DE HAVILLAND AIRCRAFT OF CANADA LIMITED

PPS 32.36

PRODUCTION PROCESS STANDARD

PROPRIETARY INFORMATION

THIN FILM SULPHURIC ACID ANODIZING (A7)

Issue 6
- This standard supersedes PPS 32.36, Issue 5.
- Extensive changes and deletions have been made at this issue and, therefore, detail changes have not been noted.
- Direct PPS related questions to christie.chung@dehavilland.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

Prepared By: (Christie Chung) December 14, 2020

PPS Group

Approved By: (Stephen Mabee) December 14, 2020

M&P Engineering

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

Issue 6 - 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.

- Replaced throughout PPS where “Bombardier” is specified with “De Havilland Aircraft of Canada Limited” or “DHC”.
- Specified use of the following Bombardier documents at frozen revisions: BAERD GEN-018, Rev. E; BAERD GEN-023, Rev. A; BATS 3075, Rev. B; and BATS 5076, Rev. NC.
- Replaced the post anodize seal process with the new Socomore Socosurf TCS/PACS process.

TABLE OF CONTENTS

Sections **Page**

TABLE OF CONTENTS CON'T

Sections **Page**

Tables

Figures

Flow Charts

1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for thin film sulphuric acid anodizing (TFSAA) of aluminum and aluminum alloy parts which will not be high strength adhesive bonded. **Chromic acid anodize parts that are to be high strength adhesive bonded according to PPS 32.11.** Thin film sulphuric acid anodizing is identified by protective treatment code A7.

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.

2 HAZARDOUS MATERIALS

2.1 Before receipt at De Havilland Aircraft of Canada Limited (DHC), all materials shall be approved and assigned Material Safety Data Sheet (MSDS) numbers by the DHC 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 DHC Environment, Health and Safety Department.

3 REFERENCES

3.1 ASTM B117 - Standard Test Method of Salt Spray (Fog) Testing.

3.2 ASTM B137 - Standard Test Method for Measurement of Weight of Coating on Anodically Coated Aluminum.

3.3 ASTM D2794 - Standard Test for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).

3.4 BAERD GEN-007, Rev. C - Quality Control of Heat Treating Equipment and Hot Forming Equipment.

3.5 BAERD GEN-018, Rev. E - Engineering Requirements for Laboratories.

3.6 BAERD GEN-023, Rev. A - Contamination Control for Compressed Air.

3.7 BATS 3075, Rev. B - Fatigue Testing.

3.8 BATS 5076, Rev. NC - Sealing Efficiency.

3.9 DHC Laboratory Drawings - LAB 064, LAB 065, LAB 066 and LAB 073.

3.10 DHLPM Procedure No. 3111 - Coating Weight of Anodic Coatings - *DHC internal operating procedure*.

3.11 DHLPM Procedure No. 6011 - Description of Operation and Conditions Required For Salt Spray (Fog) Testing For Specification Purposes - *DHC internal operating procedure*.

3.12 EHS-OP-005 - Hazardous Materials Management - *DHC internal procedure*.

3.13 MIL-A-8625 - Anodic Coatings for Aluminum and Aluminum Alloys.

3.14 PPS 13.13 - Personal Protective Respiratory Equipment.

3.15 PPS 13.26 - General Subcontractor Provisions.

3.16 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.17 PPS 27.09 - Repair of Surface Defects in Aluminum Alloy Tubing.

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

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

3.20 PPS 32.11 - Chromic Acid Anodizing for High Strength Adhesive Bonding.

3.21 PPS 34.08 - Application of Epoxy-Polyamide Primer (F19 & F45).

3.22 QDI-09-02 - Process Control - *DHC internal Quality procedure*.

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Aluminum alloy wire, 1/16" and 3/32" diameter gauge.

4.1.2 Masking plugs, silicon rubber, commercial.

4.1.3 Masking tape, acid-resistant:

- Permacel P-377
- 3M Circuit Plating Tape 1280

4.1.4 Protective wrapping, neutral Kraft paper or polyethylene plastic bags.

4.1.5 Socosurf TCS, Socomore.

4.1.5.1 Socosurf TCS ADD1, Socomore.

4.1.5.2 Sococlean TCS ADD1, Socomore.

4.1.5.3 5% ammonium hydroxide.

4.1.5.4 5% sulphuric acid.

4.1.6 Socosurf PACS, Socomore.

4.1.6.1 Hydrogen Peroxide, 35 wt%, technical grade.

4.1.6.2 5% ammonium hydroxide.

4.1.6.3 5% nitric acid.

4.1.7 Sulphuric acid, 66° Bé.

4.1.8 Test Specimens - LAB 064-1; LAB 064-9; LAB 065-1; LAB 066-1; LAB 073-01; LAB 073-03 (AMS 4050); LAB 073-04 (AMS 4078); QQ-A-250/4; QQ-A-250/5. See Table II and Table III.

