BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 32.07

PRODUCTION PROCESS STANDARD

CORROSION PROTECTION OF MAGNESIUM ALLOYS

Issue 12
- This standard supersedes PPS 32.07, Issue 11.
- 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.

Prepared By:	(Christie Chung)	March 28, 2016
	PPS Group	
Approved By:	(*K .Quon*, for Bruce Campbell)	March 30, 2016
	Materials Technology	
	(Stephen Pitt)	March 31, 2016
	Quality	

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

TABLE OF CONTENTS

Sections **Page**

Tables

Flow Charts

1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the corrosion protection of magnesium alloys by dichromate treatment (protective treatment code C4) or chrome pickle treatment.

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 17.02 - Abrasive Blasting.

3.5 PPS 31.02 - Cleaning Processes for Aluminum and Aluminum Alloys.

3.6 PPS 31.04 - Degreasing Processes.

3.7 PPS 31.17 - Solvent Usage.

3.8 MIL-PRF-7870 - Lubricating Oil, General Purpose, Low Temperature.

3.9 AMS-M-3171 - Magnesium Alloy, Processes for Pretreatment and Prevention of Corrosion on.

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Nitric acid, 42° Bé, A-A-59105.

4.1.2 Sulphuric acid, 66° Bé.

4.1.3 Sodium dichromate, A-A-59123.

4.1.4 Sodium acid fluoride or potassium acid fluoride or ammonium acid fluoride.

4.1.5 Hydrofluoric acid, 70/75%, MIL-A-24641.

4.1.6 Calcium fluoride or magnesium fluoride.

4.1.7 Selenious acid.

4.1.8 Chromic acid flakes, technical grade, A-A-55827.

4.2 Equipment

4.2.1 Immersion tanks resistant to the chemicals and to the operating temperatures used.

4.2.2 Neoprene gloves (e.g., DSC 422-5).

4.2.3 Cotton gloves (e.g., DSC 422-1).

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 the corrosion protection of magnesium alloys by dichromate treatment (protective treatment code C4) or chrome pickle treatment 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 the corrosion protection of magnesium alloys by dichromate treatment (protective treatment code C4) or chrome pickle treatment 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 The chrome pickle treatment shall only be used by the foundry for temporary protection of magnesium castings during shipping or storage. Do not apply this process to parts having close dimensional tolerances.

5.1.2 Unless otherwise specified, carry out dichromate treatment after all machining or forming operations.

5.1.3 Wear clean neoprene gloves at all times when handling parts during cleaning, pre-treating and application of finish treatments as specified herein.

5.1.4 Wear clean cotton gloves at all times when handling finish 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.

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

TABLE I - MAKE-UP OF SOLUTIONS

BATH TYPE (NOTE 3)	BATH MAKE-UP (NOTES 1 & 2)				OPERATING TEMPERATURE
	CHEMICALS	IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	
Nitric/Sulphuric Acid	Nitric Acid	12.8 fl oz/gal	80 mL/L	10.6 fl oz/gal	60°F - 90°F
	Sulphuric Acid	3.2 fl oz/gal	20 mL/L	2.7 fl oz/gal	
Chrome Pickle (Note 4)	Sodium Dichromate	1.8 lbs/gal	180 g/L	1.5 lbs/gal	70°F - 140°F
	Nitric Acid	30 fl oz/gal	187 mL/L	25 fl oz/gal	
	Sodium or Potassium or Ammonium Acid Fluoride	2.4 oz/gal	15 g/L	2.0 oz/gal	
Hydrofluoric Acid	Hydrofluoric Acid (70%)	40 fl oz/gal	252 mL/L	33 fl oz/gal	60°F - 90°F
Dichromate	Sodium Dichromate	1.8 lbs/gal	180 g/L	1.5 lbs/gal	212°F (Note 5)
	Calcium Fluoride or Magnesium Fluoride	0.4 oz/gal	2.5 g/L	0.3 oz/gal	
Selenious Acid	Selenious Acid	10% by weight in water			60°F - 90°F
Henkel 6/16	according to PPS 31.02				
Henkel 7/17	according to PPS 31.02				

