BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 32.06

PRODUCTION PROCESS STANDARD

APPLICATION OF MANGANESE PHOSPHATE (C2) TO STEEL PARTS

Issue 10
- This standard supersedes PPS 32.06, Issue 9.
- 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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TABLE OF CONTENTS

Sections **Page**

Tables

Flow Charts

1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for manganese phosphate coatings (protective treatment code C2) applied to carbon and low alloy steels.

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 ASTM B117 - Salt Spray (Fog) Testing.

3.2 BAERD GEN-018 - Engineering Requirements for Laboratories.

3.3 BAERD GEN-023 - Contamination Control for Compressed Air.

3.4 DHLPM Procedure No. 6011 - Description of Operation and Conditions Required for Salt Spray (Fog) Testing for Specification Purposes.

3.5 PPS 13.26 - General Subcontractor Provisions.

3.6 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.7 PPS 17.02 - Abrasive Blasting.

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

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

3.10 PPS 31.04 - Degreasing Processes.

3.11 PPS 31.11 - Vapour Blast Cleaning.

3.12 PPS 32.09 - Application of Dry Film Lubricant (C3, C7 and C8).

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Thermoil Granodine #112, Henkel Technologies.

4.1.2 Parco Lubrite 2, Henkel Technologies.

4.1.2.1 Neutralizer 200, Henkel Technologies.

4.1.3 Oil, general purpose, low temperature lubrication to specification MIL-L-3150.

4.1.4 Bonderite M-CR 1200S Aero, Henkel Technologies.

4.1.5 Steel wool, commercial grade.

4.1.6 Masking material (e.g., Microstop and Microstrip).

4.1.7 Lint-free cotton gloves (e.g., DSC 422-1).

4.2 Equipment

4.2.1 Immersion tanks for water rinse, phosphate and acidulated rinse baths as listed in Table I. Immersion tanks shall be resistant to the chemicals and to the operating temperatures used (e.g., mild steel for acidulated solution; and stainless steel for manganese phosphate solutions). Tanks shall be equipped with temperature indicating, regulating and recording devices capable of controlling the chemical solution temperatures within ± 5°F and equipped with mechanical or air agitation.

4.2.2 Compressed air shall meet the requirements of BAERD GEN-023.

4.3 Facilities

4.3.1 This PPS has been categorized as a Controlled Special Process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform manganese phosphate coatings (protective treatment code C2) applied to carbon and low alloy steels according to this PPS.

4.3.2 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.

4.3.3 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.

4.3.3.1 For approval of subcontractor facilities to perform manganese phosphate coatings (protective treatment code C2) applied to carbon and low alloy steels 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.

4.3.3.2 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

5.1 General

5.1.1 Refer to Flow Chart 1 for processing operations and sequence.

5.1.2 Operators shall wear clean cotton gloves at all times when handling phosphate treated parts.

5.2 Preparation of Solutions

5.2.1 Prepare the solution baths as follows:

Step 1. Fill the tank half full with water.

Step 2. Add the required amount of chemicals according to Table I slowly into the tank. When making up Parco Lubrite 2 solution, heat water to 120°F to 160°F before adding the chemical (do not exceed 160°F).

Step 3. Fill the tank up to the operating level with water.

TABLE I - MAKE-UP AND CONTROL OF SOLUTIONS

SOLUTION	BATH COMPOSITION			OPERATING TEMPERATURE	ANALYSIS FREQUENCY
	CHEMICALS	CONCENTRATION	WATER		
MANGANESE PHOSPHATE SOLUTIONS (NOTE 1)					
Thermoil Granodine #112	Thermoil Granodine #112	10% by volume	Tap	200 - 210°F	Monthly
Parco Lubrite 2	Parco Lubrite #2	11% by volume	Tap	205 - 210°F	Monthly
	Iron	0.1 to 0.3% by volume			
	Total acid	11.5 - 12.5 points (Note 2 & 3)			
	Free Acid	2.0 - 2.2 points (Note 2 & 4)			
ACIDULATED RINSE					
Bonderite M-CR 1200S Aero	Bonderite M-CR 1200S Aero	2 - 6 oz/100 gal	De-ionized	120 - 140°F	Monthly

Note 1. To condition a new (or iron-deficient) bath, place steel wool into bath (2-3 lbs/100 gal_{US}) and allow to stand for one hour.
Note 2. Using the Henkel Technologies' titration method for determining acid value, the mL of Titrating Solution 11 used is the total acid or free acid value in points.
Note 3. To increase total acid value by 0.1 point, add 1.0 pound of Parco Lubrite 2 per 100 gal_{US} of solution.
Note 4. To decrease the free acid value by 0.1 point, add 4 ounces of Neutralizer 200 per 100 gal_{US} of solution. Slurry the Neutralizer 200 in water before making the addition.