4.2 Equipment

4.2.1 Aluminum wool or brass wire brush.

4.2.2 Aluminum or titanium racks, straps and clamps capable of providing both support and positive electrical contact with the parts.

4.2.3 Compressed air shall meet the requirements of BAERD GEN-023, Rev. A.

4.2.4 Immersion tanks resistant to the chemicals and to the operating temperatures used (e.g., stainless steel or polyethylene lined). Immersion tanks shall be equipped with an agitation system capable of providing uniform solution temperature throughout the tank (to prevent localized overheating). The quality of compressed air used for solution agitation shall be controlled according to BAERD GEN-023, Rev. A.

4.2.4.1 The anodizing tank shall be equipped with cathodes with an effective surface area equal to or larger than 50% of the largest parts load to be treated in the installation (including non-protected surfaces of aluminum racks).

4.2.4.2 Ensure the following for Socosurf TCS and Socosurf PACS solution tanks:

- Equip with mechanical agitation only.
- Heating coil shall be protected with PVC or Teflon.
- Socosurf PACS tank shall be equipped with a lid.

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

4.2.6 Low voltage gloves (e.g., DSC 422-10).

4.2.7 Neoprene rubber boots and aprons.

4.2.8 Protective gloves, neoprene or rubber (e.g., DSC 422-2 or DSC 422-5).

4.2.9 Rectifier (e.g., Plating Electronic Power Station pe3000-6).

4.3 Facilities

4.3.1 This PPS has been categorized as a Controlled Critical Process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform TFSAA of aluminum and aluminum alloy parts according to this PPS.

4.3.2 Subcontractors shall direct requests for approval to DHC Quality.

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, DHC 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 DHC Quality.

4.3.3.1 For approval of subcontractor facilities to perform TFSAA of aluminum and aluminum alloy parts 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 DHC Materials Laboratory or by laboratories accredited according to BAERD GEN-018, Rev. E.

5 PROCEDURE

5.1 General

5.1.1 For the purposes of this PPS, the term “MRB” (Material Review Board) is considered to include DHC MRB and DHC delegated MRB.

5.1.2 A7 thin film sulphuric acid anodizing consists of forming a thin, impervious, oxide layer on the surface of aluminum alloys by electro-chemical means to provide increased corrosion resistance and improved paint adhesion.

5.1.3 Complete all fabricating operations (i.e., heat treatment, machining, forming, filing, etc.) before anodizing.

5.1.4 Do not anodize parts or assemblies that contain joints or recesses which could entrap solutions. Do not anodize assemblies containing inserts or attachments unless such inserts have been suitably masked off, both chemically and electrically, to prevent burning and corrosion in the surrounding areas. When masking off inserts and attachments, it is important that the masking completely seals the faying surface between the insert and parent metal to prevent ingress of the solution.

5.1.5 Refer to Flow Chart 1 for processing sequences and operations. Do not allow parts to dry between processing steps (wet process).

5.2 Preparation of Solutions

5.2.1 Prepare and operate solutions according to Table I. Prepare the chemical solutions as follows:

Step 1. Half fill the tank with de-ionized water.

Step 2. Add the required amount of chemicals.

Step 3. Fill the tank to operating level with de-ionized water.

Step 4. Gently agitate solution to ensure temperature and chemical uniformity.

5.2.2 Apply mild mechanical agitation to the Socosurf TCS and Socosurf PACS solutions to ensure solution uniformity prior to use. However, do not agitate the solutions when parts are being processed. Avoid air bubble and turbulence.

5.2.3 Equip rinse tanks with inlet and outlet provisions to allow fresh de-ionized water to be added, as required, to maintain the rinse tanks within the limits specified in Table V.

5.2.4 There should be a dedicated rinse tank for rinsing Socosurf TCS treated parts and a separate dedicated rinse tank for rinsing Socosurf PACS treated parts. **Do not** use these two rinse tanks for rinsing off any other chemical solutions.

TABLE I - SOLUTION PREPARATION

BATH TYPE (NOTE 2)	SOLUTION MAKE-UP (NOTE 1)			OPERATING TEMPERATURE (°F)
	CHEMICALS	METRIC UNITS	WATER	
Anodizing bath	Sulphuric Acid	4.5 Kg/100 L	De-ionized	75 to 85
Socosurf TCS	Socosurf TCS	32% v/v	De-ionized	95 to 113
Socosurf PACS	Socosurf PACS	10% v/v	De-ionized	59 to 86
	Hydrogen Peroxide (H_2O_2 - 35 wt%)	5% v/v		
De-ionized Water Rinse (Note 3)	—		De-ionized	95 maximum

Note 1. It is acceptable for subcontractors to deviate from the specified make-up of solutions provided that the control requirements of Table V are met.
Note 2. The tank material shall be resistant to the chemicals and to the operating temperatures used (e.g., stainless steel or polyethylene lined).
Note 3. There should be a dedicated rinse tank for rinsing Socosurf TCS treated parts and a separate dedicated rinse tank for rinsing Socosurf PACS treated parts. Do not use these two rinse tanks for rinsing off any other chemical solutions.