Note 1. It is acceptable for subcontractors to deviate from the specified make-up of solutions provided that the control requirements of Table IV are met.
Note 2. Use tap water to make-up all solutions baths except for the dichromate bath. For the dichromate bath, use de-ionized water.
Note 3. Refer to paragraph 4.2.1 for tank requirements. Make-up the selenious acid solution in a glass jar.
Note 4. If sodium acid fluoride is used, add it before the nitric acid or dissolve in a small quantity of water before adding since sodium acid fluoride does not go into solution with nitric acid present.
Note 5. Do not allow the temperature of the dichromate bath to drop below 200°F.

5.3 Chrome Pickle Treatment

5.3.1 General

5.3.1.1 Refer to Flow Chart 1 for the processing operations and sequence to be followed for chrome pickle treatment.

5.3.1.2 Do not treat machined surfaces with chrome pickle solutions. Coat such parts with oil to MIL-L-7870 for temporary protection.

5.3.1.3 Ensure the chrome pickle solution is agitated during immersion of parts.

5.3.2 Touch-Up

5.3.2.1 Touch-up damaged chrome pickle coatings by brushing chrome pickle solution onto the defective area, allowing it to stand for one minute and then immediately washing it off with water.

5.4 Dichromate Treatment

5.4.1 General

5.4.1.1 Refer to Flow Chart 2 for the processing operations and sequence to be followed for dichromate treatment.

5.4.1.2 Unless otherwise specified, carry out dichromate treatment after all machining or forming operations.

5.4.1.3 If the dichromate treatment is delayed more than 24 hours, coat machined or formed surfaces with oil to MIL-L-7870 for temporary protection.

5.4.1.4 Do not immerse parts containing aluminum inserts in the hydrofluoric acid bath.

5.4.2 Repair of Damaged Coatings

5.4.2.1 Before painting, repair damaged dichromate coatings by brushing a 10% selenious acid solution onto the exposed surface until a permanent brown/black colour is obtained. Wash thoroughly and dry.

6 REQUIREMENTS

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

6.2 Protective coatings shall be uniform and free from breaks, scratches and abrasions.

6.3 Chrome pickle coatings shall appear as a matte grey to iridescent yellow-red, showing a network of pebbles when viewed with a magnifying glass. Bright brassy coatings with only occasional rounded pits are acceptable though they are indicative of incorrect composition of the bath. Non-uniform colour of brush touched-up chrome pickle coatings is also acceptable.

6.4 Dichromate coatings may vary from light to dark brown, depending upon the alloy.

6.5 Powdery coatings are not acceptable.

6.6 Table II gives information as to the possible cause of unsatisfactory treatments.

TABLE II - POSSIBLE CAUSES OF UNSATISFACTORY TREATMENTS

TYPE OF TREATMENT	DISCREPANCY	POSSIBLE CAUSE
Chrome Pickling	Bright brassy coating with only occasionally rounded pits	• Excess of nitric acid or nitrate build-up in the chrome pickle solution.
	Brown, non-adherent, powdery coating	• Excessive draining. • Ratio of nitric acid to sodium dichromate too high. • Temperature of solution above 140°F. • Insufficient degreasing. • Chrome pickle bath revivified too many times. • Excessive build-up of nitrate.
	Gray, powdery coating	• Too little or no bifluoride in the chrome pickle solution.
Dichromate Treatment	Abnormally heavy and loose powdery coatings	• Hydrofluoric acid bath too diluted. • pH of dichromate bath too low. • Contact between work and tank. • Prolonged dichromate treatment. • Insufficient removal of corrosion products.
	Failure to coat or non-uniform coatings	• pH of dichromate bath too high. • Insufficient dichromate concentration. • Oil on parts or oily film on bath. • Previous chrome pickle film not completely removed. • Parts not treated in hydrofluoric acid solution. • Excessive treatment of AZ31B alloy in hydrofluoric acid. • Temperature of dichromate bath too low. • Insufficient rinsing after hydrofluoric acid dip.
	Streaked Coatings	• Dichromate bath contains hydrofluoric acid.

