BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 31.02

PRODUCTION PROCESS STANDARD

CLEANING PROCESSES FOR ALUMINUM AND ALUMINUM ALLOYS

Issue 36
- This standard supersedes PPS 31.02, Issue 35.
- 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)	September 20, 2018
	PPS Group	
Approved By:	(*K. Quon*, for Stephen Mabee)	September 24, 2018
	Materials Technology	
	(Chris Schnitzler)	September 25, 2018
	Quality	

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

Issue 36 - Summary of Changes (over the previous issue)

The following summaries are not detailed and are intended only to assist in alerting PPS users to changes which may affect them; refer to the applicable sections of this PPS for detailed procedure and requirements.

- Where nitric acid is specified, defined it to be 42° Bé throughout with the exception of nitric acid used for the manual FPI sodium hydroxide paste make-up.
- Specified to top up to 100 mL when preparing the FPI sodium hydroxide paste.
- Deleted requirement to check for intergranular attack and end grain pitting when making up new FPI sodium hydroxide paste solution.
- Specified six months expiration date for manual fluorescent penetrant inspection (FPI) solutions.
- Added new section 10, Disposal of Chemical Wastes, regarding chemical waste disposal.

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for cleaning aluminum and aluminum alloys as bare or treated surfaces at various fabrication stages.

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.

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 F2111 - Standard Practice for Measuring Intergranular Attack or End Grain Pitting on Metals Caused by Aircraft Chemical Processes.

3.2 BAERD GEN-018 - Engineering Requirements for Laboratories.

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

3.4 EHS-OP-005 - Hazardous Materials Management - *Bombardier Toronto internal operating procedure*.

3.5 PPS 13.13 - Personal Protective Respiratory Equipment.

3.6 PPS 13.26 - General Subcontractor Provisions.

3.7 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.8 PPS 17.02 - Abrasive Blasting.

3.9 PPS 20.03 - Fluorescent Penetrant Inspection.

3.10 PPS 31.01 - Cleaning of Aluminum and Aluminum Alloys for Resistance Welding.

3.11 PPS 31.04 - Degreasing Processes.

3.12 PPS 31.07 - Cleaning and Stripping of Painted Surfaces.

3.13 PPS 31.17 - Solvent Usage.

3.14 PPS 32.01 - Chemical Conversion Coating of Aluminum and Titanium Alloys by Immersion (C1).

3.15 PPS 32.02 - Manual Application of C1 Chemical Conversion Coatings.

3.16 PPS 32.05 - Colour or Colourless Anodizing - Sulphuric Acid Process (A3).

3.17 PPS 32.35 - Chemical Conversion Coating for Low Electrical Resistance (C10).

3.18 QDI-09-02 - Process Control - *Bombardier Toronto internal Quality procedure.*

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Alkaline cleaners as listed in Table I.

4.1.2 Deoxidizers for manual cleaning as listed in Table I.

4.1.3 Deoxidizers for immersion cleaning as listed in Table I.

4.1.4 Ammonium bifluoride, technical grade.

4.1.5 Chromic acid, A-A-55827.

4.1.6 Hydrofluoric acid, MIL-A-24641.

4.1.7 Nitric acid, 42° Bé, A-A-59105.

4.1.8 Phosphoric acid, A-A-55820.

4.1.9 Potassium ferricyanide, commercial grade.

4.1.10 Silver nitrate, technical grade.

4.1.11 Sodium chloride, technical grade.

4.1.12 Sodium hydroxide, technical grade.

4.1.13 Manual cleaning solution for Fluorescent Penetrant Inspection (FPI) (see section 5.3.2.1):

- 2N Nitric Acid
- Sodium Hydroxide
- Corn Starch
- De-ionized water

4.1.14 Protective wrapping paper (e.g., Kraft paper).

4.1.15 Compressed air utilized herein shall meet the requirements of BAERD GEN-023.

4.2 Equipment

4.2.1 Immersion tanks for re-circulating water rinse and chemical baths as listed in Table I. Immersion tanks shall be resistant to the chemicals and to the operating temperatures used (e.g., mild steel with heating coil and agitation equipment for containing alkaline solutions; acid resistant tanks for manual deoxidizers; and stainless steel tanks with agitation equipment for immersion deoxidizers). 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.

4.2.1.1 Alkaline scrub tanks shall meet the following additional requirements:

- Mechanical (venturi nozzles) or air agitation shall be introduced from both sides along the full tank length. Circulation nozzles are preferred over air agitation to prolong the bath life and reduce clogging problems.
- Agitation nozzles shall be angled towards the centreline of the tank to ensure thorough cleaning of part surfaces (the angle necessary is dependent on the tank configuration).
- The agitation nozzles shall be spaced so as to ensure complete and thorough agitation of the tank volume (i.e., there shall be no “dead” zones in the tank).
- The intention is to induce a scrubbing action of the alkaline solution on and over the part surfaces (as opposed to a mere soaking) while ensuring thorough mixing and heating of the solution.
- The temperature of the bath shall be controlled at a sufficient level to facilitate removal of soils whose solubility is temperature sensitive (such as petrolatum).
- The tank shall be equipped with a racking system which will allow solution to flow over all part surfaces while allowing full drainage of solution from parts (i.e., parts shall not be racked so tightly as to prevent solution from contacting and flowing over all part surfaces freely).

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

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

4.2.4 Polyethylene squeeze bottle.

4.2.5 Glass storage bottle, 4 Litres volume, for manual FPI 2N Nitric Acid solution.

4.2.6 Rubber aprons and boots.

4.2.7 Wiping cloths (e.g., DSC 378-2).

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 cleaning aluminum and aluminum alloys as bare or treated surfaces at various fabrication stages 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 cleaning aluminum and aluminum alloys as bare or treated surfaces at various fabrication stages according to this PPS, completion of a test program and submission of suitable test samples representative of production parts may be required.

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 For the purposes of this PPS, the following water rinse types are defined as follows (refer to Table III for analysis requirements and control limits):

- Initial Rinse: An immersion tank filled with re-circulating water controlled to less stringent control limits. The initial rinse may or may not be followed by a final rinse, as specified herein.
- Final Rinse: An immersion tank filled with re-circulating water controlled to more stringent limits.
- Spray Rinse: A fresh (non-recycled) water spray rinse.

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 - SOLUTION MAKE-UP

BATH TYPE (NOTE 3)	BATH MAKE-UP (NOTES 1 & 2)				OPERATING TEMPERATURE (°F)
	CHEMICALS	IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	
ALKALINE CLEANING SOLUTIONS					
Bonderite C-AK 4215 NC-LT	Bonderite C-AK 4215 NC-LT	52 lbs/100 gal	5.2 Kg/100 L	43 lbs/100 gal	120 - 140
Oakite 164 (Note 4)	Oakite 164	50 lbs/100 gal	5 Kg/100 L	41 lbs/100 gal	140 - 190
Oakite 166	Oakite 166	48 lbs/100 gal	4.8 Kg/100 L	40 lbs/100 gal	120 - 140
Oakite 61B	Oakite 61B	41 lbs/100 gal	4.1 Kg/100 L	34 lbs/100 gal	160 - 190
Turco Aldet LNS	Aldet LNS	4.5 gal/100 gal	4.5 L/100 L	4.5 gal/100 gal	120 - 150
Turco Aldet	Aldet	38 lbs/100 gal	3.8 Kg/100 L	31 lbs/100 gal	120 - 140
Isoprep 44	Isoprep 44	50 lbs/100 gal	5 Kg/100 L	41 lbs/100 gal	135 - 145
Turco Airlion (T-4090)	Turco Airlion (T-4090)	50 lbs/100 gal	5 Kg/100 L	41 lbs/100 gal	150 - 185
Turco Altrex 24	Altrex 24	6 gal/100 gal	6 L/100 L	6 gal/100 gal	120 - 180
IMMERSION DEOXIDIZING SOLUTIONS					
Henkel 7/17	Nitric acid (42° Bé)	12 gal/100 gal	12 L/100 L	12 gal/100 gal	60 - 90
	Henkel #7	23 lbs/100 gal	2.3 Kg/100 L	19 lbs/100 gal	
Henkel 6/16	Nitric acid (42° Bé)	10 gal/100 gal	10 L/100 L	10 gal/100 gal	60 - 90
	Deoxidizer #6	5 gal/100 gal	5 L/100 L	5 gal/100 gal	
Oakite LNC	Oakite LNC	15 gal/100 gal	15 L/100 L	15 gal/100 gal	50 - 100
Turco DW 514	DW 514	120 lbs/100 gal	12 Kg/100 L	100 lbs/100 gal	70 - 100
Deox 560	Deox 560	12 gal/100 gal	12 Kg/100 L	12 gal/100 gal	60 - 90
Turco Aldox NLA	Aldox NLA	7% by volume			70 minimum
Tri-acid etchant	Chromic acid	48 lbs/100 gal	4.8 Kg/100 L	40 lbs/100 gal	60 - 95
	Hydrofluoric acid or ammonium bifluoride	0.9 gal/100 gal or 12 lbs/100 gal	0.9 L/100 L or 1.2 Kg/100 L	0.9 gal/100 gal or 10 lbs/100 gal	
	Nitric acid (42° Bé)	10 gal/100 gal	10 L/100 L	10 gal/100 gal	
Turco Smut Go No. 1	Smut Go No. 1	120 lbs/100 gal	12 Kg/100 L	100 lbs/100 gal	60 - 90
Turco Smut Go No. 4	Smut Go No. 4	44 lbs/100 gal	4.4 Kg/100 L	37 lbs/100 gal	60 - 90
	Nitric acid (42° Bé)	12 gal/100 gal	12 L/100 L	12 gal/100 gal	