5.3 Preparation of Parts

5.3.1 Racking of Parts

5.3.1.1 Assemble parts on splines or wire them directly to the anode rack to:

- permit free circulation of the anodizing solution to all work surfaces
- permit good drainage
- prevent contact with the wall of the tank or adjacent parts
- prevent air entrapment
- minimize the number of contact points on the part

5.3.1.2 If the parts are too large to be clipped to the splines, wire them directly to the anode rack ensuring that:

- there are no contact points between adjacent parts
- the racking wires are used only once unless the oxide layer on the wire formed during anodizing is stripped before re-use
- the cross-sectional area of the suspending wire from the parts to the rack is kept uniform
- the wire is wound tightly around the parts to ensure good electrical contact

5.3.2 Cleaning of Parts

5.3.2.1 Clean all parts, while racked, according to PPS 31.02 immediately before anodizing. Clean and anodize parts in an uninterrupted sequence.

5.4 Anodizing

5.4.1 Handle all dried anodized parts with clean cotton gloves.

5.4.2 All production parts shall be anodized at 15 ± 2 volts DC (current density of approximately 0.5 A/dm^2).

5.4.3 Anodize parts at 15 ± 2 volts as follows:

Step 1. Immerse the parts completely in the agitated anodizing bath.

Step 2. Apply the current within 2 minutes of immersion by starting at zero volts and increasing at 3 to 4 volts per minute (ramp-up rate) for 8 minutes until 15 ± 2 volts is reached.

Step 3. Anodize at 15 ± 2 volts for 20 to 25 minutes.

Step 4. Shut-off the current.

Step 5. Remove the parts from the bath within 2 minutes of the current being shut-off.

Step 6. Drain parts over the anodizing bath for approximately 1 minute.

Step 7. Rinse parts thoroughly in cold de-ionized water (maximum 95°F) for 2 to 15 minutes.

Step 8. For coating weight and fatigue test panels, allow test panels to dry (i.e., continue to Step 13 as sealing in Socosurf TCS/PACS solutions is not required). For all other parts and test panels, continue processing parts by sealing the anodic treatment in the Socosurf TCS/PACS solutions specified below.

Step 9. Immerse parts in an **unagitated** Socosurf TCS solution for 10 to 15 minutes.

Step 10. Rinse parts thoroughly in cold de-ionized water (maximum 95°F) for 2 to 15 minutes (see paragraph 5.2.4). Ensure complete removal of Socosurf TCS solution.

Step 11. Immerse parts in an **unagitated** Socosurf PACS solution for 3 to 7 minutes.

Step 12. Rinse parts thoroughly in the final cold de-ionized water (maximum 95°F) tank for 2 to 15 minutes (see paragraph 5.2.4). Any powdery coating visible on the part is unacceptable.

Step 13. Air dry the parts at room temperature. If required, drying may be hastened by directing clean, dry, oil-free compressed air over the anodized parts. Dry fuel tank components and other parts difficult to drain by heating in an oven at a maximum temperature of 160°F.

Step 14. Remove maskant from the dried parts unless needed for further processing operations.

Step 15. If the parts are to be transported or held for more than 24 hours, wrap in neutral Kraft paper and seal parts in polyethylene plastic bags. However, if the parts are to be primed within 24 hours, they do not require protective wrapping but shall be kept free from contamination and handled only while wearing clean lint-free cotton gloves.

5.5 Touch-Up of Anodic Coating

5.5.1 Repair isolated small areas where the anodic coating has been scratched (i.e., hairline surface scratches) by touching up with chemical conversion coating according to PPS 32.02.

5.5.2 Tubes which have had surface defects repaired according to PPS 27.09 shall be cleaned according to section 5.3.2 and re-anodize as follows:

Step 1. Wind aluminum wire twice around the circumference of the section of the tube where the anodic coating have been removed.

Step 2. Rack the tubes according to section 5.3.1.

Step 3. Re-anodize the tubes according to section 5.4.

6 REQUIREMENTS

6.1 General

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

6.2 Process Qualification

6.2.1 General

6.2.1.1 For process qualification, process test panels through the full anodizing cycle (including Socosurf TCS/PACS treatment) and submit for testing as specified in Table II. Additional testing may be requested at any time at the discretion of DHC.

