BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 33.12

PRODUCTION PROCESS STANDARD

LOW HYDROGEN EMBRITTLEMENT STYLUS CADMIUM PLATING

Issue 5
- This standard supersedes PPS 33.12, Issue 4.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS related questions to PPS.Group@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 application of low hydrogen embrittlement stylus cadmium plating to localized areas of copper alloy and ferrous alloy parts by means of portable equipment.

1.1.1 This PPS shall **only** be used when specifically authorized by the engineering drawing or an approved dispositioned Report of Non-Conformance (RNC).

1.1.2 The maximum area to be stylus cadmium plated at one time shall be 6 square inches. The total area of a part to be stylus cadmium plated according to this PPS shall be 36 square inches.

1.1.3 This PPS complements the engineering drawings or approved RNC 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 or approved RNC, follow the engineering drawing or approved RNC. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

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

1.1.5 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 ASTM F519 - Standard Test Method for Mechanical Hydrogen Embrittlement Evaluation of Plating/Coating Processes and Service Environments.

3.2 Bombardier Aerospace Test Standard, BATS 4002 - Coating Thickness Determination by Non-Destructive Procedure.

3.3 Bombardier Aerospace Test Standard, BATS 4860 - Paint Adhesion, Tape Test.

3.4 PPS 13.26 - General Subcontractor Provisions.

3.5 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.6 PPS 16.01 - Application of Hard and Soft Film (F13) Corrosion Preventive Compound.

3.7 PPS 16.20 - Temporary Corrosion Protection of Carbon and Low Alloy Steel Parts.

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

3.9 PPS 30.06 - Heat Treatment of Precipitation Hardenable (PH) Stainless Steels.

3.10 PPS 30.08 - Heat Treatment of Martensitic Stainless Steels.

3.11 PPS 32.08 - Application of Zinc Phosphate Coatings to Plated Parts (C5).

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 General

4.1.1 Use of the following electroplating systems are acceptable provided that the requirements of the engineering drawing and section 6 of this PPS are met. Set-up and operate all systems according to the solution/equipment manufacturer's instructions.

- Sifco Applied Surface Concepts (ASC) plating process
- Liquid Development Company (LDC) plating process
- Selectrons Ltd. plating process

4.2 Materials

4.2.1 Plating process solutions as specified by the manufacturer's designation (i.e., cleaning, plating and post plating).

4.2.2 Abrasive paper, 120 - 180 grit size, aluminum oxide.

4.2.3 Masking tape (e.g., 3M No. 470 tape, 3M Company).

4.2.4 Masking tape for paint adhesion testing, 1 inch wide, adhesion tested according to ASTM D3330 Method A with a minimum bond strength 60 oz/inch width (e.g., 3M Company No. 250 or No. 300). The masking tape shall also be adhesion tested according to ASTM D3330 Method A at the end of 12 months from the date of manufacture and every 3 months thereafter for up to 2 years.

4.2.5 Wiping cloth (e.g., DSC 378-2).

4.3 Equipment

4.3.1 Plating power pack as specified by the manufacturer's instructions.

4.3.2 Application container resistant to chemicals used.

4.3.3 Thickness gauge, measuring device based on eddy current (e.g., calibrated elcometer) capable of measurement of ± 0.05 mil (± 0.00005 inch).

4.4 Facilities

4.4.1 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 low hydrogen embrittlement stylus cadmium plating to localized areas of copper alloy and ferrous alloy parts by means of portable equipment according to this PPS.

4.4.2 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.

4.4.3 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.

4.4.3.1 For approval of subcontractor facilities to perform the application of low hydrogen embrittlement stylus cadmium plating to localized areas of copper alloy and ferrous alloy parts by means of portable equipment 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.

5 PROCEDURE

5.1 Terms Applicable to Stylus Cadmium Plating

5.1.1 *Water Break-Free Surface* - A surface which maintains a continuous water film for a period of at least 15 seconds without discontinuities or breaks after having been spray or immersion rinsed in clean water at a temperature below 100°F.

5.1.2 *Forward Current* - Anode (plating tool) is connected to the positive terminal of the power supply and the part to be processed to the negative terminal.

5.1.3 *Reverse Current* - Anode is connected to the negative terminal of the power supply and the part to the positive terminal.

5.1.4 *Electrode* - Stylus and anode assembly.

5.1.5 *Prior Preparation* - Cleaning solutions are not designed to remove large amounts of grease, oil oxides and scale. Mechanical methods should be used to remove large amounts of scale or oxides. Solvents should be used to remove large amounts of grease or oil.