5.3 Preparation of Parts

5.3.1 Stress Relief

5.3.1.1 Stress relieve all parts having a tensile strength range of 180 - 200 ksi and greater, and which have been machined, cold formed, cold straightened or ground according to PPS 30.04 before cleaning and the application of phosphate coating.

5.3.2 Cleaning

5.3.2.1 Vapour blast parts to be dry film lubricated (C3) according to PPS 31.11 or abrasive blast clean using 180 grit or finer aluminum oxide according to PPS 17.02 before manganese phosphating.

5.3.2.2 Clean all other parts according to PPS 31.03.

5.3.3 Masking

5.3.3.1 Mask off all areas not to be manganese phosphated.

5.4 Application of Phosphate Coating

5.4.1 Apply manganese phosphate coating as follows:

Step 1. Immerse parts in manganese phosphate solution for 10 to 20 minutes. The required thickness of the coating shall be as specified in section 6.4.

Step 2. Cold water rinse parts for approximately 1 minute.

Step 3. Immerse parts in the acidulated final rinse for a minimum of 1 minute.

Step 4. On removal from the acidulated rinse, allow parts to dry at room temperature before further processing.

Step 5. Blow out part cavities which can entrap moisture using clean compressed air.

Step 6. Remove maskant.

5.5 Embrittlement Relief

5.5.1 Embrittlement relieve aircraft parts with a tensile strength range of 150-170 ksi or greater according to PPS 30.04 within 4 hours of phosphating.

5.6 Lubrication and Oiling

5.6.1 If specified on the engineering drawing, apply a supplementary coating of oil conforming to MIL-L-3150 to the phosphate treated surfaces.

5.6.2 Do not apply oil if dry film lubricant is specified. Apply dry film lubricant according to PPS 32.09. If dry film lubricant application is not carried out immediately, wrap parts in clean, wax-free paper. Do not remove the protective paper until immediately before the application of lubricant.

5.7 Stripping

5.7.1 If necessary, strip phosphate coated parts by immersing in Rust-Off #2 solution according to PPS 31.03.

6 REQUIREMENTS

6.1 Testing Requirements

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

6.1.2 Refer to Table II for a summary of test panel requirements.

TABLE II - SUMMARY OF TESTING REQUIREMENTS

TEST	TESTING FREQUENCY	NUMBER OF PANELS	TEST SPECIMENS	TESTING PROCEDURE (NOTE 1)
Visual Inspection	According to Table III and section 6.2	According to Table III	Production parts	Visual (according to section 6.2)
Surface Roughness	According to Table III and section 6.3	According to Table III	Production parts	Surface Roughness (according to section 6.3)
Coating Thickness	According to Table III and section 6.4	According to Table III	Production parts	Coating Thickness (according to section 6.4)
Corrosion Resistance	Quarterly (see section 6.5)	4	LAB 064-3 (see section 6.5)	DHLPM Procedure No. 6011 or ASTM B117
Coating Weight	Quarterly (see section 6.6)	2	LAB 065-3	According to section 6.6

Note 1. Refer to the appropriate sections for details regarding test requirements.

6.1.3 For visual inspection according to section 6.2, surface roughness according to section 6.3, and non-destructive coating thickness tests according to section 6.4, select a sample from each production lot, by taking at random from the lot, not less than the number of items indicated in Table III.

6.1.3.1 If the number of non-conforming items in any sample exceeds the acceptance number specified in Table III, reject the represented lot, and disposition them according to paragraph 6.7.1.