7 SAFETY PRECAUTIONS

7.1 Safety precautions applicable to the materials and procedures specified herein shall be defined by the subcontractor performing such 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 General

9.1.1 Maintain solution operating temperatures according to Table I.

9.1.2 A sample of the cleaning, treatment and water rinse baths shall be tested at the analysis frequency specified in Table IV. Thoroughly mix the solutions before sampling.

9.1.3 If solutions fail to meet the requirements specified in Table IV, suspend the applicable process until the solution has been re-adjusted to meet these requirements. Re-analyze the solution within 24 hours of any adjustment.

9.1.4 If necessary, dispose of any solutions according to section 10 and prepare a new solution according to section 5.2.

9.1.5 Ensure baths are kept clean and free from dirt, sludge, scum and oil surface films as far as possible. When such contamination results in malfunctioning, the tank shall be drained, flushed and the solution renewed.

9.2 Chrome Pickle Bath

9.2.1 The chrome pickle bath shall be revivified at the end of each run by bringing sodium dichromate and the nitric acid content up to the figures given in Table III. The end of the run is that point at which the nitric acid has been depleted to 10 to 12 fl. oz. per imperial gallon (62 to 75 mL/L.).

9.2.2 The bath shall not be revivified more than 30 times after which time the solution shall be discarded and a new bath made up according to paragraph 9.1.4.

TABLE III - CONTROL OF CHROME PICKLE BATH

RUN NUMBER	CHEMICAL CONTENT OF BATH	
	SODIUM DICHROMATE	NITRIC ACID
1	29 wt oz/gal$_{imp}$ (181 g/L)	30 fl oz/gal$_{imp}$ (188 mL/L)
2	29 wt oz/gal$_{imp}$ (181 g/L)	26 fl oz/gal$_{imp}$ (163 mL/L)
3	29 wt oz/gal$_{imp}$ (181 g/L)	22 fl oz/gal$_{imp}$ (138 mL/L)
4 and up	29 wt oz/gal$_{imp}$ (181 g/L)	18 fl oz/gal$_{imp}$ (113 mL/L)