TABLE I - SOLUTION MAKE-UP

BATH TYPE (NOTE 3)	BATH MAKE-UP (NOTES 1 & 2)				OPERATING TEMPERATURE (°F)
	CHEMICALS	IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	
MANUAL DEOXIDIZING SOLUTIONS					
Turco Deoxidine #624	Deoxidine #624	25% by volume			60 - 90
Turco Alumiprep 33	Alumiprep 33				
Turco WO#1	Turco WO#1				
Armalite CB-4 (Alcohol/Phosphoric Acid Etch) (Note 5)	Armalite CB-4	20% by volume			
ALTERNATE IMMERSION ETCHING SOLUTION FOR FLUORESCENT PENETRANT INSPECTION (NOTE 6)					
Sodium Hydroxide	Sodium Hydroxide	20 - 25% by concentration			n/a
NITRIC ACID SOLUTION					
Nitric Acid	NItric acid (42° Bé)	2 gal/100 gal	2 L/100 L	2 gal/100 gal	160 - 180
BRIGHT DIP SOLUTIONS (Note 7)					
Bright Dip	Sodium hydroxide	3.8 lbs/100 gal	0.38 Kg/100 L	3.2 lbs/100 gal	120 - 150
Bright Dip Alternate	Phosphoric acid	85 gal/100 gal	85 L/100 L	85 gal/100 gal	170 - 210
	Alchemize additive	5 gal/100 gal	5 L/100 L	5 gal/100 gal	
RINSE WATER					
Initial Rinse	Re-circulating water	According to Table III			120 maximum
Final Rinse	Re-circulating water	According to Table III			180 maximum
Spray Rinse	Fresh (non-recycled) water	—			—
De-ionized water rinse	De-ionized water (Note 8)	According to Table III			60 - 90
IRON DETECTION SOLUTION					
Iron Detection Solution (Note 5)	Potassium Ferricyanide	16 wt oz/gal	100 g/L	13 wt oz/gal	60 - 90
	Sodium Chloride	8 wt oz/gal	50 g/L	6.7 wt oz/gal	

Note 1. It is acceptable for subcontractors to deviate from the specified make-up of solutions provided that the control requirements of Table III are met.
Note 2. Unless otherwise specified herein, use tap water to make-up all solution baths. Tap water utilized to make-up the solutions shall be controlled at 350 ppm (550 µS/cm at 77 ± 10°F) and pH range of 5.0 - 8.0.
Note 3. Refer to paragraph 4.2.1 for tank requirements.
Note 4. Only Oakite 164 is approved for use in an alkaline scrub operation provided that the tank meets the requirements of paragraph 4.2.1.1 and the process has been qualified according to section 6.3.
Note 5. Use a polyethylene squeeze bottle to dispense solution.
Note 6. For manual etching prior to FPI, prepare solution according to section 5.3.2.
Note 7. Use de-ionized water with a maximum TDS requirement of 12 ppm (20 µS/cm at 77 ± 10°F) for the make-up of Bright Dip solutions.
Note 8. Incoming de-ionized water shall meet a maximum TDS requirement of 12 ppm (20 µS/cm at 77 ± 10°F).

5.3 Cleaning

5.3.1 General

5.3.1.1 Suitably mask close tolerance holes and surfaces before deoxidizing. Masking of close tolerance holes is not necessary if final reaming of close tolerance holes will be performed at the assembly stage.

5.3.1.2 If the parts require racking, wire the parts to baskets or suspend them from racks so that:

- adjacent parts do not touch;
- the cleaning solution can circulate freely between the parts; and
- the parts are in a position that promotes solution drainage without solution entrapment in recesses or creation of air pockets.

5.3.1.3 Refer to Table II for the cleaning method to use before and after specific manufacturing operations.

5.3.1.4 “Jog” the crane up and down a few times, as necessary, during immersion of parts in cleaning and rinse tanks to enhance fluid flow over the parts.

5.3.1.5 Whenever immersion rinsing is specified herein, parts shall be immersed in the rinse tank as soon as possible. Do not spray rinse above the rinse tank before immersion.

5.3.1.6 Protect cleaned surfaces from contamination by wrapping in Kraft paper. Wear clean cotton gloves when handling cleaned parts.

TABLE II - CLEANING METHODS FOR GIVEN MANUFACTURING OPERATIONS

MANUFACTURING OPERATION (Note 2)	STANDARD CLEANING PROCEDURE	ALTERNATE CLEANING PROCEDURE
Before immersion chemical conversion coating (C1 or C10) of detail parts (except Type II IVD aluminum coated parts)	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. Step 3. Deoxidize according to Flow Chart 6.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. Deoxidize according to Flow Chart 6.
Before chromic acid anodizing (A1)		
Before hard anodizing (A2)		
Before thin film sulphuric acid anodizing (A7)		
Before masking extrusions, severely worked parts or parts with heavy oxide or scale for chemical milling		
Before electrical discharge machining		
Before magnetic pulse forming		

TABLE II - CLEANING METHODS FOR GIVEN MANUFACTURING OPERATIONS

MANUFACTURING OPERATION (Note 2)	STANDARD CLEANING PROCEDURE	ALTERNATE CLEANING PROCEDURE
Before fusion welding (Note 1) Before brazing (Note 1)	Step 1. Degrease parts according to PPS 31.04. Step 2. Alkaline clean according to Flow Chart 2. Step 3. Deoxidize according to Flow Chart 6.	Step 1. Degrease parts according to PPS 31.04. Step 2. Mechanically clean surfaces to be welded or brazed according to Flow Chart 4.
Before C1 manual chemical conversion coating as specified in PPS 32.02 (except Type II IVD aluminum coated parts)	Step 1. Degrease according to Flow Chart 1. Step 2. If heavy oxides are present, mechanically clean according to Flow Chart 4. Step 3. Manually deoxidize according to Flow Chart 5.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. If heavy oxides are present, mechanically clean according to Flow Chart 4. Step 3. Manually deoxidize according to Flow Chart 5.
Before C10 manual chemical conversion coating according to PPS 32.35 (except Type II IVD aluminum coated parts)	Step 1. Degrease according to Flow Chart 1. Step 2. If heavy oxides or non-conductive material is present, mechanically clean according to Flow Chart 4. Step 3. Manually deoxidize according to Flow Chart 5.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. If heavy oxides or non-conductive material is present, mechanically clean according to Flow Chart 4. Step 3. Manually deoxidize according to Flow Chart 5.
Before adhesive bonding	Clean according to the applicable adhesive bonding PPS.	
Before high strength metal to metal and metal honeycomb (hot) bonding	Clean according to the applicable bonding PPS.	
Before applying organic coatings (priming or painting)	Clean according to the applicable priming or painting PPS.	
Before masking for chemical milling (except extrusions, severely worked parts and parts with heavy oxide or scale) Before conversion coating of Type II IVD aluminum coated parts when the delay between ivadizing and conversion coating exceeds 48 hours (no cleaning required when conversion coated within 48 hours of ivadizing)	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2.	Alkaline scrub according to Flow Chart 3 (Note 4).
Before sulphuric acid anodizing (A3) of castings and dye coloured parts	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. Step 3. Deoxidize according to Flow Chart 6. Step 4. Nitric acid clean for 15 minutes. Step 5. Rinse in de-ionized water (60 - 90°F). Do not allow the parts to dry before anodizing.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. Deoxidize according to Flow Chart 6. Step 3. Nitric acid clean for 15 minutes. Step 4. Rinse in de-ionized water (60 - 90°F). Do not allow the parts to dry before anodizing.