TABLE III - VISUAL AND COATING THICKNESS SAMPLING SCHEDULE

NUMBER OF ITEMS IN INSPECTION LOT	NUMBER OF ITEMS IN SAMPLE (SELECTED AT RANDOM)	ACCEPTANCE NUMBER (NOTE 1)	REJECTION NUMBER
1 to 5	All	0	1
6 to 25	5	0	1
26 to 50	8	0	1
51 to 90	13	0	1
91 to 150	20	1	2
151 to 280	32	1	2
281 to 500	50	2	3
501 to 1200	80	3	4

Note 1. Any defective items within the permitted number of defectives shall not be accepted with the lot but be rejected.

6.2 Visual Inspection

6.2.1 The phosphate coating shall be evenly deposited, have a uniformly crystalline texture and be gray or black in colour.

6.2.2 The presence of brown or orange stains resulting from the acidulated rinse shall not be cause for rejection.

6.2.3 Coatings shall be free of white stains due to dry phosphating solution, rust or fingerprints.

6.2.4 Compare the surface finish of the phosphate coating to an approved sample panel prominently displayed in the operating area.

6.3 Surface Roughness

6.3.1 Surface roughness values shall be no less than 64 RMS. On parts with an original surface finish of 125 RMS or greater, readings on coated parts shall not exceed the original surface finish.

6.4 Coating Thickness

6.4.1 Unless otherwise specified on the engineering drawing, the thickness of the phosphate coating shall be 0.0002 - 0.0004 inches.

6.4.2 Carry out the thickness test before any supplementary treatments.

6.4.3 Perform measurements at several locations on each part to prevent the acceptance of irregular coatings.

6.4.4 Consider parts as non-conforming if one or more measurements fail to meet the specified minimum thickness.

6.5 Corrosion Resistance

6.5.1 For corrosion resistance testing, on a quarterly basis, expose 4 phosphate coated LAB 064-3 test panels to a 5% salt spray according to ASTM B117 or DHLPM Procedure No. 6011, except the test surface shall be inclined 15° from the vertical. Two of the test specimens shall be supplied without supplementary finish, the remaining two shall be coated with oil according to paragraph 5.6.1. Expose test panels without supplementary oil coating for 1 1/2 hours. Expose test panels with supplementary oil coating for 24 hours. Examine all the panels for corrosive attack. If there is evidence of corrosive attack in excess of the following limits disposition according to paragraph 6.7.2:

- There shall be no spots or pits larger than 0.031" in diameter and no more than 15 isolated spots or pits in total on the 150 in^2 of test area (do not count spots or pits less than 0.010" in diameter or within 0.25" of identification markings, holding points or panel edges).
- There shall be no more than 5 isolated spots or pits on any single panel (do not count spots or pits less than 0.010" in diameter or within 0.25" of identification markings, holding points or panel edges).

6.6 Coating Weight

6.6.1 For coating weight determination, process 2 phosphate coated LAB 065-3 test panels quarterly with a production lot. Supply both of the test specimens without supplementary oil coating.

6.6.2 Submit the 2 test panels to a laboratory as specified in paragraph 4.3.3.2 for testing as follows:

Step 1. Weigh the test specimen.

Step 2. Strip the phosphate coating by immersion in Rust-Off #2 solution.

Step 3. Re-weigh the test specimen.

6.6.3 The minimum acceptable coating weight shall be 1500 milligrams per square foot.

6.6.3.1 If either of the test specimens fail to meet the minimum coating weight requirement, disposition according to paragraph 6.7.2.

6.7 Disposition

6.7.1 Any rejected lots shall be 100% inspected. Accept all parts that meet the above requirements. For parts that do not meet the requirements, strip according to section 5.7, re-coat and re-inspect as specified herein.

6.7.2 For corrosion resistance testing and coating weight determination, if the test panels should fail the specified requirements, suspend the phosphating coating process until the cause of the failure has been established and corrective action taken. Re-submit additional test panels as specified in section 6.5 or section 6.6, as applicable, and acceptable results shall be obtained prior to further processing of production parts.

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.