TABLE IV - CONTROL OF SOLUTIONS

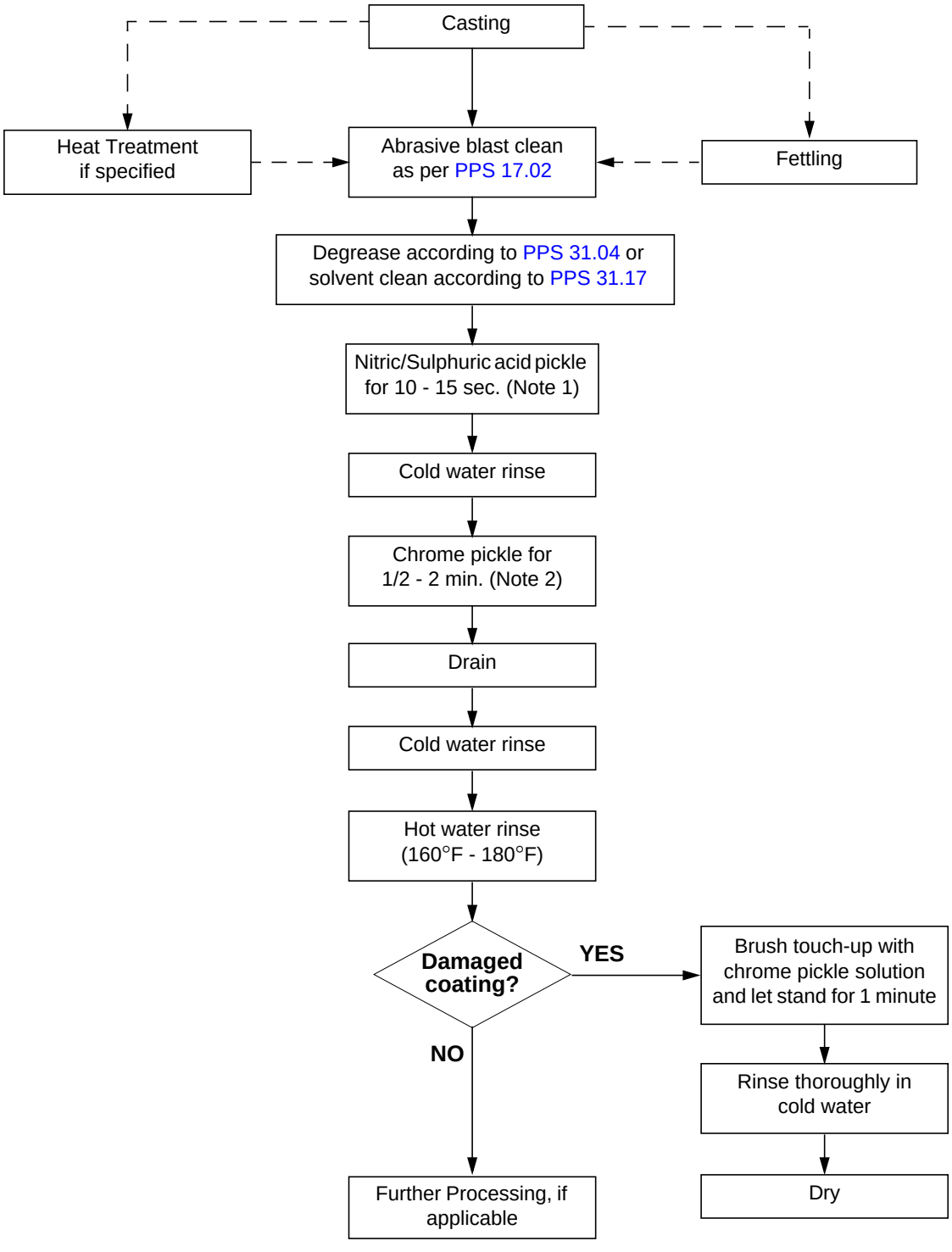
BATH TYPE	SOLUTION COMPONENT	CONCENTRATION				pH
		IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	ANALYSIS FREQUENCY	
Nitric/Sulphuric Acid	Nitric Acid	12.8 fl oz/gal	80 mL/L	10.6 fl oz/gal	Monthly	—
	Sulphuric Acid	3.2 oz/gal	20 mL/L	2.7 fl oz/gal		
Chrome Pickle (Note 4)	Sodium Dichromate	according to section 9.2			Monthly	—
	Nitric Acid					
	Sodium or Potassium or Ammonium Acid Fluoride					
Hydrofluoric Acid	Hydrofluoric Acid (70%)	10 and 20 percent HF (70%) by weight			Monthly	—
Dichromate	Sodium Dichromate	19 - 29 oz/gal	120 - 180 g/L	16 - 24 oz/gal	Weekly	4.1 - 5.2 (Note 1)
Henkel 7/17	according to PPS 31.02					
Henkel 6/16	according to PPS 31.02					

Note 1. Maintain the pH value of the solution by adding chromic acid (10% solution) when the pH value is too high.