TABLE II - CLEANING METHODS FOR GIVEN MANUFACTURING OPERATIONS

MANUFACTURING OPERATION (Note 2)	STANDARD CLEANING PROCEDURE	ALTERNATE CLEANING PROCEDURE
Before sulphuric acid anodizing (A3) of decorative appearance items (consider all parts to be sulphuric acid anodized except castings and dye coloured parts to be decorative appearance items)	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. Step3. Immerse in Bright Dip solution. Immerse Brush finished parts (SF 32) for 20 - 30 seconds. Immerse Satin finished parts (SF 21, SF 22, SF 24) for 3 - 5 minutes. Step 4. Rinse in tap water. Step 5. Deoxidize according to Flow Chart 6. Step 6. Nitric acid clean for 15 minutes. Step 7. Rinse in de-ionized water (60 - 90°F). Do not allow the parts to dry before anodizing.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. Immerse in Bright Dip solution. Immerse Brush finished parts (SF 32) for 20 - 30 seconds. Immerse Satin finished parts (SF 21, SF 22, SF 24) for 3 - 5 minutes. Step 3. Rinse in tap water. Step 4. Deoxidize according to Flow Chart 6. Step 5. Nitric acid clean for 15 minutes. Step 6. Rinse in de-ionized water (60 - 90°F). Do not allow the parts to dry before anodizing.
Before resistance welding (Note 1)	Clean according to PPS 31.01.	
Before abrasive blast cleaning Before vapour blasting Before heat treatment Before shot peening	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4).
Cleaning before fluorescent penetrant inspection (FPI) when no material removal is required (Note 5)	**Immersion Method:** Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. **In-Situ Method:** Step 1. Solvent wipe according to PPS 31.17.	**Alternate Immersion Method:** Step 1. Alkaline scrub according to Flow Chart 3 (Note 4).
Cleaning before fluorescent penetrant inspection (FPI) when minimum material removal is required (Note 5) Where "*etching*" before fluorescent penetrant inspection (FPI) is specified on the engineering drawing or PPS 20.03 (Note 5)	**Immersion Method:** Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. Step 3. Deoxidize/etch according to Flow Chart 6 or Flow Chart 7. **In-Situ Method:** Perform in-situ FPI according to section 5.3.2.	**Alternate Immersion Method:** Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. Deoxidize/etch according to Flow Chart 6 or Flow Chart 7.

TABLE II - CLEANING METHODS FOR GIVEN MANUFACTURING OPERATIONS

MANUFACTURING OPERATION (Note 2)	STANDARD CLEANING PROCEDURE	ALTERNATE CLEANING PROCEDURE
De-smutting during chemical milling	Deoxidize according to Flow Chart 6.	
After buff finishing After brush finishing	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2.	Alkaline scrub according to Flow Chart 3 (Note 4).
After fusion welding (to remove weld spatter and/or heat discolouration)	Step 1. Parts with oil based contaminants: Degrease according to Flow Chart 1. All others: Alkaline clean according to Flow Chart 2. Step 2. Mechanically clean according to Flow Chart 4.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. Mechanically clean according to Flow Chart 4.
After fusion welding or brazing (to remove flux)	Step 1. Soak in hot (140 - 212°F) water for 10 - 60 minutes. Step 2. If adhering particles remain, scrub with a stiff bristle brush. Step 3. Initial rinse. Step 4. If flux remains, manually deoxidize according to Flow Chart 5. Step 5. At the request of Bombardier Quality, test for the presence of chloride flux according to section 6.2.	
After shot peening	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. Step 3. For parts shot peened with steel shot, deoxidize according to Flow Chart 5 or Flow Chart 6 and then examine for steel shot contamination according to Flow Chart 8.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. For parts shot peened with steel shot, deoxidize according to Flow Chart 5 or Flow Chart 6 and then examine for steel shot contamination according to Flow Chart 8.
After vapour blasting	Step 1. Initial rinse to remove adhering grit. Step 2. Final rinse (140 - 180°F) or spray rinse (140 - 180°F). Step 3. Air dry.	
After fluorescent penetrant inspection (FPI)	Step 1. Water rinse (see Table III). Step 2. Alkaline clean according to Flow Chart 2.	
After immersion stripping of painted metal surfaces as specified in PPS 31.07	Step 1. Deoxidize according to Flow Chart 6.	
After manual stripping of painted metal surfaces as specified in PPS 31.07	Step 1. Deoxidize according to Flow Chart 5.	

TABLE II - CLEANING METHODS FOR GIVEN MANUFACTURING OPERATIONS

MANUFACTURING OPERATION (Note 2)	STANDARD CLEANING PROCEDURE	ALTERNATE CLEANING PROCEDURE
Cleaning of satin finished parts that have been abrasive blasted using steel grit	Step 1. Degrease parts with oil based contaminants according to Flow Chart 1. Step 2. Alkaline clean according to Flow Chart 2. Step 3. Deoxidize according to Flow Chart 6.	Step 1. Alkaline scrub according to Flow Chart 3 (Note 4). Step 2. Deoxidize according to Flow Chart 6.
Removal of anodic and chemical conversion coatings		
Removal of die pick-up on parts formed by drop hammer, dual form, brake, spinning or Kirksite dies		

Note 1. Record the time and date of cleaning on the manufacturing document (e.g., Process Sheet).
Note 2. If parts are soiled with hard to remove contaminants such as pencil and ink markings, remove such marks by mechanically cleaning according to Flow Chart 4.
Note 3. Do not deoxidize raw forgings and parts that will be machined after cleaning.
Note 4. The alkaline scrub process shall be qualified as specified in section 6.3 before use and alkaline scrub tanks shall meet the requirements specified in paragraph 4.2.1.1.
Note 5. Carry out "*etching*" before FPI only when specified by the engineering drawing or PPS 20.03. Only parts that have undergone metal smearing operations or operations that will smear metal or otherwise close surface openings shall be etched/deoxidized prior to FPI. See PPS 20.03 for a list of such operations. Ensure that the minimum part thickness is maintained in the etched area. Do not etch/deoxidize parts otherwise.

5.3.2 Manual Cleaning for In-Situ Fluorescent Penetrant Inspection

5.3.2.1 Solution Preparation

5.3.2.1.1 Prepare a 15% by volume sodium hydroxide paste as follows:

Step 1. Appropriately label a polyethylene squeeze bottle of an appropriate size. The following, as a minimum, should be on the bottle:

- Solution (i.e., 15% by volume sodium hydroxide).
- Etch rate and dwell time required to remove 0.2 to 0.4 mils of material.
- Date solution was made up and expiration date (see paragraph 9.5.2).
- At Bombardier Toronto, a Bombardier approved Health and Safety Department approved WHMIS label. Subcontractors shall meet their own local government regulations regarding labelling.