5.1.6 *Electroclean* - Electroclean to remove residual amounts of oil, grease, and light oxide films. Forward current is normally used but reverse current can be used to prevent hydrogen embrittlement. Electroclean an area larger than the area to be plated,

5.1.7 *Rinse* - The purpose of the rinse is to remove all of the previous solution, so that the following solution will not be contaminated. Rinsing is a very important step, and usually but not always follows each step. Rinse a larger area that the area to be plated. Use clean tap water.

5.1.8 *Etch* - Etch the surface as required. Small amounts of oxides may still remain on the surface of many materials after electroplating. "Flowed" metal is often present on the surface from machining, grinding, and polishing operations or through usage of the part. The etching operation is used with reverse current and is continued until the oxide film, flowed metal and contaminated surface material have been removed and a uniform "grainy" surface appearance is obtained.

5.1.9 *Desmutting* - The etching operation on some materials results in the formation of a loose layer of insoluble material. This layer causes poor adhesion to the base material. This layer can be removed by an appropriate desmutting operation. The desmutting is completed when the surface is uniform in appearance, and continued desmutting does not result in the surface becoming lighter in colour.

5.1.10 *Activating* - Activate the surface as required for plating on aluminum alloys, high alloy steel or stainless steel. The purpose of the activation step is to remove the characteristically passive surface of these metals.

5.1.11 *Preplate* - Preplate as required. In many cases to obtain maximum adhesion, preplates of a suitable metal are deposited prior to deposition of the metal desired. Follow solution manufacturer's recommendations for bonding and preplate thickness.

5.1.12 *Electroplate* - The final preparatory operation should be followed as soon as possible by the plating operation. Unless otherwise specified by the engineering drawing or MRB disposition, if this PPS conflicts with the solution manufacturer's instructions, follow the manufacturer's instructions.

5.1.13 *Dry* - Dry using a warm air blower, paper towelling, or clean dry rags.

5.2 General

5.2.1 Complete all machining, forming, welding, brazing or shot peening before plating. Unless otherwise specified, apply stylus plating only to surfaces that are smooth and substantially free from blemishes, pits, tool marks, weld flash or slag, and other irregularities except the evenly textured surface imparted during abrasive cleaning.

5.2.2 Unless otherwise called for by the engineering drawing or MRB disposition, the plating thickness shall be 0.0002 inch minimum.

5.2.3 The part surface should be at 32°F to ambient temperature to preclude freezing of the plating solutions and rinse water, and cool enough to preclude drying of the surface during the plating process.

5.2.4 Use cleaning and plating solutions as supplied. Do not re-use solution after its removal from the original container.

5.2.5 Use a suitably sized container for the volume of solution required and size of the anode.

5.2.6 Clearly mark the container with the name or code of solution being used and shall be dedicated to a single solution.

5.3 Post Plating Sequence

5.3.1 Chromate Treatment for Cadmium Plating

5.3.1.1 If the engineering drawing or MRB disposition specifies a Type II cadmium plating, swab the plated surfaces with the appropriate chromate conversion coating solution.

5.3.2 Embrittlement Relief

5.3.2.1 Remove masking material from plated parts.

5.3.2.2 Unless otherwise specified on the engineering drawing or MRB disposition, embrittlement relieve the following parts according to PPS 30.04, PPS 30.06 or PPS 30.08, as applicable, within 4 hours of plating. It is also not necessary to embrittlement relieve parts plated with Sifco Cadmium (No Bake) 2023 solution (see section 9.2 requirements):

- Aircraft parts with a tensile strength range of 150 - 170 ksi or greater.
- Springs with a tensile strength of 180 - 200 ksi or greater.

5.3.2.3 If more than one type of plating is required on a part, it is not necessary to embrittlement relieve between plating processes provided that the part is embrittlement relieved after the final plating cycle within 4 hours of the completion of the first plating process.

5.3.2.4 For parts that require both embrittlement relief and phosphate treatment according to PPS 32.08 after plating, perform embrittlement relief before phosphate treatment. For parts heat treated to 180 - 200 ksi or less, it is permissible to phosphate treat and plate before embrittlement relief provided that embrittlement relief is performed within 4 hours of the completion of the first plating process.

5.3.3 Post Plating Protection Requirements

5.3.3.1 Perform the following post plating protection treatment before shipping or placing parts into storage within 30 minutes of the final operation (i.e., plating, embrittlement relief or phosphate treatment):

- Oil dip coat unplated areas of low alloy steel parts and plated low alloy steel tubes that are not hermetically sealed according to PPS 16.20.
- Treat unplated areas of corrosion resistant steel parts and the inside diameter of corrosion resistant steel tubes that are not hermetically sealed according to PPS 16.01.