TABLE II - PROCESS QUALIFICATION TESTING REQUIREMENTS

TEST	NUMBER OF PANELS	TEST SPECIMENS	PROCESS	TESTING PROCEDURE (NOTE 1)
Visual Inspection	All	As specified below	All	Visual (according to section 6.3.5)
Coating Weight	4	LAB 065-1 or 2024-T3 per QQ-A-250/4 (0.032" min)	Anodize and Not Sealed	DHLPM Procedure No. 3111 or ASTM B137
Corrosion Resistance	10	LAB 064-1 or 2024-T3 per QQ-A-250/4 (0.032" min)	Anodize and Seal	DHLPM Procedure No. 6011 or ASTM B117
Filiform Corrosion	4	2024-T3 per QQ-A-250/4 (0.020" or 0.032")	Anodize, Seal and F19 Prime	According to section 6.2.2
Sealing Efficiency	4	LAB 064-9 or 2024-T3 per QQ-A-250/4 (0.032" min)	Anodize and Seal	BATS 5076, Rev. NC (Note 2)
Paint Adhesion	8	LAB 066-1 or 2024-T3 per QQ-A-250/5 (0.032" min)	Anodize, Seal and F19 Prime	According to section 6.3.9
Fatigue	10	LAB 073-01 or 2024-T351 per QQ-A-250/4	Anodize and Not Sealed	According to section 6.2.3
	10	LAB 073-03 or 7050-T7451 per AMS 4050		
	10	LAB 073-04 or 7075-T7351 per AMS 4078		

Note 1. Refer to the appropriate sections for details regarding test requirements.
Note 2. Sealing efficiency is acceptable if the exposed area is not stained by the dye. A very faint colour is acceptable.

6.2.2 Filiform Corrosion

6.2.2.1 For process qualification testing, process four 4" x 6" x 0.020" or 4" x 6" x 0.032" 2024-T3 bare aluminum (QQ-A-250/4) test panels as follows:

Step 1. Anodize panels as specified herein.

Step 2. Finish one side of each of the test panels with one coat of F19 Type 2 epoxy primer according to PPS 34.08.

Step 3. Scribe two intersecting lines, 1/16th to 1/8th inch (1.6 to 3.2 mm) wide, extending from corner to corner of the panel, through the coating and the pre-treatment, down to the base metal.

Step 4. Expose the panels to vapour from 12 Normal HCl for 1 hour at 75°F ± 5°F by suspending the panels approximately two inches above the liquid level in a closed container similar to the one shown in Figure 1. Do not rinse or dry.

Step 5. At the end of the acid-vapour exposure period, immediately transfer the specimens to a humidity chamber maintained at 95°F ± 5°F and 80% ± 5% relative humidity. Position the panels with the long (6 inches) dimension 6 degrees from the vertical and the short (4 inches) dimensional horizontal.

Step 6. After 30 days, examine the panels according to paragraph 6.2.2.2.

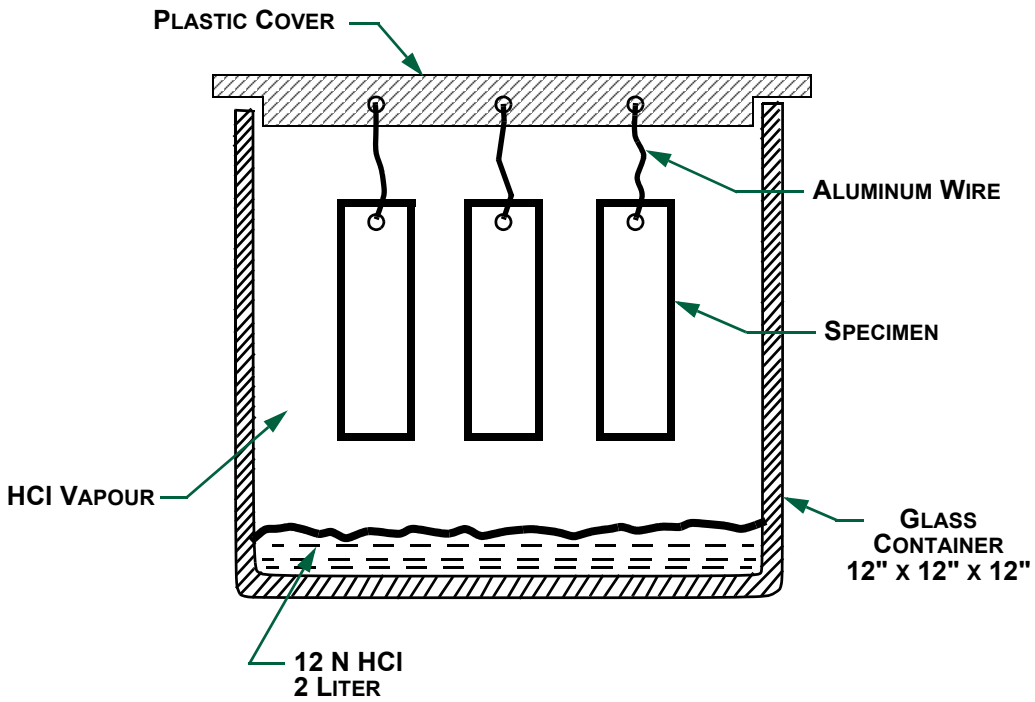


FIGURE 1 - ACID-VAPOUR EXPOSURE CHAMBER

6.2.2.2 There shall be no visible corrosion of the metal beyond 1/8th inch from the scribe marks, no evidence of blisters in the primer and no signs of other film failures after exposure in humidity chamber for 30 days.

