BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 33.06

PRODUCTION PROCESS STANDARD

ELECTROLESS NICKEL PLATING (E4)

Issue 9
- This standard supersedes PPS 33.06, Issue 8.
- Vertical lines in the left hand margin indicate technical 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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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the electroless nickel plating (finish code E4 according to PPS 23.02) of carbon and low alloy steel parts.

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 PPS 13.26 - General Subcontractor Provisions.

3.2 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.3 PPS 23.02 - Protective Treatment and Decorative Surface Finish Code System

3.4 PPS 30.04 - Steel Heat Treatment - Carbon and Low Alloy Steels.

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

3.6 PPS 33.02 - Removal of Metallic Coatings.

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 General

4.1.1 All materials, equipment and facilities processing parts according to the procedure 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 categorized as a Controlled Critical Process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform electroless nickel plating of carbon and low alloy steel parts according to this PPS.

4.2.2 Bombardier subcontractors shall direct requests for approval to Bombardier Aerospace Supplier Quality Management. Bombardier Aerospace 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 electroless nickel plating of carbon and low alloy steel parts according to this PPS, completion of a test program and submission of suitable test samples representative of production parts may be required. Test samples shall meet the requirements specified by Bombardier Toronto Engineering.

5 PROCEDURE

5.1 General

5.1.1 Electroless nickel plating provides a hard, wear resistant and corrosion resistant surface on carbon and low alloy steel parts with uniform build-up on complex shapes.

5.1.2 Electroless nickel plating is specified on engineering drawings by class and type as follows:

Class 1 - As plated, no subsequent heat treatment.
Class 2, Type A - Heat treated for hydrogen embrittlement relief.
Class 2, Type B - Heat treated to increase plating hardness.

5.1.2.1 If the engineering drawing does not specify the class and, if applicable, the type, contact Bombardier Engineering.

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 before cleaning and plating.

5.2.2 Clean parts according to PPS 31.03 immediately before plating.

5.3 Plating Procedure

5.3.1 Immerse parts in the plating solution in such a way that blind holes are completely filled with solution and, if possible, with hole entry facing up.

5.3.2 Gently agitate complex parts with numerous holes, angles, etc. during the plating cycle.

5.3.3 Plating shall be continuous without interruption.

5.3.4 Carry out plating for the time required to provide a plate thickness of 0.001 ± 0.0001".

5.3.5 Upon completion of plating, rinse parts in water meeting a solid accumulation requirement of 350 ppm maximum.

5.4 Post-Plate Heat Treatment

5.4.1 After plating, heat treat all Class 2 plated parts as follows:

- Embrittlement relieve Class 2, Type A parts according to PPS 30.04.
- Heat treat Class 2, Type B parts for 1 hour at 700 ± 10°F to increase the plating hardness.

5.4.2 A record of heat treatment time, temperature and batch numbers shall be maintained by the facility performing the heat treatment operations.

5.5 Stripping of Plating

5.5.1 If necessary, strip nickel plating according to PPS 33.02 and re-plate according to section 5.2 and section 5.3.

6 REQUIREMENTS

6.1 General

6.1.1 Refer to Table I for a summary of test requirements.

TABLE I - SUMMARY OF TESTING REQUIREMENTS

TEST	TESTING FREQUENCY	NUMBER OF PANELS	TEST SPECIMENS	TESTING PROCEDURE (NOTE 1)
Visual Examination	According to Table II	According to Table II	Production Parts	According to section 6.2.2
Non-Destructive Plating Thickness	According to Table II	According to Table II	Production Parts	According to section 6.2.3
Adhesion	Every Production Lot	1	LAB 051-3	According to section 6.3.3
Destructive Plating Thickness	Every Production Lot	2	LAB 051-3	According to section 6.3.4
Plating Hardness	Every Production Lot	1	LAB 051-3	According to section 6.3.5
Note 1. Refer to the appropriate sections for details regarding test requirements.				

6.2 Sampling

6.2.1 For visual examination according to section 6.2.2 and non-destructive plating thickness tests according to section 6.2.3, select a sample from each lot by taking at random from the lot, not less than the number of items indicated in Table II. If the number of non-conforming items in any sample exceeds the acceptance number specified in Table II, 100% inspect the lot. Parts meeting the requirements shall be accepted. For any parts that do not meet the requirements, strip, re-plate together with test specimens and re-inspect as specified herein.