5.4 Removal of Plating

5.4.1 When required, remove plating in localized areas by abrasive methods. All other methods shall be approved by MRB prior to use.

5.4.2 After the plating has been removed, wipe the surface with clean damp cloths and then air dry with an air blast.

6 REQUIREMENTS

6.1 Thickness

6.1.1 Unless otherwise called for by the engineering drawing or MRB disposition, the plating thickness shall be 0.0002 inch minimum. Perform thickness measurements according to BATS 4002 and accurate to within +/- 10%. Testing frequency shall as specified in section 6.4.

6.2 Quality of Plating

6.2.1 All localized brush plated surface shall be smooth, fine grained, free from blisters, pits, nodules, indications of burning or other defects.

6.2.2 The chromate conversion coating on cadmium plating shall have a uniform colour and be free of powdery products.

6.3 Adhesion

6.3.1 Test the adhesion according to BATS 4860, Type I, Class 5 and shall be performed on all localized brush plated surface of part.

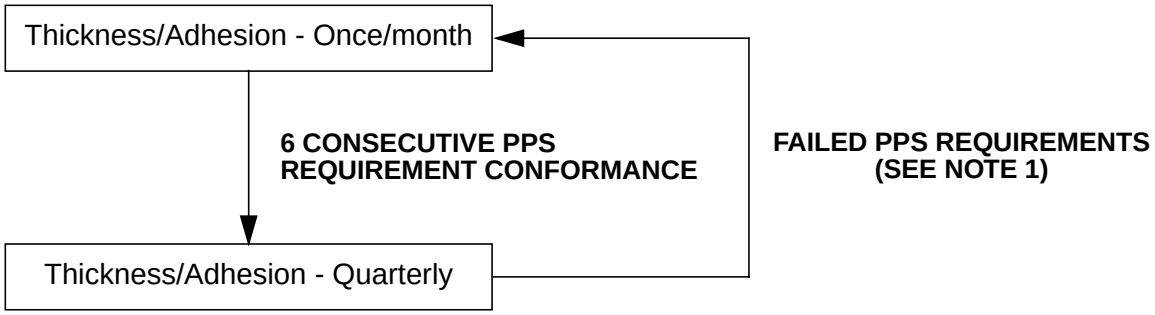
6.3.2 The brush plating shall not show evidence of separation at the interface with base material or with the previous plating.

6.3.3 The adhesion of cadmium plating with chromic conversion coating finish shall be done after 24 hours from treatment completion.

6.4 Process Control

6.4.1 Except for localized brush plated assemblies, process a test piece with each lot of parts processed to this PPS.

6.4.2 The test piece shall be a minimum of 4 inches long by 1 inches wide of the appropriate representative substrate metal of the production part. One side of the test piece shall be masked with tape (see paragraph 4.2.3) so that the exposed area is the same as that of the surface to be plated on the part represented by the test piece. Perform the process control check at the following specified frequency.



Note 1. Refer to MRB for disposition of parts processed since the last successful testing.

6.4.3 The test piece shall be clean and plated according to this PPS. The plating time shall be the same as that used on the part represented by the test piece.

6.4.4 Check the test piece for thickness and adhesion according to section 6.1 and section 6.3.

6.4.5 In the event that process control panels fail to meet the requirements specified herein, production shall be suspended until corrective action is implemented and verified by re-testing. Parts fabricated during the loss of control time period shall be rejected and processed through MRB.

7 SAFETY PRECAUTIONS

7.1 Observe standard plant safety precautions when performing the procedure specified herein.

7.2 Refer to the applicable chemical solution's MSDS for additional safety precautions.

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.

9 SOLUTION CONTROL

9.1 General

9.1.1 All solutions used shall be checked for the expiration date prior to use.

9.1.2 Use the cleaning, plating and post plating solutions as supplied.

9.1.3 Discard solutions when a precipitate or cloudiness is observed.

9.2 Hydrogen Embrittlement for Cadmium (No Bake) 2023 Solution

9.2.1 Each individual lot number of solution shall meet requirements of hydrogen embrittlement according to ASTM F519 on unbaked specimens before the initial use and every 12 months thereafter.

9.2.2 The initial test for hydrogen embrittlement may be omitted if a test report has been received from the solution manufacturer.

9.2.3 Record all laboratory results along with the lot information.