BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 32.35

PRODUCTION PROCESS STANDARD

CHEMICAL CONVERSION COATING FOR LOW ELECTRICAL RESISTANCE (C10)

Issue 13
- This standard supersedes PPS 32.35, Issue 12.
- 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.

- **THIS STANDARD SPECIFIES MANUFACTURING PROCESSES WHICH ARE CRITICAL TO THE LIGHTNING PROTECTION AND TRANSPORT CANADA CERTIFICATION OF BOMBARDIER AIRCRAFT.**
- **IT IS IMPERATIVE THAT THE PROCEDURE SPECIFIED HEREIN BE STRICTLY ADHERED TO.**
- **THE CURRENT ISSUE OF THIS PPS AND ANY SUBSEQUENT REVISIONS TO THE PROCEDURE AND REQUIREMENTS SPECIFIED HEREIN MUST BE AUTHORIZED BY AN UNDERSIGNED TRANSPORT CANADA DESIGN APPROVAL DESIGNEE (DAD).**

(P. Bootsma, DAD 212) October 23, 2018

Lightning/EMI/HIRF

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PPS Group

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Materials Technology

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Quality

Issue 13 - 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.

- Specified that compressed air utilized must meet BAERD GEN-023.
- Updated the following product name:
  - Oakite Chromicoat L-25 to Chemetall Chromicoat L-25
  - Bonderite M-CR 1200 to Bonderite M-CR 1200 Aero
  - Bonderite M-CR 1000 to Bonderite M-CR 1000L Aero
  - Deleted option of Alodine 1000
  - Alodine 1201 to Bonderite M-CR 1201 Aero
- Added option of AEMC Micro-Ohmmeter Model 6240
- Specified that solution make-up procedure is also applicable to top up of solution.
- Deleted the term “tap water” from solution make-up as any water is acceptable provided the water quality requirements are met (i.e., TDS).
- Specified to allow new Bonderite M-CR 1200 Aero solution to stand for at least 24 hours prior to use.
- Revised Bonderite M-CR 1200 Aero solution initial concentration make-up to 1.5 Kg/100 L in place of 18 g/L.
- Specified an extended solution control analysis base on consecutive successful 12 months testing (i.e., through SPC charts, etc.).
- Defined “room temperature” as 60 to 90°F.
- Specified to always use the oldest stock first (i.e., first in/first out (FIFO) basis).
- Specified that at Bombardier Toronto, dispose of chemical contaminated work clothes, rags, etc., into Red Containers labelled “Waste Rags”.

TABLE OF CONTENTS

Sections **Page**

Tables

Flow Charts

Figures

1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for chemical conversion coating of aluminum alloy surfaces for protection against corrosion where low electrical resistance is required.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS must 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.

1.2 Chemical conversion coating of aluminum alloys as specified in this PPS is identified as protective treatment code C10 according PPS 23.02. This coating meets the requirements of MIL-DTL-5541 Class 3.

2 HAZARDOUS MATERIALS

2.1 Before receipt at Bombardier Toronto, all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto Environment, Health and Safety Department. Refer to the manufacturer's MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact the Bombardier Toronto Environment, Health and Safety Department.

3 REFERENCES

3.1 ASTM B117 - Salt Spray (Fog) Testing.

3.2 ASTM D3359 - Standard Test Methods for Measuring Adhesion by Tape Test.

3.3 BAERD GEN-018 - Engineering Requirements for Laboratories.

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

3.5 DHLPM Procedure No. 3055 - Tape Adhesion Test for Organic Coatings.

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

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

3.8 MIL-DTL-5541 - Chemical Conversion Coatings on Aluminum and Aluminum Alloys.

3.9 MIL-DTL-81706B - Chemical Conversion Materials for Coating Aluminum and Aluminum Alloys.

3.10 PPS 13.13 - Personal Protective Respiratory Equipment.

3.11 PPS 13.26 - General Subcontractor Provisions.

3.12 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.13 PPS 23.02 - Protective Treatment and Decorative Surface Finish Code System.