TABLE II - VISUAL AND PLATING THICKNESS SAMPLING SCHEDULE

NUMBER OF ITEMS IN INSPECTION LOT	NUMBER OF ITEMS IN SAMPLE (SELECTED AT RANDOM)	ACCEPTANCE NUMBER (NOTE 1)
1 to 5	All	0
6 to 25	5	0
26 to 50	8	0
51 to 90	13	0
91 to 150	20	1
151 to 280	32	1
281 to 500	50	2
501 to 1200	80	3
Note 1. Any defective items within the permitted number of defectives shall not be accepted with the lot but shall be stripped, re-plated and re-checked as specified herein.		

6.2.2 Visual Examination

6.2.2.1 Plating shall be firmly bonded to the base metal and shall be free from peel, pinholes and imperfections which would be detrimental to the part.

6.2.2.2 Discolouration resulting from heat treatment is not cause for rejection.

6.2.2.3 Plate appearance (i.e., dull or bright) is not cause for rejection.

6.2.3 Plating Thickness

6.2.3.1 The thickness of the nickel plating shall be 0.001 ± 0.0001".

6.2.3.2 Calculate the plating thickness from measurements taken before and after plating at several locations on the part.

6.3 Test Specimens

6.3.1 Process three Lab 051-3 test specimens together with each lot of production parts through the pre-plate cleaning, plating and, if applicable, post-plate heat treatment operations.

6.3.1.1 Submit one test specimen for plate adhesion testing according to section 6.3.3 and two test specimens for destructive plating thickness testing according to section 6.3.4 to the Bombardier Materials Laboratory or a Bombardier approved laboratory.

6.3.2 Process one additional LAB 051-3 test specimen through the pre-plate cleaning, plating and, if applicable, post-plate heat treatment operations, except that the plating of the specimen shall be carried out for the time required to provide a minimum plate thickness of 0.003".

6.3.2.1 The test specimen shall be identified as having thicker plating by cropping off one corner.

6.3.2.2 Submit the test specimen to the Bombardier Materials Laboratory or a Bombardier approved laboratory, as directed by Bombardier Quality, for plating hardness testing according to paragraph 6.3.5.

6.3.3 Adhesion Tests

6.3.3.1 At room temperature, rapidly bend the test specimen once through an angle of 180° around a diameter equal to the specimen thickness.

6.3.3.2 Using a sharp instrument, it shall not be possible to detach any appreciable area of the plating from the base metal on the outside radius of the bend.

6.3.3.3 Cracks in the plating or test piece are acceptable, providing the plating does not peel or flake.

6.3.3.4 If the test specimen fails to meet the adhesion requirements, reject the represented lot of production parts and action according to paragraph 6.3.7.

6.3.4 Destructive Plating Thickness Test

6.3.4.1 Metallographically prepare and examine microscopically two 1" sections from the test specimens prepared in paragraph 6.3.1 according to ASTM B487.

6.3.4.2 If the coating thickness at any place on the test specimens fails the requirement specified in paragraph 6.2.3.1, 100% inspect the lot. Parts meeting the requirements shall be accepted. For any parts that do not meet the requirements, strip, re-plate together with test specimens and re-inspect as specified herein.

6.3.5 Plating Hardness Tests

6.3.5.1 The test specimen prepared according to paragraph 6.3.2 shall be tested for plating hardness using a Vickers or Rockwell superficial hardness tester.

6.3.5.2 Plating hardness shall be as follows for the applicable class and type:

Class 1 - R15N80 (390 Vickers) minimum.
Class 2, Type A - R15N80 (390 Vickers) minimum.
Class 2, Type B - R15N90 (700 Vickers) minimum.

6.3.5.3 If the test specimen fails to meet the minimum hardness requirements, reject the represented lot of production parts and action according to paragraph 6.3.7.

6.3.6 Disposition

6.3.7 Lots rejected for plating adhesion according to section 6.3.3 or plating hardness according to section 6.3.5, shall be stripped according to PPS 33.02, re-plated together with test specimens and re-inspected.

