BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 33.03

PRODUCTION PROCESS STANDARD

ELECTRO DEPOSITED NICKEL PLATING (E3)

Issue 11
- This standard supersedes PPS 33.03, Issue 10.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS related questions to christie.chung@aero.bombardier.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

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Signed original on file. Validation of paper prints is the responsibility of the user.

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the application of electro-deposited nickel plating (finish code E3 according to PPS 23.02) to carbon and low alloy steels, corrosion resistant steels, and copper alloys.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS shall be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. do not supersede the procedure or requirements specified in this PPS. Similarly, the procedure and requirements specified in this PPS are not applicable when use of a BAPS, MPS, LES or P. Spec. is specified.

2 HAZARDOUS MATERIALS

2.1 Before receipt at Bombardier Toronto, all materials shall be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto Environment, Health and Safety Department. Refer to the manufacturer's MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact the Bombardier Toronto Environment, Health and Safety Department.

3 REFERENCES

3.1 BAERD GEN-018 - Engineering Requirements for Laboratories.

3.2 PPS 13.26 - General Subcontractor Provisions.

3.3 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.4 PPS 23.02 - Protective Treatment and Decorative Surface Finish Code.System.

3.5 PPS 30.04 - Steel Heat Treatment - Carbon and Low Alloy Steel.

3.6 PPS 30.06 - Steel Heat Treatment - Precipitation Hardenable (PH) Stainless Steel.

3.7 PPS 30.08 - Steel Heat Treatment - Martensitic Stainless Steel.

3.8 PPS 31.03 - Cleaning of Carbon and Low Alloy Steels.

3.9 PPS 31.05 - Surface Treatment of Corrosion Resistant Steel (C9).

3.10 PPS 31.06 - Cleaning of Copper and Copper Alloys.

3.11 PPS 33.01 - Cadmium Plating (E1).

3.12 PPS 33.02 - Removal of Plating.

3.13 PPS 33.04 - Hard Chromium Plating (E2).

3.14 PPS 33.05 - Copper Plating (E7).

3.15 PPS 33.07 - Satin Finish Decorative Chromium Plating (E5 & E6).

3.16 Bombardier Toronto Laboratory Drawing - LAB 051.

3.17 de Havilland Laboratory Procedures Manual (DHLPM) - Procedure No. 3058

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials and Equipment

4.1.1 All materials and equipment employed in carrying out the processes specified herein shall be approved by Bombardier Aerospace as meeting the requirements of this standard.

4.2 Facilities

4.2.1 This PPS has been identified as a “Critical or Special” process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform the application of electro-deposited nickel plating (finish code E3 according to PPS 23.02) to carbon and low alloy steels, corrosion resistant steels, and copper alloys according to this PPS.

4.2.2 Bombardier subcontractors shall direct requests for approval to Bombardier Supplier Quality Management. Bombardier facilities shall direct requests for approval to the appropriate internal Quality Manager.

4.2.3 Facility approval shall be based on a facility report, a facility survey and completion of a qualification test program, if required. The facility report shall detail the materials and equipment to be used, the process sequence to be followed and the laboratory facilities used to show compliance with the requirements of this PPS. Any deviation from the procedure or requirements of this PPS shall be detailed in the facility report. Based upon the facility report, Bombardier Toronto Engineering may identify additional qualification and/or process control test requirements. During the facility survey, the facility requesting qualification shall be prepared to demonstrate their capability. Once approved, no changes to subcontractor facilities may be made without prior written approval from Bombardier Aerospace Supplier Quality Management.

4.2.3.1 For approval of subcontractor facilities to perform the application of electro-deposited nickel plating (finish code E3 according to PPS 23.02) to carbon and low alloy steels, corrosion resistant steels, and copper alloys according to this PPS, completion of a test program and submission of suitable test samples representative of production parts is required. Test samples shall meet the requirements specified in section 6.

4.2.3.2 All testing and evaluation specified herein shall only be performed by Bombardier Toronto Materials Laboratory or by laboratories accredited according to BAERD GEN-018.

5 PROCEDURE (SEE FLOW CHART 1)

5.1 General

5.1.1 For close tolerance surfaces where the plating thickness could affect the fit of finish of mating parts, ensure that allowance has been made for a plating thickness as specified in paragraph 6.1.1.1 during the machining operation.

5.2 Preparation of Parts for Plating

5.2.1 Stress relieve steel parts having a tensile strength range of 180 - 200 ksi or greater which have been machined, ground, cold formed or cold straightened according to PPS 30.04, PPS 30.06 or PPS 30.08, as applicable, before cleaning and plating.