3.14 PPS 24.02 - Ion Vapour Deposited Aluminum Coatings (M2).

3.15 PPS 25.50 - Use of DSC 233 RTV Silicone Adhesive/Sealant.

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

3.17 PPS 31.04 - Degreasing Processes.

3.18 PPS 31.17 - Solvent Usage.

3.19 PPS 34.03 - Application of Polyurethane Enamel (F24 & F37).

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

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

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Immersion Chemical Conversion Coating Solutions:

- Chromicoat L-25, Chemetall
- Bonderite M-CR 1200 Aero, Henkel Technologies

4.1.2 Manual Chemical Conversion Coating Solutions:

- Bonderite M-CR 1000L Aero, Henkel Technologies
- Bonderite M-CR 1132 Aero Pens, Henkel Technologies
- Bonderite M-CR 1201 Aero, Henkel Technologies

4.1.3 Nitric Acid, 40° or 42° Bé, O-N-350.

4.1.4 Protective wrapping, neutral Kraft paper.

4.1.5 Abrasive paper, aluminum oxide, 180 - 240 grit.

4.2 Equipment

4.2.1 General

4.2.1.1 Compressed air must meet the requirements of BAERD GEN-023.

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

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

4.2.1.4 Bombardier approved chemical splash goggles.

4.2.1.5 Spot facing tool (e.g., SD 8383).

4.2.1.6 Any of the following ohmmeters may be used, provided hardware and training is available:

- BCD M1 Milliohm meter.
- Megger digital low resistance ohmmeter (DLRO): DLRO 10 or DLRO 247001.
- SD 8778-1 10 amp constant current ohmmeter test set.
- Ducter Instruments / Megger Instruments BT51 digital low resistance ohmmeter.
- Ducter D203 Micro-Ohmmeter by Megger Instruments.
- HP 4328A milli-ohmmeter.
- HIOKI 3220 or 3540 milliohmmeter.
- Eaton Corp. model 584 resistance tester.
- Eutron S.A.S. micro-ohmmeter BVM 3-10.
- AOIP Measures OM 21-1 ohmmeter.
- AEMC Micro-Ohmmeter, Model 5600, Model 6240 or Model 6250.

4.2.2 Immersion Chemical Conversion Coating

4.2.2.1 Immersion tanks resistant to the chemicals and to the operating temperatures used (e.g., stainless steel or polyethylene lined mild steel).

4.2.3 Manual Chemical Conversion Coating

4.2.3.1 Foam tip applicator, 1 or 2 fl. oz. plastic bottle with foam tip (18 mm, Dab-O-Matic #W/D-119-82) and polypropylene cap (Dab-O-Matic #18/400).

4.2.3.2 Acid resistant mixing containers of stainless steel, plastic, rubbers or wood. Do not use lead, glass or galvanized iron.

4.2.3.3 Polyethylene squeeze bottles or plunger-type containers which have been properly labelled with the solution name and expiry date.

4.2.3.4 Abrasive pads (e.g., Scotch-Brite pads, Medium, Fine or Very Fine, 3M Canada Ltd.).

4.2.3.5 Abrasive paper, aluminum oxide, 180 - 240 grit or finer (e.g., 3M TRI-M-ITE).

4.2.3.6 Spot facing tool (e.g., SD 8383).

4.2.3.7 Clean lint-free cotton wipers (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 chemical conversion coating of aluminum alloy surfaces for protection against corrosion where low electrical resistance is required according to this PPS.

4.3.2 Bombardier subcontractors must direct requests for approval to Bombardier Aerospace Supplier Quality Management. Bombardier Aerospace facilities must direct requests for approval to the appropriate internal Quality Manager.

4.3.3 Facility approval must be based on a facility report, a facility survey and completion of a qualification test program, if required. The facility report must 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 must 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 must 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 chemical conversion coating of aluminum alloy surfaces for protection against corrosion where low electrical resistance is required according to this PPS, completion of a test program and submission of suitable test samples representative of production parts is required. Test samples must meet the requirements specified in section 6.

4.3.3.2 All testing and evaluation specified herein must 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 term “MRB” (Material Review Board) must be considered to include Bombardier Toronto MRB and Bombardier Toronto delegated MRB.

5.2 Application of Chemical Conversion Coating By Immersion (see Flow Chart 2)

5.2.1 General

5.2.1.1 Immersion chemical conversion coating may be performed using any of the baths specified in Table I.

5.2.1.2 Except as noted, only process aluminum alloys or alloys with aluminum coatings through these tanks. For assemblies which may entrap solution, apply chemical conversion coating manually according to section 5.3. DSC 233-1 silicone adhesive may be applied to tubes according to PPS 25.50 before chemical conversion coating according to this PPS.