Step 2. In the labelled polyethylene squeeze bottle, for every 80 mL of de-ionized water, add 15 g of sodium hydroxide. Cap and gently mix the solution until complete dissolution of the sodium hydroxide. Solution will heat up during dissolution of sodium hydroxide. Top up solution to a final volume of 100 mL with de-ionized water. Cap and gently mix.

Step 3. Add 5 grams of cornstarch for every 100 mL of solution and mix until a uniform consistency is achieved.

5.3.2.1.2 Prepare a 2N nitric acid solution as follows:

Step 1. Appropriately label a 4 L glass chemical storage bottle. The following, as a minimum, should be on the bottle:

- 2N Nitric Acid Solution for FPI.
- Date solution was made up and expiration date (see paragraph 9.5.2).
- At Bombardier Toronto, a Bombardier approved Health and Safety Department approved WHMIS label. Subcontractors shall meet their own local government regulations regarding labelling.

Step 2. Add 3 L of de-ionized water directly to the glass bottle.

Step 3. Measure out 517 mL of concentrated nitric acid in a graduated cylinder and carefully add it to the water. ***Always add the acid to water.***

5.3.2.2 In-Situ Cleaning/Etching for Fluorescent Penetrant Inspection

5.3.2.2.1 Prepare surfaces for in-situ fluorescent penetrant inspection as follows. Take extreme care at all times to prevent ingress and/or seepage of cleaning solutions/rinse water, and to prevent contact with sealant and/or materials sensitive to cleaning solutions/rinse water.

Step 1. Suitably protect the surrounding structure (e.g., mask) around the area to be etched. See PPS 20.03 for additional precautionary instructions.

Step 2. Solvent clean the area to be cleaned according to PPS 31.17.

Step 3. Using a cotton swab, liberally apply 15% sodium hydroxide paste prepared according to paragraph 5.3.2.1.1 to the area to be fluorescent penetrant inspected. Take care to prevent contamination (e.g., splashing) of the surrounding structure with chemical solution.

Step 4. Allow the 15% sodium hydroxide paste to dwell on the surface for the time required to remove 0.2 to 0.4 mils material.

Step 5. Wipe off the sodium hydroxide paste with a clean cloth.

Step 6. Wipe the area with a water dampened cloth to remove sodium hydroxide paste residue. Ensure complete removal of sodium hydroxide paste, repeat water dampened wipe, as necessary.

Step 7. Wet a cloth with the 2N nitric acid solution prepared according to paragraph 5.3.2.1.2 and wipe the treated area thoroughly.

Step 8. Wipe the area with a water dampened cloth to remove the 2N nitric acid solution. Ensure complete removal of nitric acid solution, repeat water dampened wipe, as necessary.

Step 9. Allow the area to dry.

Step 10. Perform FPI according to PPS 20.03.

6 REQUIREMENTS

6.1 Cleaned Surfaces

6.1.1 All part surfaces shall be water break-free and exhibit a uniform surface appearance after the cleaning process. A water break-free surface is defined as a surface on which a water film will remain continuous for a period of at least 15 seconds without discontinuities or breaks.

6.1.2 Parts with evidence of scale, oxide or residual abrasive cleaning materials shall be re-cleaned according to Table II.

6.1.3 Parts with evidence of pitting, etching or surface erosion resulting from abrasive cleaning are not acceptable. Submit defective parts to Bombardier Toronto MRB or Bombardier Toronto delegated MRB for disposition.

6.2 Flux Removal Testing

6.2.1 Test welded or brazed joints for complete chloride flux removal by wetting the joints with distilled water containing a few drops of 5% silver nitrate solution. If a white precipitate appears indicating the presence of residual flux, re-clean the part according to Table II.

6.3 Process Qualification - Alkaline Scrub

6.3.1 Before processing production parts in the Oakite 164 alkaline scrub tank, qualify the process by ensuring that the alkaline scrub is capable of removing lubricants and contaminants with which parts may be contaminated when placed in the tank. For the following parts, use of the alkaline scrub is not acceptable:

- double flared tubing
- tubing with swaged ends
- re-cleaning of chemical conversion coated parts
- any difficult to clean parts (e.g., parts with recesses that could entrap grease or oil or parts coated with wax type lubricants)

7 SAFETY PRECAUTIONS

7.1 The safety precautions specified herein are specific to Bombardier Toronto to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is strongly recommended that subcontractors consider these safety precautions; however, subcontractors are responsible for ensuring that their own environmental, health and safety precautions satisfy the appropriate local government regulations.

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

7.3 Do not keep, handle or eat food in the vicinity of cleaning baths.

7.4 Do not use baths, including water baths, for heating or cooling food or drink.

7.5 Avoid ingestion of any of the materials specified herein. If ingestion occurs, obtain immediate medical attention.

7.6 Wash hands thoroughly after working with chemical baths.

7.7 Do not keep street clothes in the vicinity of chemical baths.

7.8 Wear protective gloves, boots and aprons when operating chemical baths.

7.9 Avoid skin contact with chemical solutions. If skin contact occurs, wash the affected area with large quantities of clean water. If skin irritation occurs, immediately contact the Health Centre.

7.10 Operators who have any broken skin or open wounds on hands or wrists shall not work with chemical baths.

7.11 Wear safety glasses when working with the materials specified herein. Use safety goggles or a face shield when blowing out seams and laps. If eye contact occurs, flush the eyes for a minimum of 15 minutes at the nearest eye-wash station and obtain immediate medical attention.

7.12 Ensure that sufficient ventilation is provided when using the chemical solutions specified herein. Consult the Health and Safety Department for the threshold limit values.

7.13 Operators shall wear protective respiratory equipment according to PPS 13.13 when operating chemical baths.

7.14 Refer to PPS 31.17 for the safety precautions for handling and using solvents.

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 EQUIPMENT AND SOLUTIONS

9.1 Maintenance of Equipment

9.1.1 Once a year, calibrate all instruments (i.e., gauges and regulators).

9.2 Maintenance of Solutions

9.2.1 A sample of the applicable alkaline cleaning, deoxidizing, Bright Dip, nitric acid, sodium hydroxide and water rinse baths shall be tested at the analysis frequency specified in Table III by an approved laboratory as specified in paragraph 4.3.3.2. Thoroughly mix the solutions before sampling.

9.2.2 Maintain operating temperatures according to Table I.

9.2.3 If a water break-free surface on the part cannot be achieved following alkaline cleaning, suspend the alkaline cleaning process and take the necessary corrective action. If necessary, dispose of the alkaline solution according to section 10 and prepare a new solution according to Table I.

9.2.4 If the solutions fail to meet the requirements specified in Table III, suspend the applicable process (i.e., deoxidizing, alkaline cleaning, alkaline scrub, bright dip, nitric acid or sodium hydroxide) until the solution has been re-adjusted to meet these requirements. Re-analyze the solution within 24 hours of any adjustment.

9.2.5 At Bombardier Toronto, if necessary, at least once a year or more frequently, remove solution from alkaline cleaning tanks, remove any particulate (sludge) and ensure that the agitation system is operating properly. Dispose of particulate (sludge) according to section 10.

9.3 Deoxidizing Solution Etch Rate

9.3.1 The etch rate of the deoxidizing solution shall be verified on a 2024 clad aluminum test specimen (e.g., 3" x 3" x 0.032") to ensure that no more than 0.0004"/surface of material will be removed after the immersion time specified by Flow Chart 6. Calculate the etch rate using the following formula:

$$\text{Etch Rate (mils/surface/hour)} = \frac{30\,(W_1 - W_2)\,T}{W_1\,t} \quad X \quad 1000$$

W_1 = weight before etching, grams
W_2 = weight after etching, grams
T = original thickness, inches
t = etch time, minutes

9.3.2 When a new deoxidizing solution is made-up or a major replenishment occurs (i.e., more than 70% of a tanks content is replenished with new solution), the tank shall be analyzed to ensure that the deoxidizing solution does not cause end grain pitting in excess of 0.001" or intergranular attack in excess of 0.0002" by processing a 1" width by 2" length by 0.125" to 0.250" thick 2024 bare aluminum test specimen through the deoxidizing solution. Perform end grain pitting and intergranular attack determination according to ASTM F2111.