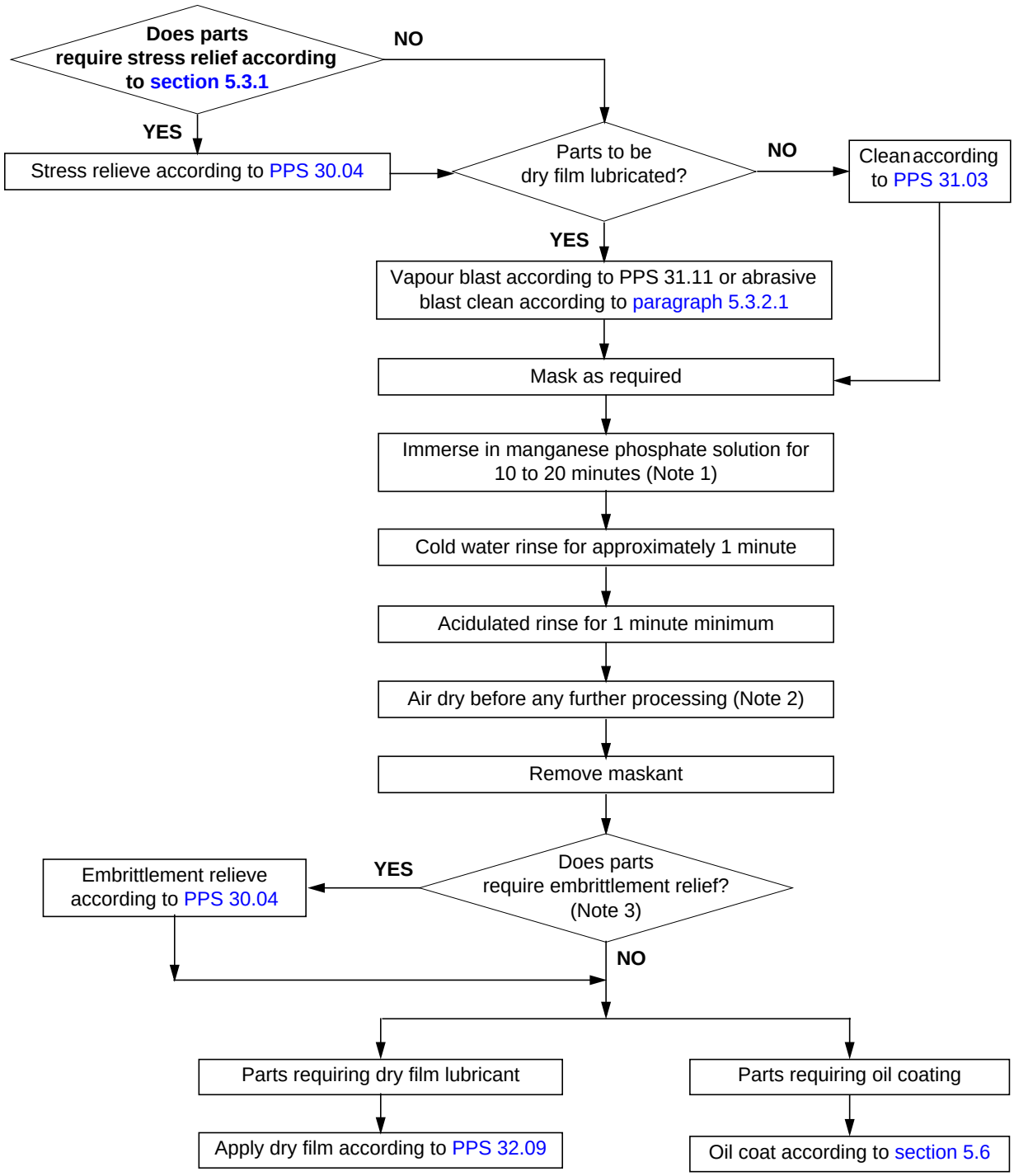
8 PERSONNEL REQUIREMENTS

8.1 This PPS has been categorized as a Controlled Special Process according to PPS 13.39. Refer to PPS 13.39 for personnel requirements.

9 MAINTENANCE OF SOLUTIONS

9.1 Phosphate and acidulated rinse baths shall be analyzed at regular intervals so that proper concentrations and operating conditions are maintained.

FLOW CHART 1 - MANGANESE PHOSPHATE COATING PROCESS



Note 1. To obtain a film thickness as specified in section 6.4.
Note 2. If required, blow out part cavities which can entrap moisture using clean compressed air.
Note 3. See section 5.5 for embrittlement relief requirements.