10 DISPOSAL OF CHEMICAL WASTES

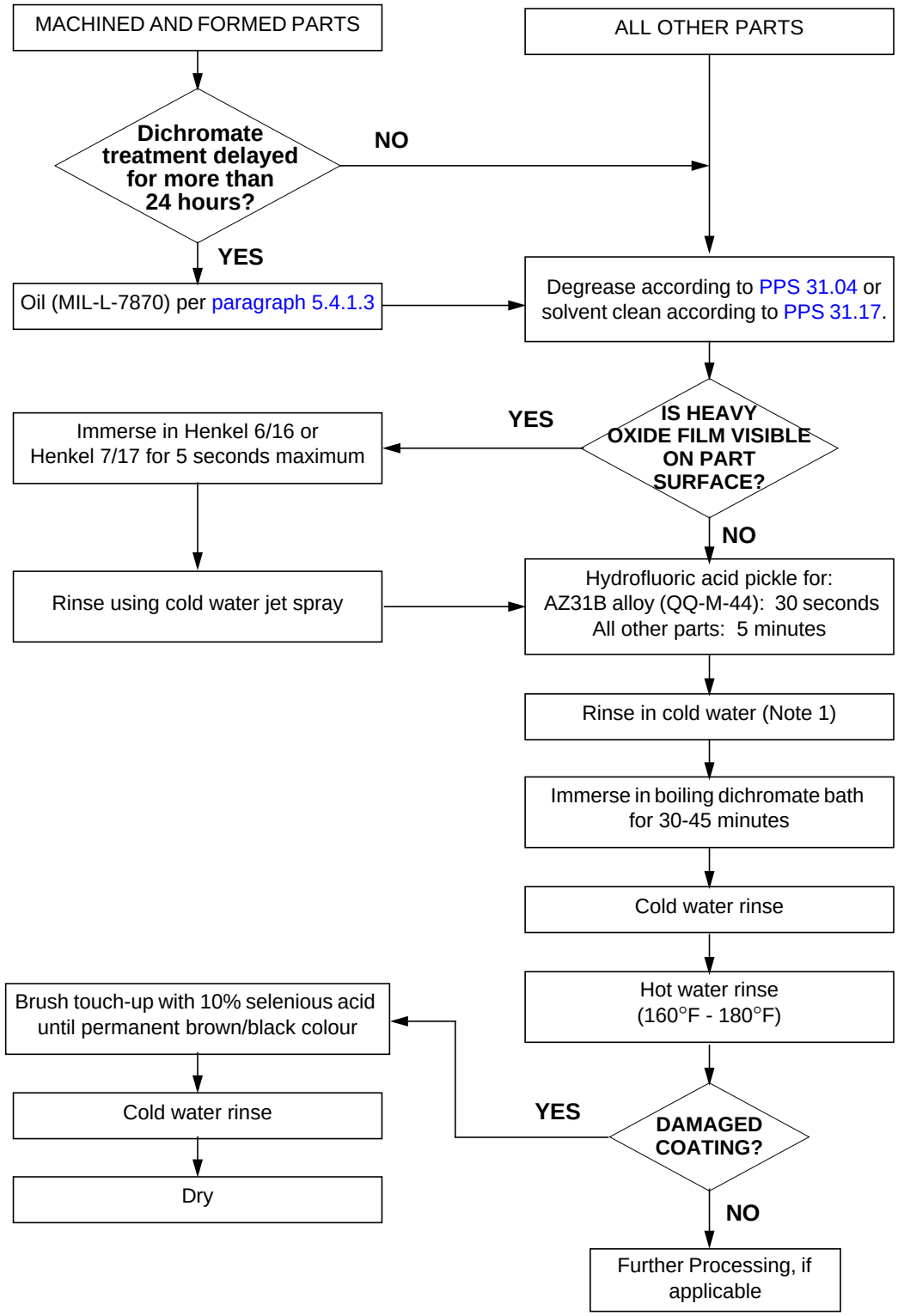
10.1 Dispose of all chemical waste according to national legislation and local regulations.

FLOW CHART 1 - CHROME PICKLE TREATMENT (DONE BY FOUNDRY)



Note 1. Immersion time shall be that necessary to remove approximately 0.002 inch from the surface.
Note 2. The immersion time will depend on the freshness of the solution.

FLOW CHART 2 - DICHROMATE TREATMENT



Note 1. Thoroughly rinse parts to prevent hydrofluoric acid carry-over into the dichromate bath.