9.4 Immersion Sodium Hydroxide Solution Etch Rate

9.4.1 Control the sodium hydroxide solution to maintain an etch rate of 1 to 5 mils/surface/hour on a 2024 clad aluminum test specimen (e.g., 3" X 3" X 0.032").

9.4.2 Process test specimen to determine the etch rate as follows:

Step 1. Weigh the test specimen and record initial weight, W_1.

Step 2. Immerse the test specimen in the sodium hydroxide solution for 10 ± 1 minute.

Step 3. Initial water rinse.

Step 4. Immerse in deoxidizer, Oakite LNC, or 2N nitric acid for 1 to 2 minutes.

Step 5. Final water rinse.

Step 6. Air dry or oven dry at 200°F maximum.

Step 7. Re-weigh the test specimen, W_2, and calculate the etch rate using the following formula:

$$\textbf{Etch Rate (mils/surface/hour)} = \frac{100\,(W_1 - W_2)}{W_1}$$

W_1 = weight before etching, grams
W_2 = weight after etching, grams

9.4.3 When a new sodium hydroxide solution is made-up or a major replenishment occurs (i.e., more than 70% of a tanks content is replenished with new solution), the tank shall be analyzed to ensure that the sodium hydroxide solution does not cause end grain pitting in excess of 0.001" or intergranular attack in excess of 0.0002" by processing a 1" width by 2" length by 0.125" to 0.250" thick 2024 bare aluminum test specimen through the sodium hydroxide solution. Perform end grain pitting and intergranular attack determination according to ASTM F2111.

9.5 Manual In-Situ 15% Sodium Hydroxide Paste Etch Rate

9.5.1 Using a 2024 clad aluminum test specimen (e.g., 3" X 3" X 0.032"), determine each bottle of sodium hydroxide paste etch rate as follows:

Step 1. Solvent clean the test specimen.

Step 2. Weigh the test specimen and record initial weight, W_1.

Step 3. Apply 15% sodium hydroxide paste liberally to one side of the test specimen and allow to dwell for 10 ± 1 minute.

Step 4. Using a clean cloth, wipe off the 15% sodium hydroxide paste.

Step 5. Dampen a clean cloth with water and wipe off the sodium hydroxide paste.

Step 6. Allow test panel to dry completely.

Step 7. Re-weigh the test specimen, W_2, and calculate the etch rate using the following formula:

$$\textbf{Etch Rate (mils/min)} = \frac{\textbf{2 (W}_1\textbf{ - W}_2\textbf{)}}{\textbf{A x D x T}}$$

W_1 = weight before etching, grams
W_2 = weight after etching, grams
A = specimen area, in^2
D = density of alloy (specimen) - lb/in^3
T = etching time, minutes

9.5.2 Both the 15% sodium hydroxide paste and 2N nitric acid solutions may be used for 6 months from the date of solution/paste make-up. Do not re-use solution/paste or expired solution/paste. Dispose of chemicals according to section 10.

9.6 Reports on Solution Testing

9.6.1 Prepare a weekly report of the analysis of the solutions (e.g., according to QDI-09-02). If additions of chemicals are required, indicate the amount to be added. Also indicate in the report (e.g., on a Process Bath Analyses Form, DH4989), that the recommended adjustments have been made. Re-analyze the solution within 24 hours of any adjustment. Maintain records of the solution tests (e.g., according to QDI-09-02).

10 DISPOSAL OF CHEMICAL WASTES

10.1 Dispose of all chemical wastes according to national legislation and local regulations. At Bombardier Toronto, dispose of chemical wastes according to EHS-OP-005.

10.2 At Bombardier Toronto, dispose of chemical contaminated work clothes, rags, etc., into Red Containers labelled “Waste Rags”.

TABLE III - CONTROL OF SOLUTIONS

SOLUTION	SOLUTION COMPONENT	CONCENTRATION CONTROL LIMITS			ANALYSIS FREQUENCY (NOTE 6)	
		IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	STANDARD	EXTENDED
ALKALINE CLEANING SOLUTIONS						
Bonderite C-AK 4215 NC-LT	Bonderite C-AK 4215 NC-LT	7.2 - 9.6 wt oz/gal	45.0 - 60.0 g/L	6.0 - 8.0 wt oz/gal	Weekly	Monthly
Oakite 164	Oakite 164	6.0 - 10.0 wt oz/gal	37.0 - 62.0 g/L	5.0 - 8.3 wt oz/gal		
Oakite 166	Oakite 166	6.1 - 9.6 wt oz/gal	38.0 - 60.0 g/L	5.1 - 8.0 wt oz/gal		
Oakite 61B	Oakite 61B	3.7 - 9.6 wt oz/gal	23.0 - 60.0 g/L	3.0 - 8.0 wt oz/gal		
Turco Aldet LNS	Aldet LNS	3.0 - 6.0% by volume				
Turco Aldet	Aldet	4.8 - 7.2 wt oz/gal	30.0 - 45.0 g/L	4.0 - 6.0 wt oz/gal		
Isoprep 44	Isoprep 44	7.2 - 9.6 wt oz/gal	45.0 - 60.0 g/L	6.0 - 8.0 wt oz/gal		
Turco Airlion (T-4090)	Turco Airlion (T-4090)	6.4 - 9.6 wt oz/gal	40.0 - 60.0 g/L	5.3 - 8.0 wt oz/gal		
Turco Altrex 24	Altrex 24	5 - 8% by volume				
IMMERSION DEOXIDIZING SOLUTIONS						
Henkel 7/17 (Note 1)	Nitric acid (42° Bé)	10.0 - 12.0% by volume			Weekly	Monthly
	Henkel #7 powder	3.0 - 4.0 wt oz/gal (1.5 - 2.1 wt oz/gal chromium trioxide)	19.0 - 25.0 g/L (9.0 - 13.0 g/L chromium trioxide)	2.5 - 3.3 wt oz/gal (1.2 - 1.7 wt oz/gal chromium trioxide)		
	Henkel #17 replenisher	As required to maintain Henkel #7 concentration				
Henkel 6/16	Nitric acid (42° Bé)	9.0 - 11.0% by volume				
	Chromium (Cr^{+6})	0.9 - 1.5 wt oz/gal	5.5 - 9.5 g/L	0.7 - 1.3 wt oz/gal		
	Deoxidizer #6	As required to maintain Cr^{+6} concentration when etch rate is near maximum (Note 2)				
	Deoxidizer #16 Replenisher	As required to maintain Cr^{+6} concentration and/or etch rate (Note 2)				
	Additive A	As required to maintain etch rate (Note 2) when Cr^{+6} concentration is near maximum				
Oakite Deoxidizer LNC (Notes 3 & 4)	Deoxidizer LNC	10.0 - 20.0% by volume				
Turco DW 514	DW 514	14.0 - 24.0 wt oz/gal	90.0 - 150.0 g/L	12.0 - 20.0 wt oz/gal		