5.2.2 Preparation of Solutions

5.2.2.1 Make-up a new or top up C10 immersion chemical conversion solutions using the following procedure:

Step 1. Half-fill the **remaining** operating volume of the tank with clean water (if possible, retain 1/4 of the previous bath when preparing a new bath). Check incoming water to ensure it does not contain more than 350 ppm (550 µS/cm at 77 ±10°F) of total dissolved solids (TDS). If the water TDS exceeds the specified limits, soften the water (i.e., reduce the amount of dissolved solids) or use de-ionized water. Each time a new bath is made up, or renewed, analyze the incoming water.

Step 2. Add the required amount of chemicals specified in Table I. Do not add dry powder to the bath, mix powders into a slurry with water before adding the slurry to the bath.

Step 3. Fill the tank to operating level with water and mix until the chemicals are thoroughly blended.

Step 4. Analyse a sample of the tank to ensure the concentration requirements of Table IV are met. If necessary, add the required chemical to the bath. Mix thoroughly and re-test the solution after every addition.

5.2.2.2 Prepare water rinse tanks by filling the tank to operating level with cold water. Incoming water must not contain more than 350 ppm (550 µS/cm at 77 ±10°F) of TDS. If the water TDS exceeds the specified limits, soften the water (i.e., reduce the amount of dissolved solids) or use de-ionized water. Equip the tank with an inlet and an outlet to allow fresh tap water to be added to the tank, as required, to maintain the control limits according to Table IV.

5.2.2.3 Prepare the warm de-ionized water rinse tank by filling the tank to the operating level with de-ionized water. Maintain the bath temperature between 110°F and 130°F. Equip the bath with an inlet and an outlet to allow fresh de-ionized water to be added to the bath, as required, to maintain the control limits according to Table IV.

TABLE I - MAKE-UP OF IMMERSION SOLUTIONS

SOLUTION (Note 2)	BATH MAKE-UP (NOTE 1)			OPERATING TEMPERATURE	IMMERSION TIME
	IMPERIAL UNIT	METRIC UNIT	U.S. UNIT		
Chromicoat L25	5 gal/100 gal_{IMP}	5 L/100 L	5 gal/100 gal_{US}	80 to 120°F	35 to 45 seconds
Bonderite M-CR 1200 Aero (Note 3)	15.0 lbs/100 gal_{IMP}	1.5 Kg/100 L	12.5 lbs/100 gal_{US}	60 to 90°F	60 to 90 seconds

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. The tank material must be resistant to the chemicals and to the operating temperatures used (e.g., stainless steel or polyethylene lined mild steel).
Note 3. Allow the solution to stand for at least 24 hours before use.

5.2.3 Preparation of Parts for Immersion Chemical Conversion Coating

5.2.3.1 Except for Type II ion vapour deposited (IVD) coated aluminum parts, clean aluminum parts according to PPS 31.02. Process parts in a continuous sequence.

5.2.3.2 If possible, apply chemical conversion coat to Type II IVD aluminum coated parts within 48 hours of application of Type II IVD aluminum coating. If conversion coating is not performed immediately following application of Type II IVD aluminum coating, protect such parts from contamination by wrapping with Kraft paper. If the delay between application of Type II IVD aluminum coating and chemical conversion coating exceeds 48 hours, degrease the parts according to PPS 31.04 followed by alkaline clean according to PPS 31.02 before chemical conversion coating.

5.2.3.3 Mask any bare areas on Type II IVD aluminum coated parts to prevent acid exposure during conversion coating. If masking of these areas is not possible, conversion coat the parts manually according to section 5.3.

5.2.3.4 Mask dissimilar metal inserts before applying chemical conversion solution.

5.2.4 Chemical Conversion Coating By Immersion

5.2.4.1 Apply the chemical conversion coating as follows:

Step 1. Prepare parts according to section 5.2.3.

Step 2. Immerse the cleaned parts in one of the baths specified in Table I for the time specified. The immersion time must begin once the parts are fully immersed in the solution.

Step 3. Remove the parts from the bath and allow it to drain above the bath for 30 to 60 seconds.