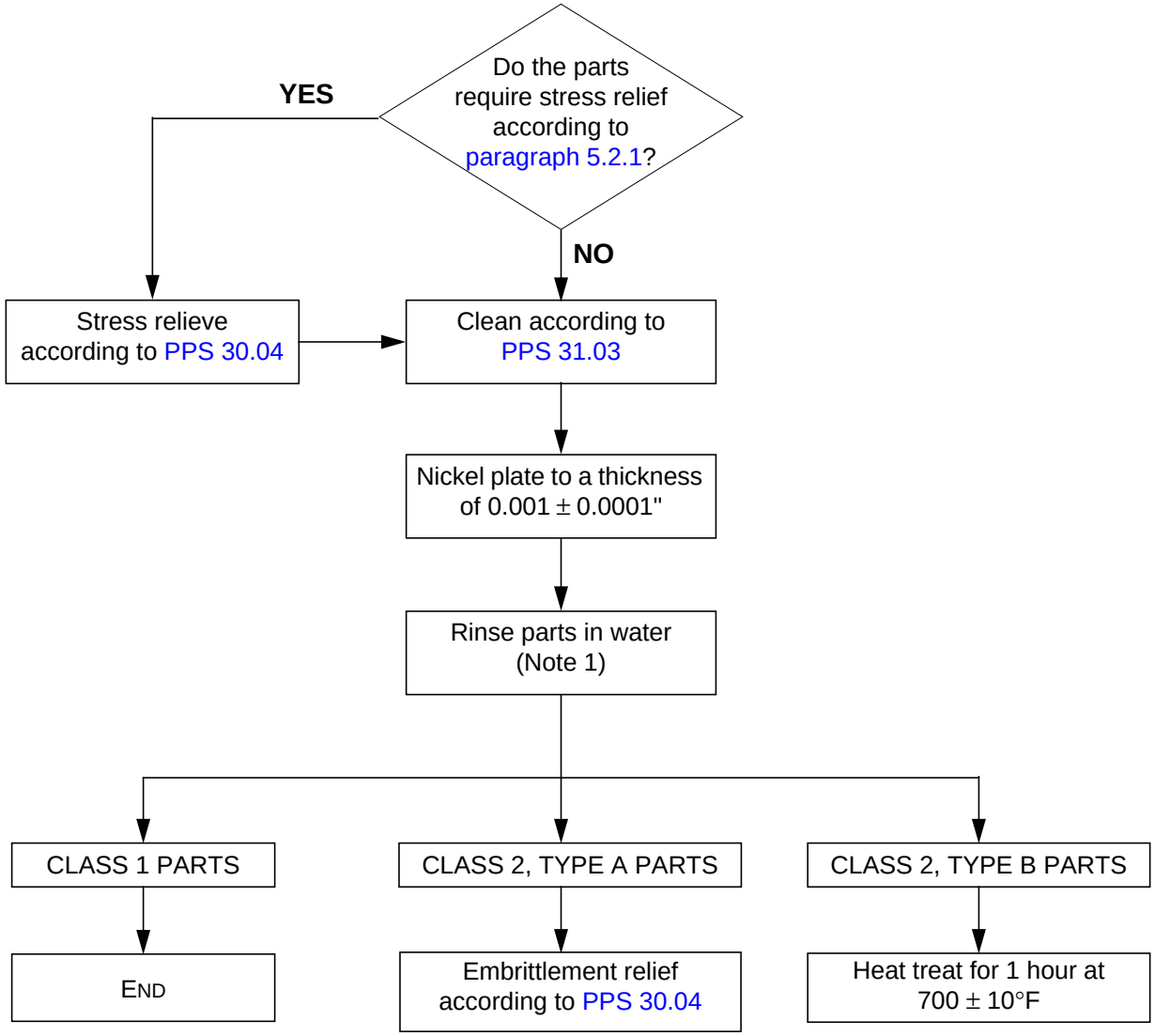
7 SAFETY PRECAUTIONS

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 Controlled Critical Process according to PPS 13.39. Refer to PPS 13.39 for personnel requirements.

FLOW CHART 1 - ELECTROLESS NICKEL PLATING



Note 1. Rinse water shall not exceed a total dissolved solids accumulation requirement of 350 ppm.