TABLE III - CONTROL OF SOLUTIONS

SOLUTION	SOLUTION COMPONENT	CONCENTRATION CONTROL LIMITS			ANALYSIS FREQUENCY (NOTE 6)	
		IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	STANDARD	EXTENDED
IMMERSION DEOXIDIZING SOLUTIONS CON'T						
Deox 560	Deox 560	7 - 15% by volume			Weekly	Monthly
Turco Aldox NLA	Aldox NLA	6 - 8% by volume				
Triacid etch	Chromium (Cr^{+6})	3.6 - 4.2 wt oz/gal	22.5 - 26.0 g/L	3.0 - 3.5 wt oz/gal		
	Fluoride	As required to maintain the etch rate (Note 2)				
	Nitric Acid (HNO_3)	12.0 -17.0 wt oz/gal	75.0 -105.0 g/L	10.0 - 14.0 wt oz/gal		
	Copper (Cu)	300 ppm maximum				
	Aluminum (Al)	2.7 wt oz/gal max.	17.0 g/L max.	2.3 wt oz/gal max.		
Turco Smut Go No. 1	Smut Go No. 1	14.4 - 21.6 wt oz/gal	90.0 - 135.0 g/L	12.0 - 18.0 wt oz/gal		
Turco Smut Go No. 4	Smut Go No. 4	4.8 - 7.2 wt oz/gal	30.0 - 45.0 g/L	4.0 - 6.0 wt oz/gal		
	Nitric acid	12.6 - 19.2 wt oz/gal	79.0 - 120.0 g/L	10.5 - 16.0 wt oz/gal		
MANUAL DEOXIDIZING SOLUTIONS						
Turco Deoxidine #624, Turco Alumiprep 33 or Turco WO#1	Deoxidine #624, Alumiprep 33 or Turco WO#1	20 - 25% by volume			n/a	n/a
ALTERNATE IMMERSION ETCHING SOLUTION FOR FLUORESCENT PENETRANT INSPECTION						
Sodium Hydroxide	Sodium Hydroxide	20 - 25% by concentration (Note 5)			Monthly	Monthly
BRIGHT DIP SOLUTIONS						
Bright Dip	Sodium hydroxide	0.4 - 0.8 wt oz/gal	2.5 - 5.0 g/L	0.33 - 0.66 wt oz/gal	Weekly	Monthly
Bright Dip Alternate	Phosphoric acid	84 - 86% by volume				
	Alchemize additive	4.5 - 5.5% by volume				
NITRIC ACID SOLUTIONS						
NItric Acid	NItric acid (40° Bé)	1.8 - 2.2% by volume			Weekly	Monthly

TABLE III - CONTROL OF SOLUTIONS

SOLUTION	SOLUTION COMPONENT	CONCENTRATION CONTROL LIMITS			ANALYSIS FREQUENCY (NOTE 6)	
		IMPERIAL UNITS	METRIC UNITS	U.S. UNITS	STANDARD	EXTENDED
RINSE WATER						
Initial rinse	Re-circulating water	Maximum TDS (Total Dissolved Solids) of 1000 ppm (1560 µS/cm at 77 ± 10°F) and pH range of 5.0 - 8.0			Weekly	Weekly
Final rinse	Re-circulating water	Maximum TDS (Total Dissolved Solids) of 350 ppm (660 µS/cm at 77 ± 10°F) and pH range of 5.0 - 8.0				
Spray rinse	Fresh (non-recycled) water	Analysis requirements and control limits apply only to water in rinse tanks, not to spray rinse				
De-ionized water rinse	De-ionized water	De-ionized water rinse shall not exceed a solid accumulation requirement of 250 ppm (390 µS/cm at 77 ± 10°F)				

Note 1. For Henkel 7/17 deoxidizer solution, it is recommended to perform a Reaction Product Determination test on a sample of the solution according to the manufacturer's instructions every 6 months. If the titration value reaches 60 or above, dispose of the solution according to section 10 and prepare a new solution according to Table I. When replacing the Henkel 7/17 solution, use approximately 25% of the old solution in the make-up of the new bath to avoid the instability common to fresh solutions.

Note 2. Control the etch rate on clad aluminum at a maximum of 0.40 mils/surface/hour.

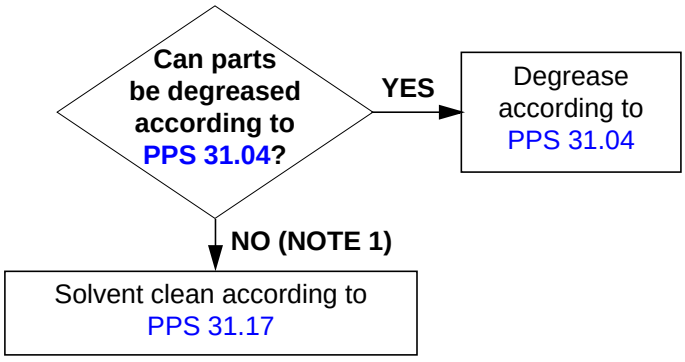
Note 3. Control the etch rate on clad aluminum at 0.03 to 0.10 mils/surface/hour.

Note 4. Normal replenishment of the Deoxidizer LNC deoxidizing solution, based on the Ferric Iron Titration, is with additions of Deoxidizer LNC. However, as the bath is used, the total acid of the solution will tend to decrease requiring occasional addition of nitric acid (ref. paragraph 4.1.7) or Gardobond Additive H7140/1, based on the Total Acid Titration (maintain a recommended total acid concentration of 0 to 2% above the Deoxidizer LNC concentration).

Note 5. Control the etch rate on clad aluminum at 1 to 5 mils/surface/hour. Add 5% corn starch to the sodium hydroxide solution if using the solution for manual or in situ etching for FPI.

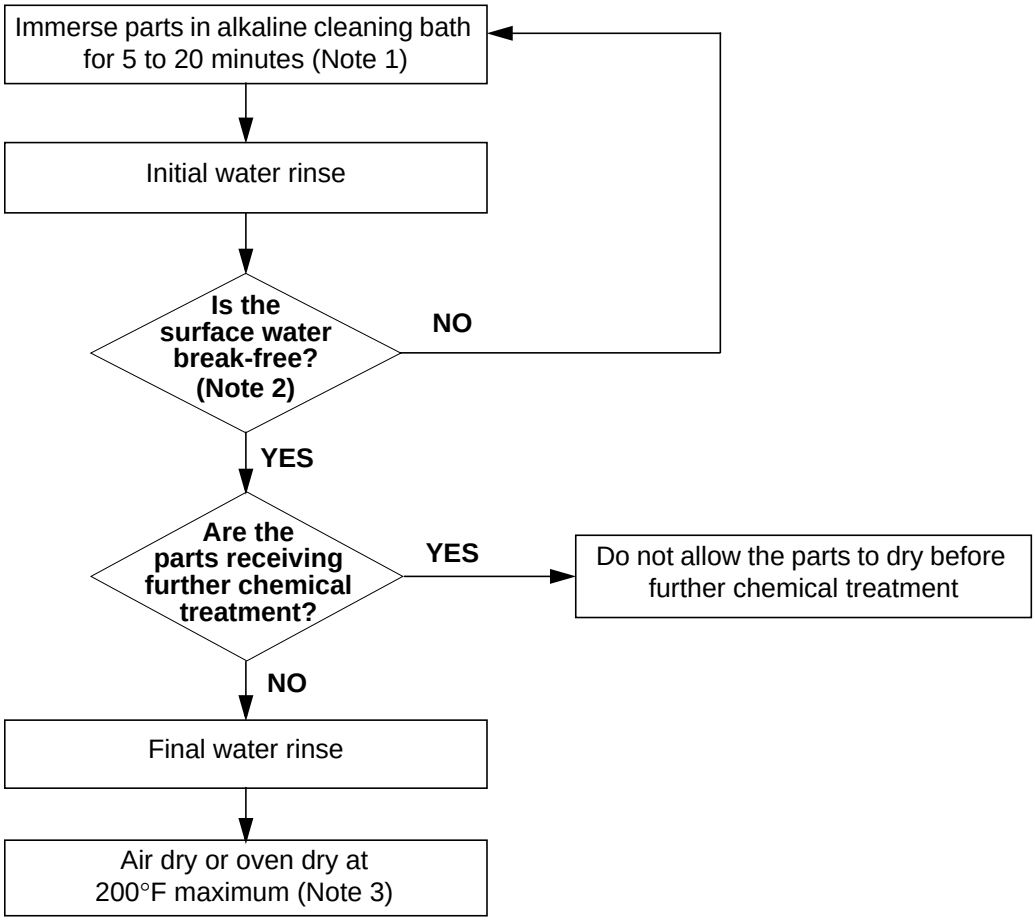
Note 6. If, over a 12 month period, it can be demonstrated (through SPC charts, etc.) that the concentration of the applicable solution component is well within the requirements specified, then the analysis frequency may be reduced from "standard" to "extended". However, in the event that the solution component analysis fails the requirements specified, revert back to the "standard" analysis frequency until a controlled process can again be demonstrated.

