewed by:

SIGNED ORIGINAL ON FILE

Ellie Cochien
Materials Technology

Kenneth Quon
Chief, Metals Technology

Approved by:

Leonard K. John
Manager
Materials Technology

REVISION RECORD

Issue	Page	Description and Reason for Change
A Amd.1	8	New Vendor was added for Class 1 & 4 coating.
B	3	Minimum microhardness requirement was changed to 980 Knoop using 50g load.
	8	Updated existing vendor information in Qualified Products List.
	8	Added new vendor to Qualified Products List.

1 SCOPE

This specification defines the requirements for electroless deposited nickel-boron plating to provide a hard, wear- and corrosion-resistant coating on metal surfaces.

1.1 Application

The nickel-boron plating is intended for use as a very hard, wear- and corrosion-resistant coating on ferrous and non-ferrous metals, except aluminum, magnesium, and alloys having a high molybdenum or zinc content.

1.2 Classification

The nickel-boron coating supplied to this specification shall be of the following classes as specified on applicable drawing:

Class 1 Electroless nickel-boron.

Class 2 Electroless nickel-boron with fluorotelemar lubricant added.

Class 3 Electroless nickel-boron with molydisulphide lubricant added.

Class 4 Electroless nickel-boron with molydisulphide lubricant impinged.

Class 5 Electroless nickel-boron with low stress nickel-phosphorus precoat and seal coat.

2 APPLICABLE DOCUMENTS

The following documents shall form part of this specification to the extent defined herein. In the event of conflicting requirements between this and the documents 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.

2.1 Specifications and Standards

MIL-S-18729	Steel Plate, Sheet and Strip, Alloy 4130 Aircraft Quality
ASTM B117	Salt Spray (Fog) Testing
LAB-051	Plating Bend Test Specimen (de Havilland Materials Laboratory Standard)

3 REQUIREMENTS

3.1 Wear Resistance

The nickel-boron coating of a designated class shall be wear tested in accordance with the requirements established by Engineering for the intended application.

3.2 Coating Thickness

3.2.1 Nickel-boron coating thickness range shall be as specified on the part drawing. The coating thickness shall be determined on a wear test sample, production part or a LAB-051 test panel prior to application of any post plating lubricant treatment.

3.2.2 The dry film lubricant coating thickness shall be as specified on the part drawing. The dry film lubricant coating thickness shall be determined on a wear test sample, production part, or a LAB-051 test panel.

3.2.3 Coating thickness determination for both the nickel-boron coating and the dry film lubricant can be performed on one LAB-051 test panel by coating the dry film lubricant on only one half of the test panel.

3.2.4 The method used to determine coating thicknesses shall be agreed upon by the vendor and de Havilland Inc. (DHI) Materials and Standards Engineering.

3.3 Microhardness

The microhardness of the nickel-boron coating shall be determined on a mounted and polished cross section of a LAB-051 or equivalent test sample having a coating thickness of not less than 0.001 inches. The microhardness measurement shall be taken after heat treatment at $450^{o} \pm 25^{o}F$ for 10 hours, and embrittlement relief at $395^{o} \pm 25^{o}F$ for 23 hours. The nickel-boron coating microhardness shall not be less than 980 Knoop using a 50g load.

3.4 Adhesion

The adhesion of the nickel-boron coating shall be determined on a LAB-051 test sample having a coating thickness as stated on the drawing. The test sample shall be cleaned, plated and heat treated together with production parts and shall be bent at room temperature through an angle of 180^{o} around a 1/4 inch diameter mandrel. The plating shall show no breakaway particles on the outside radius of the bent test panel. Breakaway particles extending inward from the edge on the inside radius of the test panel shall not be cause for rejection.