6.2.3 Fatigue

6.2.3.1 Perform fatigue testing on anodic specimens as specified in Table II according to BATS 3075 Rev. B. If any of the following conflicts with BATS 3075 Rev. B, test using the following PPS specified criteria:

- Tension: Tension loading.
- Constant amplitude sinusoidal wave loading: R = 0.1 (Min. stress/Max. stress), where R is Stress Ratio.
- Frequency: 30 to 40 Hz
- Temperature: Ambient (15 to 25°C)
- Run-out is declared at 1,000,000 cycles
- All ten (10) 2024-T351 specimens shall be tested at 24.0 ksi maximum net section stress.
- All ten (10) 7050-T7451 specimens shall be tested at 21.0 ksi maximum net section stress.
- All ten (10) 7075-T7351 specimens shall be tested at 21.0 ksi maximum net section stress.
- For each material type tested, the log-average of the 10 specimens' cycles to failure shall be 100,000 minimum
- All individual results including reduced section dimensions, applied loads (min and max), corresponding stresses, number of cycles and log-averages shall be reported.
- For each alloy, log-average is determined with the following equation:

$$\textbf{Log-average} = 10^{(\sum \log [n_{i=1\ldots10}]/10)}$$

Where $n_{1\ldots10}$ = number of cycles until failure for each specimen.

6.3 Production Parts

6.3.1 General

6.3.1.1 Every month during which there has been production of DHC parts, test panels shall be processed through the anodizing cycle and submitted to a laboratory as specified in paragraph 4.3.3.2 for coating weight determination, corrosion resistance testing and paint adhesion testing as specified herein.

- Once each quarter, subcontractors shall forward the results of monthly test panels to DHC.
- If monthly panels were tested by a DHC approved laboratory and not the DHC Materials Laboratory, subcontractors shall forward the results every 6 months to DHC.
- At the discretion of DHC, it may be necessary that monthly test panels be likewise submitted for verification of test results.
- In order to maintain qualified status, all facilities processing parts for DHC according to this PPS shall maintain records of monthly testing. If these records cannot be produced, then the facility may be required to re-qualify.

6.3.1.2 If there has been no production of DHC parts for 1 to 6 months but there has been production on non-DHC parts, forward monthly test results for corrosion resistance and coating weight distribution testing performed according to MIL-A-8625 for the period during which when no DHC parts were being processed to DHC for review and approval before resuming processing of parts for DHC. If such test results are not available, process test panels for coating weight determination, corrosion resistance testing and paint adhesion testing as specified herein and forward the test results to DHC for review and approval before resuming processing of parts for DHC.

6.3.1.3 If the A7 TFSAA line has not been processing any parts for more than 1 month or if there has been no production of DHC parts for over 6 months, process test panels for coating weight determination, corrosion resistance testing and paint adhesion testing as specified herein and forward the test results to DHC for review and approval before resuming processing of parts for DHC.

6.3.2 Process Checks

6.3.2.1 Once per shift, check the following to verify that anodizing is being conducted according to this PPS. Take corrective actions, as necessary.

- operating voltage
- all solution temperature, inclusive of rinse tanks

6.3.3 Testing Requirements

6.3.3.1 Refer to Table III for a summary of test panel requirements.

TABLE III - SUMMARY OF TESTING REQUIREMENTS

TEST	TESTING FREQUENCY	NUMBER OF PANELS	TEST SPECIMENS	TESTING PROCEDURE (NOTE 1)
Visual Inspection	According to Table IV and section 6.3.5	According to Table IV	Production parts	Visual (according to section 6.3.5)
Coating Weight	Monthly (see section 6.3.4)	3	LAB 065-1 or 2024-T3 per QQ-A-250/4 (0.032" min)	DHLPM Procedure No. 3111 or ASTM B137
Corrosion Resistance	Monthly (see section 6.3.4)	5	LAB 064-1 or 2024-T3 per QQ-A-250/4 (0.032" min)	DHLPM Procedure No. 6011 or ASTM B117
Paint Adhesion	Monthly (see section 6.3.4)	2	LAB 066-1 or 2024-T3 per QQ-A-250/5 (0.032" min)	According to section 6.3.9

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

6.3.3.2 For visual inspection according to section 6.3.5, select a sample from each production lot, including any parts that appear unusual in colour or evenness of colouration, by taking at random from the lot, not less than the number of items indicated in Table IV.

6.3.3.2.1 If the number of non-conforming items in any sample exceeds the acceptance number specified in Table IV, reject the represented lot, and disposition them according to section 6.3.10.