FLOW CHART 1 - DEGREASING



Note 1. If degreasing is possible, do not solvent clean parts, but degrease according to PPS 31.04.

FLOW CHART 2 - ALKALINE CLEANING BY IMMERSION

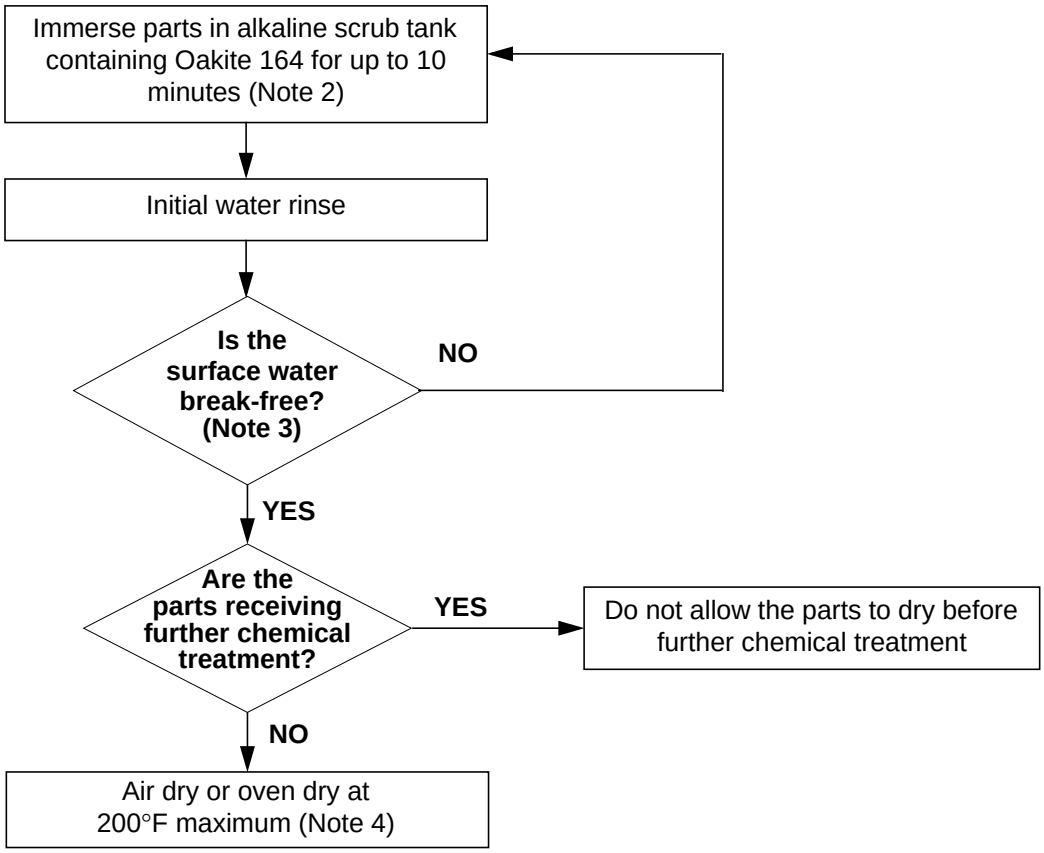


Note 1. Suspend parts so that adjacent parts do not touch, cleaning solution circulates freely between parts and the solution drains freely without entrapment in recesses and creation of air pockets.

Note 2. A water break-free surface is defined as a surface on which a water film will remain continuous for a period of at least 15 seconds without discontinuities or breaks.

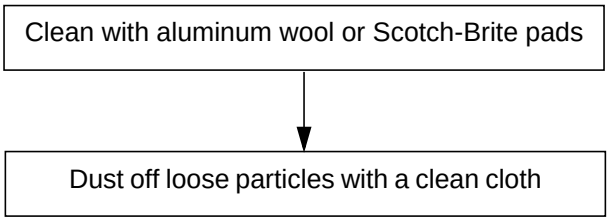
Note 3. If necessary, blow out assembly seams with clean, filtered compressed air. For parts to be fluorescent penetrant inspected according to PPS 20.03, oven dry parts according to PPS 20.03 prior to FPI.

FLOW CHART 3 - ALKALINE SCRUB (NOTE 1)

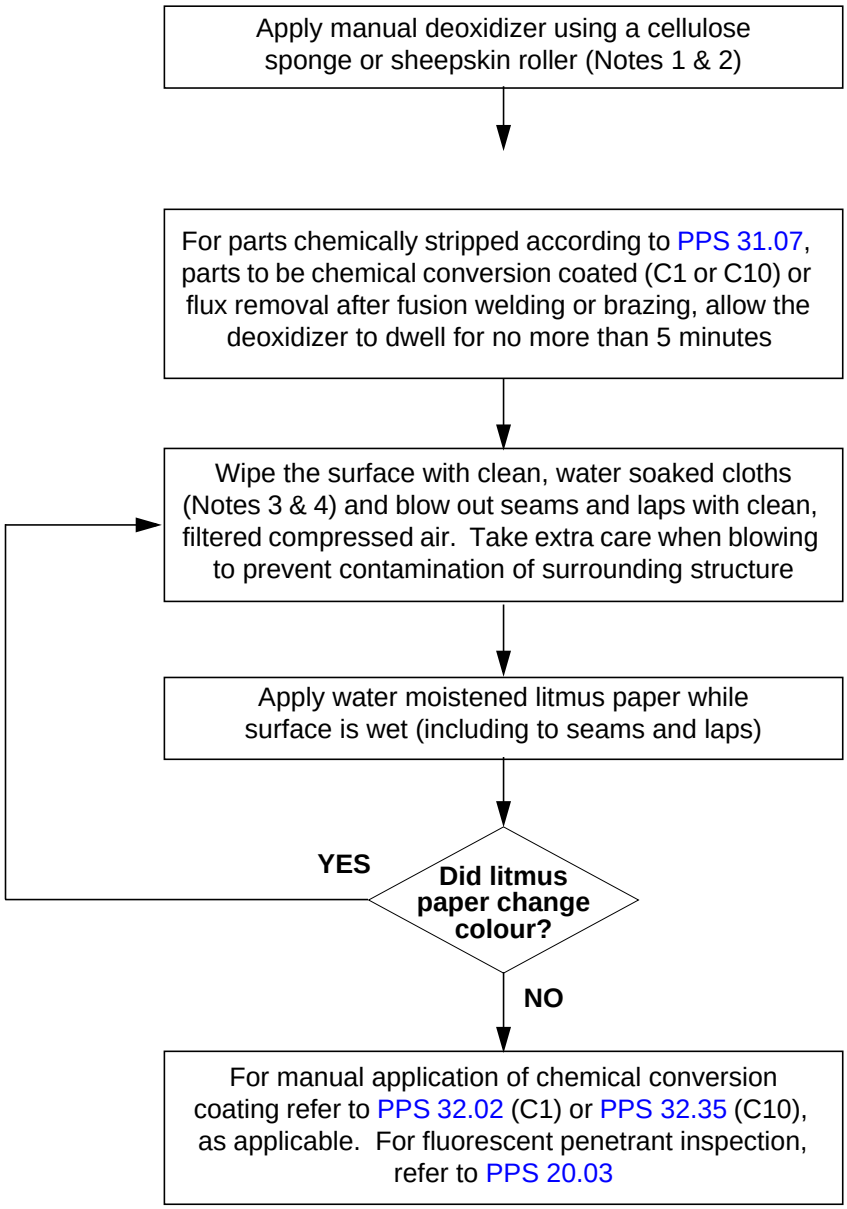


Note 1. The alkaline scrub process shall be qualified before use.
Note 2. Alkaline scrub tanks shall meet the requirements specified in paragraph 4.2.1.1.
Note 3. A water break-free surface is defined as a surface on which a water film will remain continuous for a period of at least 15 seconds without discontinuities or breaks.
Note 4. If necessary, blow out assembly seams with clean, filtered compressed air.