5.2.2 Clean martensitic stainless steel and precipitation hardenable (PH) stainless steel parts according to PPS 31.05 before plating.

5.2.3 Clean copper and copper alloy parts according to PPS 31.06 before plating.

5.2.4 Clean carbon and low alloy steel parts according to PPS 31.01 before plating.

5.2.4.1 Only if specified on the engineering drawing, apply a copper flash to carbon and low alloy steel parts as an under coat according to PPS 33.05. After applying copper flash, the nickel plating operation shall be performed immediately thereafter.

5.3 Plating Procedure

5.3.1 Once started, ensure that the plating operation is continuous until the desired plating thickness is obtained. If there is any interruption in the current flow, it is necessary to strip and re-plate the parts.

5.4 Embrittlement Relief

5.4.1 Aircraft parts having tensile strength range of 150 - 170 ksi or greater shall be embrittlement relieved according to PPS 30.04, PPS 30.06 or PPS 30.08, as applicable, after plating. For parts with a tensile strength range of 200 - 220 ksi or greater, embrittlement relieve the parts within 4 hours of plating. If more than one type of plating operation is to be carried out on a particular part, embrittlement relief between plating operations is not required provided that embrittlement relief after the final plating operation is commenced within 4 hours of completion of the **first** plating operation.

5.5 Stripping of Plating

5.5.1 If necessary, strip nickel plating according to PPS 33.02.

6 REQUIREMENTS

6.1 Production Parts

6.1.1 Select at random from each lot at least the number of parts specified in Table I for plating thickness measurement as specified in paragraph 6.1.1.1 and visual examination as specified in paragraph 6.1.1.2. Those items of a sample lot which do not meet the requirements shall be considered as non-conforming and if the number of non-conforming parts exceeds the acceptance number for that sample, check every part in the lot represented by the sample. Strip, re-plate and re-check all unacceptable parts.

6.1.1.1 Except as noted below, the plating thickness shall be at least 0.003". Calculate the plating thickness from measurements taken before and after plating at several locations in areas where the plating thickness would be expected to be at a minimum.

- If nickel plating is to be used as an undercoat for hard chromium plating (E2), the nickel plating thickness shall be 0.002" - 0.003".
- If nickel plating is to be used as an undercoat for decorative chromium plating (E5 or E6) according to PPS 33.07, the thickness shall be 0.0001" - 0.0005" (it may be necessary to limit the nickel plate to the low end of the thickness range to achieve an E5 dull chromium finish).
- If nickel plating is to be used as an undercoat for cadmium plating on stainless steel (E1) according to PPS 33.01, no thickness allowance or measurement is required.

6.1.1.2 Visually check for the following:

- The nickel plating shall be smooth, fine grained, adherent and free from blisters, pits, nodules, porosity, indications of burning and excessive edge build up. Slight discolouration resulting from heat treatment for embrittlement relief shall not be cause for rejection.
- Boundaries of the plating shall blend smoothly into the unplated surface.
- All detail of workmanship shall conform to the best practise for high quality plating.

TABLE I - SAMPLING SCHEDULE

LOT SIZE	MINIMUM SAMPLE SIZE	ACCEPTANCE NUMBER
1 - 5	ALL	0
6 - 25	5	0
26 - 50	8	0
51 - 90	13	0

LOT SIZE	MINIMUM SAMPLE SIZE	ACCEPTANCE NUMBER
91 - 150	20	1
151 - 280	32	1
281 - 500	50	2
501 - 1200	80	3

6.2 Quarterly Adhesion Tests

6.2.1 Every 3 months, plate 4 LAB 051-3 test specimens according to the procedure specified herein and submit the test specimens to a Bombardier approved laboratory (see paragraph 4.2.3.2) for plating adhesion testing according to DHLPM (de Havilland Laboratory Procedures Manual) procedure #3058, or as follows:

Step 1. Bend each test specimen repeatedly through an angle of 180° on a diameter equal to the thickness of the specimen until fracture of the basis metal occurs.

Step 2. Using a sharp instrument, attempt to detach an appreciable area of the plating from the substrate metal at the fracture. If it is possible to detach any appreciable area of the plating from the substrate metal at the fracture in any of the test specimens, the cause of the failure shall be determined and corrected and a further 4 test specimens prepared and tested.

7 SAFETY PRECAUTIONS

7.1 Safety precautions applicable to the materials and procedures specified herein shall be defined by the subcontractor performing the work for Bombardier Toronto.

8 PERSONNEL REQUIREMENTS

8.1 This PPS has been categorized as a “Critical or Special Process” according to PPS 13.39. Refer to PPS 13.39 for personnel requirements.

FLOW CHART 1 - NICKEL PLATING