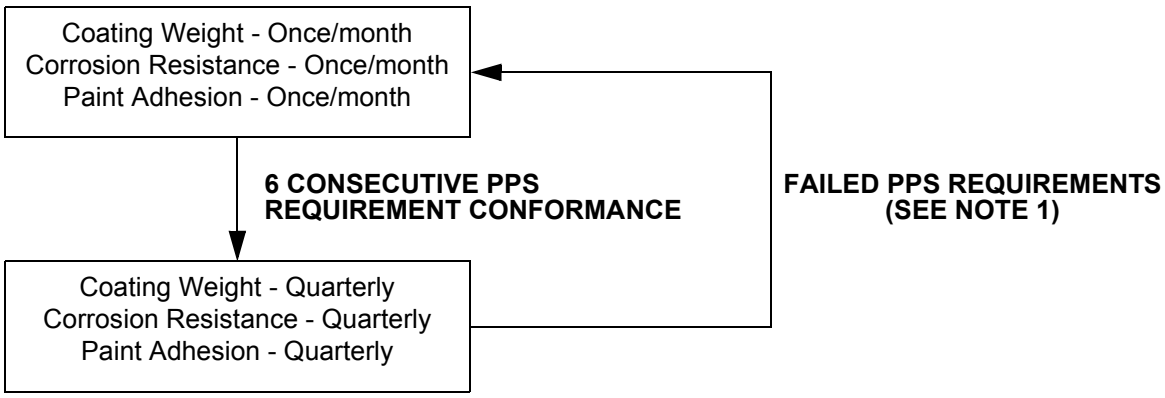
TABLE IV - VISUAL AND PLATING THICKNESS SAMPLING SCHEDULE

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 shall be rejected.

6.3.4 Testing Frequency

6.3.4.1 Process control requirements for coating weight, corrosion resistance and paint adhesion shall be tested on a periodic basis. The testing frequency shall be as follows:



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

6.3.4.2 In the event that processing 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.

6.3.5 Visual Inspection

6.3.5.1 The anodic coating shall be continuous, smooth, uniform in appearance, adherent, and is free from powdery areas, discontinuity, indications of burns, scratches or other defects.

6.3.5.2 Localized staining in non-functional and/or subject to subsequent painting areas of parts may not be cause for rejection, providing stained areas are free from water-soluble contaminants.

6.3.5.3 Colour variations caused by the condition of the surface prior to anodizing (with exception of proven machining or heat treatment defects on machined parts) shall not be cause for rejection.

6.3.6 Coating Weight

6.3.6.1 For coating weight determination, prepare and test 3 unsealed anodized LAB 065-1 test panels or 2024-T3 per QQ-A-250/4 test panels (0.032" thick minimum) according to DHLPM Procedure No. 3111 or ASTM B137. The optimum coating weight range is 200 - 450 mg/ft^2. If the coating weight of any of the panels is determined to be below 200 mg/ft^2, suspend the anodizing process until the cause of failure has been established and corrective action taken. If the coating weight of any of the panels is determined to be between 450 - 700 mg/ft^2, monitor the process and rectify the anomaly before coating weight exceeds 700 mg/ft^2. If the coating weight of any of the panels is greater than 700 mg/ft^2, determine the reasons for the increase and rectify the problem.

6.3.7 Corrosion Resistance

6.3.7.1 For corrosion resistance testing, expose 5 anodized LAB 064-1 or 2024-T3 per QQ-A-250/4 test panels (0.032" thick minimum) to a 5% salt spray according to ASTM B117 or DHLPM Procedure No. 6011, except the test surface shall be inclined 6° from the vertical. Expose the panels for 336 hours and examine them for corrosive attack. If there is evidence of corrosive attack in excess of the following limits suspend the anodizing process until the cause of the failure has been established and corrective action taken:

- 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).

6.3.8 Sealing Efficiency

6.3.8.1 When tested according to BATS 5076 Rev NC, sealing efficiency is acceptable if the exposed area is not stained by the dye. A very faint colour is acceptable.

6.3.9 Paint Adhesion

6.3.9.1 Perform paint adhesion testing on 2 anodized LAB 066-1 or 2024-T3 per QQ-A-250/5 test panels (0.032" thick minimum) as follows:

Step 1. Finish one side of each of the test panels with one coat of F19 Type 2 epoxy primer according to PPS 34.08.

Step 2. Subject all the test panels to a forward impact (coated side up) of 40 inch-pounds and reverse impact (coated side down) of 30 inch-pounds according to ASTM D2794. Adhesion is considered satisfactory if the primer does not crack, flake or peel. If one or more of the test panels shows evidence of cracking, flaking or peeling, suspend the anodizing process until the cause of failure has been established and corrective action taken.

6.3.10 Disposition

6.3.10.1 Any rejected lots shall be 100% inspected. Accept all parts that meet the above requirements. For anodized parts that fail to meet the requirements after initial processing, determine the cause of failure and correct before stripping according to PPS 31.02, re-processing and re-inspecting the parts as specified herein. If a coating fails to meet the requirements a second time after having already been stripped and re-processed once, refer the part to MRB for disposition.