FLOW CHART 4 - MECHANICAL CLEANING

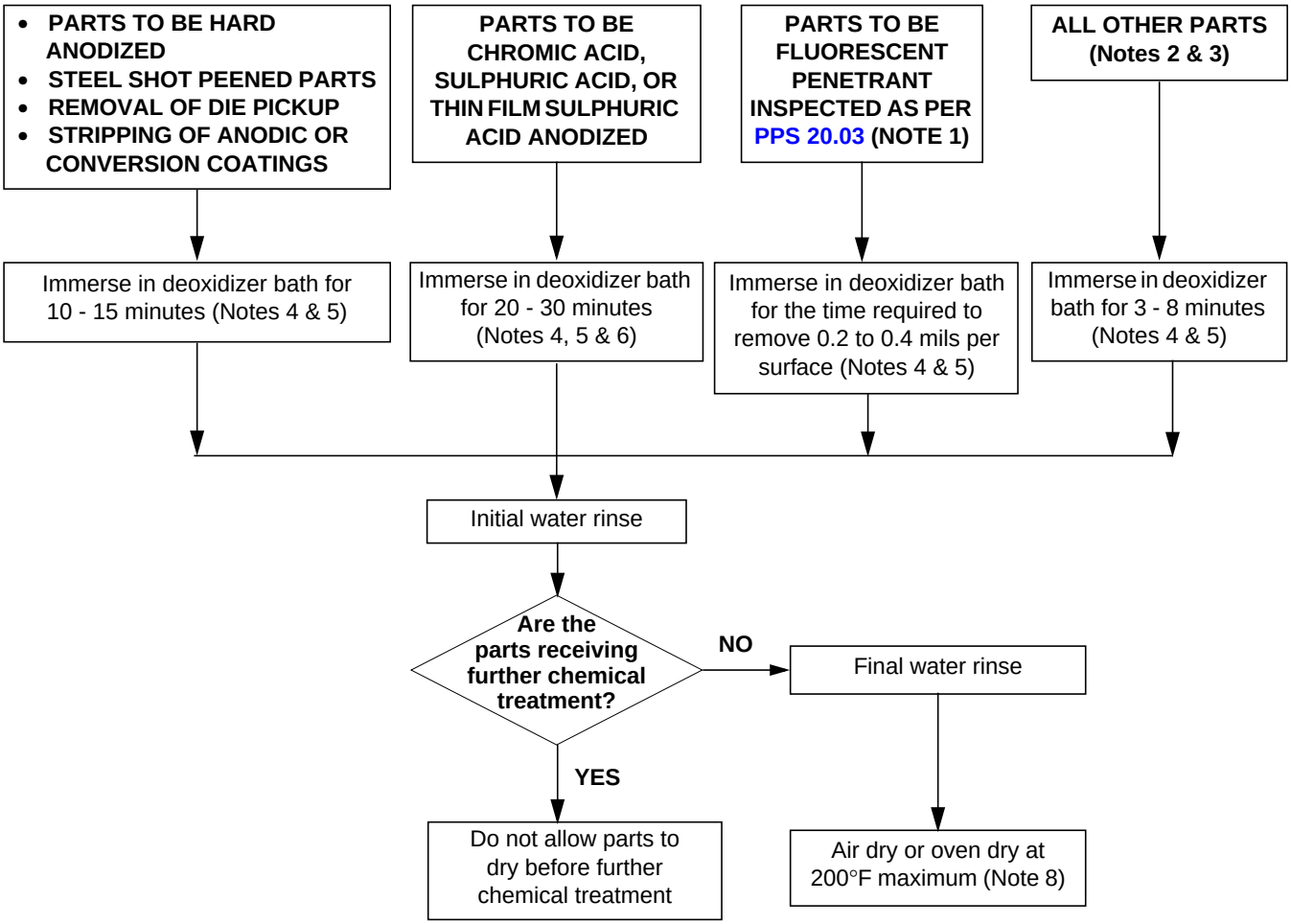


FLOW CHART 5 - MANUAL DEOXIDIZING



Note 1. Close tolerance holes and surfaces shall be masked before deoxidizing. Close tolerance holes do not require masking if final reaming of close tolerance holes will be performed at the assembly stage.
Note 2. Clean only small areas at a time. Do not allow the solution to dry on the surface. If necessary, apply the deoxidizer to a section of the part at a time.
Note 3. If the surfaces have been chemical conversion coated, wipe lightly to prevent damage to the coating.
Note 4. Rinse cloths with clean water frequently.

FLOW CHART 6 - DEOXIDIZING BY IMMERSION



Note 1. Alternatively, it is acceptable to process parts according to Flow Chart 7 to remove 0.2 to 0.4 mils of material per surface.

Note 2. Mechanically clean bonded assemblies and assemblies containing dissimilar metals (e.g., anchor nuts) according to Flow Chart 4.

Note 3. Deoxidize spot welded assemblies and assemblies which may entrap the deoxidizer solution according to Flow Chart 5 or mechanically clean according to Flow Chart 4. Parts which are deoxidized, spot welded and chemically treated within 4 hours do not require deoxidizing after spot welding (i.e., degreasing according to Flow Chart 1 is sufficient). However, if the requirements of the chemical treatment specification that follows cannot be met, then deoxidizing according to Flow Chart 5 is required after spot welding.

Note 4. Close tolerance holes and surfaces shall be masked before deoxidizing. Close tolerance holes do not require masking if final reaming of close tolerance holes will be performed at the assembly stage.

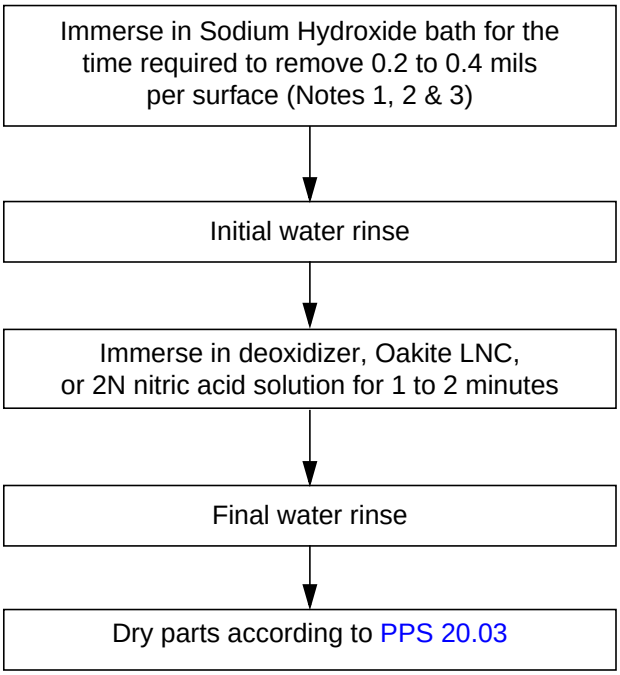
Note 5. Suspend parts so that adjacent parts do not touch, cleaning solution circulates freely between parts and the solution drains freely without entrapment in recesses and creation of air pockets.

Note 6. Immersion time for Turco Smut Go No. 4 deoxidizer bath is 1 to 30 minutes and this shall be determined by the etch rate. The etch rate shall not exceed 0.40 mil/surface/hour.

Note 7. Immersion time in the deoxidizer bath for parts to be chemical conversion coated (C1) in a tri-valent chrome solution (i.e., Alodine T5900, Metalast TCP-HF or SurTec 650) shall be for 2 to 4 minutes.

Note 8. For parts to be fluorescent penetrant inspected according to PPS 20.03, dry parts according to PPS 20.03.

FLOW CHART 7 - ALTERNATE ETCHING FOR PARTS TO BE FLUORESCENT PENETRANT INSPECTED



Note 1. Calculate solution etch rate according to section 9.4.
Note 2. Close tolerance holes and surfaces shall be masked before etching. Close tolerance holes do not require masking if final reaming of close tolerance holes will be performed at the assembly stage.
Note 3. Suspend parts so that adjacent parts do not touch, cleaning solution circulates freely between parts and the solution drains freely without entrapment in recesses and creation of air pockets.

FLOW CHART 8 - STEEL SHOT DETECTION