3.5 Corrosion Resistance

The corrosion resistance of the coating class as stated on the drawing shall be determined on test sample per paragraph 4.2 and having a coating thickness of 0.0010 ± 0.0002 inches. The test sample shall be cleaned, plated and heat treated together with production parts and shall be exposed to 5% salt spray in accordance with ASTM B117, except that test surface shall be inclined at 5^{o} to the vertical. The test sample shall show no noticeable corrosion of the basis metal when subjected to the minimum exposure times stated below:

Class 1	48 hours minimum
Class 2	72 hours minimum
Class 3	72 hours minimum
Class 4	72 hours minimum
Class 5	96 hours minimum

3.6 Workmanship

The nickel-boron coating shall be smooth, continuous, adherent, and free from pinholes, blisters, pits, nodules, porosity, cracks and other defects detrimental to the performance of the part.

4 TEST PANELS

Test panels used for coating thickness, hardness and adhesion tests shall be made in accordance with LAB-051. The test panels shall be cleaned and treated in accordance with the required procedure to apply the coating class as specified on the part drawing.

Test panels for corrosion resistance test shall be made from 0.032 or 0.040 inch thick 4130 low alloy steel sheet conforming to MIL-S-18729 or of commercial quality. The test panels shall be approximately 3 inches x 6 inches in size and shall be cleaned and treated in accordance with the required procedure to apply the coating class as specified on the part drawing. The wear resistance test sample may also be used for corrosion resistance tests.

5 QUALITY ASSURANCE PROVISIONS

5.1 Qualification Tests

5.1.1 All requests for source/coating qualification shall be directed to the Quality Assurance Department of de Havilland Inc.

5.1.2 A supplier is responsible for the performance of all qualification testing, as specified in Table 1 of this specification.

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

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

5.1.5 Coatings which are qualified will be listed in the Qualified Products List of this specification.

5.2 Qualification by Similarity

Where a product has been qualified to another similar specification, the supplier may submit this qualification test data in lieu of performing a separate qualification test as required by paragraph 5.1 of this specification. The similar specification may be a government, company or other specification, where the requirements are similar to those of this specification.

5.3 Acceptance Tests

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.

TABLE 1. Qualification and Acceptance Tests

Test	Paragraph	Qualification	Acceptance
Wear Resistance	3.1	x	
Coating Thickness Nickel-Boron	3.2.1	x	x
Coating Thickness Dry Film Lubricant	3.2.2	x	x
Hardness	3.3	x	x
Adhesion	3.4	x	x
Corrosion Resistance	3.5	x	

6 ORDERING DATA

6.1 Prerequisite

Coatings furnished under this specification for production use shall be qualified and listed on the Qualified Product List prior to the issuing of a Purchase Order.

6.2 Procurement Documents

Procurement documents shall specify the following:

- Title, Number, Issue and Amendment Number of this specification
- Class of Coating
- Part Number and Quantity

6.3 Deviation Authorization

When the drawing and purchase order does not state the Class of coating, a Request for Deviation form should be sent to de Havilland Inc. to request this information.

7 SHIPPING DOCUMENTATION

The shipping document shall show:

- de Havilland Purchase Order Number
- Specification Number
- Quantity of Parts
- Number of Containers or Packages
- Acceptance Test Report

QUALIFIED PRODUCTS LIST

MANUFACTURER'S NAME AND ADDRESS	MANUFACTURER'S PRODUCT IDENTIFICATION	DE HAVILLAND QUALIFICATION SHEET #	MSDS #	DATE OF PRODUCT APPROVAL
	Class 1 Coatings			
Pure Coatings Inc. 3301 Electronics Way West Palm Beach, Florida 33407 USA (561) 844-0100 (561) 845-7480	NiBRON		n/a	
Anodyne Inc. 2230 South Susan Street Santa Ana, CA 92704 USA (714) 549-3321 (213) 587-5339	Borodyne	PQS #2	n/a	July 1, 1992
McComas Industries Inc. 20 East Wilmot Street Richmond Hill, ON L4B 1C8 Canada (905) 886-1200 (905) 886-1203	CEM 3000	PQS #3	n/a	November 4, 1999
	Class 4 Coatings			
Pure Coatings Inc.	Nibrolube 3		n/a	
Anodyne Inc.	Borodyne DFL-100	PQS #2	n/a	July 1, 1992