6.4 Solutions Control

6.4.1 Take samples of the anodizing bath, Socosurf TCS, Socosurf PACS and de-ionized water rinse solutions for chemical analysis according to the analysis frequency specified in Table V. Ensure that the solutions are thoroughly mixed immediately before taking samples. Verify that the solutions meet the requirements specified in Table V.

6.4.2 Prepare and maintain records of all solution tests according to QDI-09-02. If additions are required, then indicate in the report the amount to be added. Re-test the solution within 24 hours of any adjustment.

6.4.3 Check the pH of all solutions weekly.

TABLE V - CONTROL OF SOLUTIONS

BATH TYPE	SOLUTION COMPONENT	CONCENTRATION	CONCENTRATION ANALYSIS FREQUENCY (Note 1)		pH (NOTE 2)
		METRIC UNITS	STANDARD	EXTENDED	
Anodizing bath	Free sulphuric acid	30 - 35 g/L	Twice/Week	Weekly	N/+A
	Chlorides (as NaCl)	20 ppm maximum	Monthly	Monthly	
	Copper	100 ppm maximum	Monthly	Every 3 months	
Socosurf TCS	Socosurf TCS Zr^{4+}	31 - 41 %v/v (Note 3)	Weekly	Weekly	3.8 - 4.0 (Note 5)
	Socosurf TCS ADD1 Cr^{3+}	31 - 41 %v/v (Note 4)	Weekly	Weekly	
Socosurf PACS	Socosurf PACS (La^{3+})	8 - 12 %v/v	Weekly	Weekly	4.2 - 5.3 (Note 6)
	Hydrogen Peroxide (H_2O_2 - 35 wt%)	5 - 7 %v/v	Twice/Week	Weekly	
Rinse	De-ionized water	350 ppm maximum total dissolved solids	Weekly	Weekly	3.0 - 8.0
	Tap water	350 ppm maximum total dissolved solids	Weekly	Weekly	5.5 - 8.0

Note 1. 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.

Note 2. Check pH of all solutions weekly.

Note 3. Adjust with Socosurf TCS.

Note 4. Adjust with Sococlean TCS ADD1.

Note 5. The pH of the Socosurf TCS bath shall be adjusted as follows:

- Slowly add 5% ammonium hydroxide to increase pH
- Slowly add 5% sulphuric acid to decrease pH.

Note 6. The pH of the Socosurf PACS bath shall be adjusted as follows:

- Slowly add 5% ammonium hydroxide to increase pH.
- Slowly add 5% nitric acid to decrease pH.

7 DHC SAFETY PRECAUTIONS

7.1 The safety precautions specified herein are specific to DHC to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is strongly recommended that other facilities consider these safety precautions; however, suppliers, subcontractors and partners 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 Wear neoprene or rubber protective gloves (see paragraph 4.2.8), aprons and boots and DHC approved chemical splash goggles while carrying out A7 thin film sulphuric acid anodizing operations.

7.4 Provide sufficient ventilation when working with chemical baths in confined areas. Wear respiratory equipment according to PPS 13.13 when operating chemical baths.

7.5 Avoid skin contact with solutions. If salts or solutions come into contact with skin or clothing, wash the affected area immediately in running water. The salts and solutions are highly corrosive and will cause damage to clothing and burning of the skin.

7.6 Take the necessary steps to protect cuts or abrasions of the skin with a waterproof type bandage when engaged in the anodizing process.

7.7 Keep the tank sides, tops and walkways clean and free from spilled solutions.

7.8 Avoid eye contact with chemicals or solutions. If eye contact occurs, immediately flush eyes in a directed stream of water for at least 15 minutes while forcibly holding eyelids apart to ensure completed irrigation of all eye and lid tissue. Contact the Health Centre and a physician.

7.9 Thoroughly rinse rags, paper and refuse which come into contact with the acid solutions in water before being placed in disposal containers. Dried, unruliness material may result in spontaneous combustion.

8 PERSONNEL REQUIREMENTS

8.1 This PPS has been categorized as a Controlled Critical Process according to PPS 13.39. Refer to PPS 13.39 for additional personnel requirements. Certified and/or qualified personnel shall have a good working knowledge of the following, as applicable:

- the function of A7 TFSAA.
- the importance of proper solution preparation and control.
- the requirements of surface cleaning, per-treatment and the effects of improperly cleaned part surfaces on the performance of the coating.
- the method of obtaining A7 thin film sulphuric acid anodic coating.
- the restrictions on various alloys with reference to this process.
- the theory behind the anodizing procedure.
- the importance of the Socosurf TCS/PACS solutions in the anodizing process.
- the importance of not agitating the Socosurf TCS/PACS solutions when in use.
- material and part handling requirements.
- the sequence of operations in the process line.
- proper part racking procedures and crane operation.
- the function and operation of the process tanks.
- how to use all processing parameter controls to produce acceptable production parts.
- the relevant safety equipment and precautions.
- requirements for coating appearance, coating weight, paint adhesion and corrosion resistance and how they are evaluated or measured.
- engineering drawing notations regarding A7 TFSAA.
- the procedure and requirements for preparation of aluminum surfaces for A7 TFSAA.
- how to process production parts.
- how to identify and process required test specimens.

9 DISPOSAL OF CHEMICAL WASTES

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

10 MAINTENANCE OF EQUIPMENT

10.1 Tighten and replace all loose clips attached to the racks.

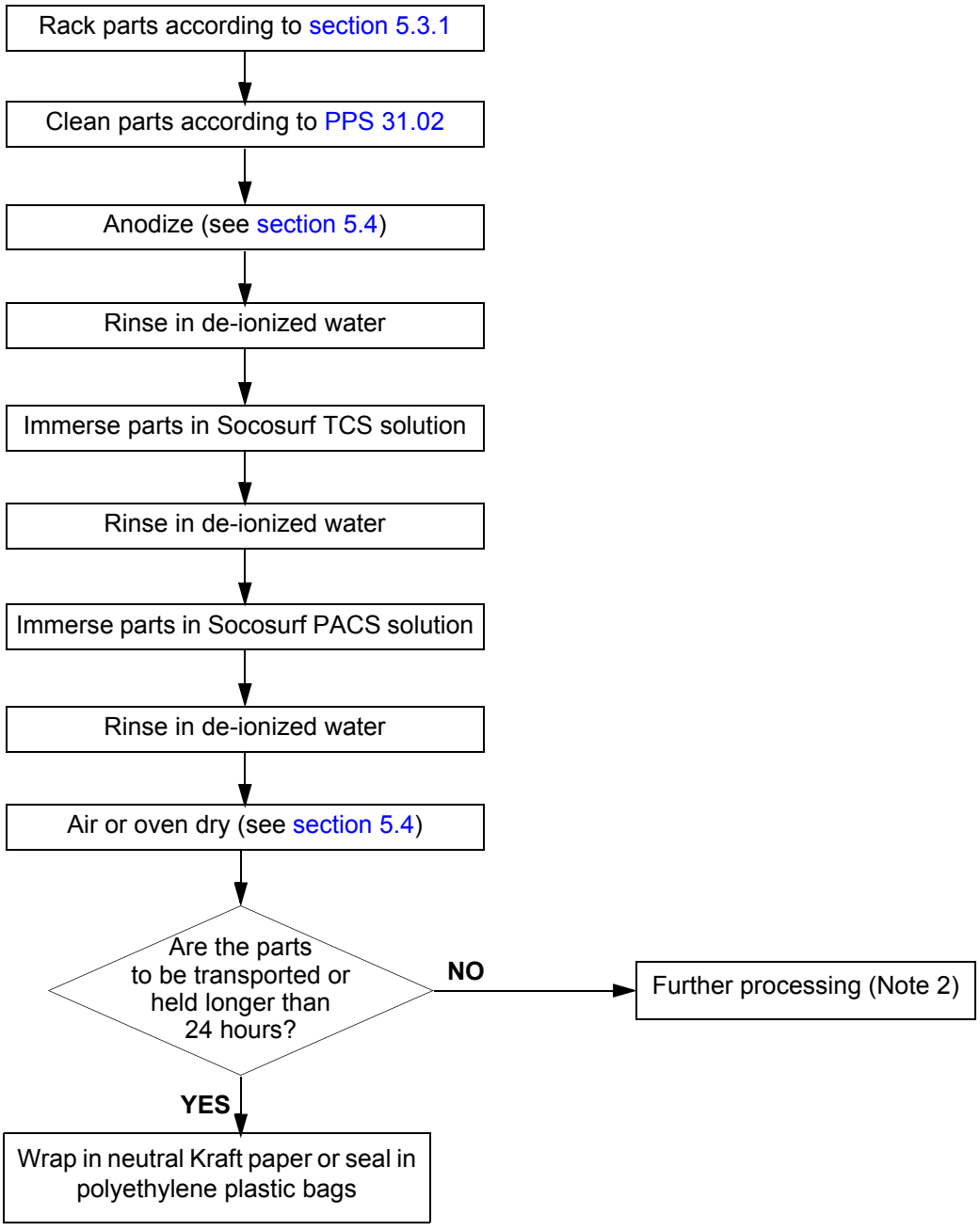
10.2 Keep the contact surfaces of the rack hook and anode rack clean and free from chemical residue.

10.3 Examine contact pads weekly and clean contact areas with aluminum wool or a brass wire brush.

10.4 Wipe electrical equipment weekly with a cloth to remove dust and grime.

10.5 Once every 6 months, the anodizing control unit (i.e., voltage ramp, anodizing voltage and cycle time control units) shall be calibrated.

FLOW CHART 1 - OVERALL PROCEDURE FOR A7 TFSAA PROCESSING



Note 1. Drain excess solution over the processing tank (approximately 1 minute) prior to immersion to the next solution tank to minimize solution cross contamination. However, do not allow parts to dry.

Note 2. Keep free from contamination and handle only with clean lint-free cotton gloves.