Step 4. Thoroughly rinse the parts in the water rinse tank for approximately 60 seconds. Parts may be rinsed by either immersion or spray rinsing. If spray rinsing, incoming water shall meet the requirements specified in paragraph 5.2.2.2. Ensure complete removal of chemical conversion treatment solution. If it is intended that this be the final rinse (i.e., if omitting the warm de-ionized water rinse specified in Step 5), it is recommended that warm (100 - 130°F) tap water be used to aid drying of parts

Step 5. Remove the parts and rinse thoroughly in the warm de-ionized water rinse for approximately 60 seconds. This de-ionized water rinse may be omitted if the tap water rinse that preceded has completely removed all trace of the conversion treatment solution.

Step 6. Remove the parts from the final rinse tank and allow parts to dry.

Step 7. Test chemical conversion coated surface for consistent electrical conductivity according to section 5.3.6.

5.3 Manual Application of Chemical Conversion Coating

5.3.1 General

5.3.1.1 Manually apply chemical conversion coating solution **only** if application of the solution by immersion is not permitted due to the part's size or the assemblies' potential for solution entrapment.

5.3.1.2 Except as specified in paragraph 5.3.1.2.1, touch-up small surfaces (i.e., spotfacing, countersinks, repair areas, etc.) with conversion coating chemicals according to section 5.3.4. Manually apply the coating to larger areas according to section 5.3.5.

5.3.1.2.1 Use Bonderite M-CR 1132 Aero Pens for touch-up of chemical conversion coating on aluminum or aluminum coated parts only. Due to difficulties associated with puddling of the Bonderite M-CR 1132 Aero Pens when applied to small areas, the Bonderite M-CR 1132 Aero Pen is not recommended on small surfaces less than half a square inch where low electrical resistance of < 2.5 milliohms is required.

5.3.1.2.2 Where low electrical resistance of < 2.5 milliohms is required, the Bonderite M-CR 1132 Aero Pen coating must be light to moderate. Heavy coatings or puddling will result in high electrical resistance and failure of the applicable electrical bonding Functional Test Procedures (FTP).

5.3.1.3 If the assemblies contain materials other than aluminum, take extreme care when processing these assemblies because the chemical conversion coating solution may cause corrosion.

5.3.1.4 Ensure part surface temperature is between 60°F and 100°F when applying chemical conversion coating solution.

5.3.1.5 Wear clean protective gloves when handling cleaned parts for manual conversion coating.

5.3.1.6 Water utilize in the manual chemical conversion coating process (e.g., rinse) should not exceed a conductivity limit of 600 µmhos and the pH must be from 5.0 to 8.0.

5.3.2 Preparation and Maintenance of Manual Chemical Conversion Coating Solutions

5.3.2.1 Prepare manual chemical conversion coating for manual application according to Table II.

5.3.2.2 For Bonderite M-CR 1000L Aero, mix only sufficient solution for the job on hand or which will be used up within the specified working life of the solution (i.e., 7 days in a closed container). Discard solution upon expiration of the working life according to section 10.4.

TABLE II - CONTROL OF MANUAL CHEMICAL CONVERSION COATING SOLUTIONS

SOLUTION (See Note 1)	CHEMICAL CONCENTRATION			pH	DWELL TIME
	IMPERIAL UNIT	METRIC UNIT	U.S. UNIT		
Bonderite M-CR 1000L Aero (Notes 2 & 3)	0.6 wt oz/gal$_{IMP}$	3.75 g/L	0.5 wt oz/gal$_{US}$	< 4.5	See Note 4
Bonderite M-CR 1132 Aero Pens	Use as supplied				See Note 5
Bonderite M-CR 1201 Aero	Use as supplied				2 to 3 minutes

Note 1. Maintain solutions at 60 to 90°F.
Note 2. Allow the solution to stand for at least one hour before use.
Note 3. Mix only sufficient solution for the job on hand or which will be used up within the specified working life of the solution. The mixed solution has a working life of 7 days (i.e., 7 days from the date the solution was made-up) in a closed container.
Note 4. The dwell time is 30 seconds less than the time required to produce a colour change. Determine the time to produce a colour change by processing a test piece.
Note 5. The time must be that required to dry each coat (approximately 5 minutes).

5.3.3 Preparation of Parts for Manual Chemical Conversion Coating

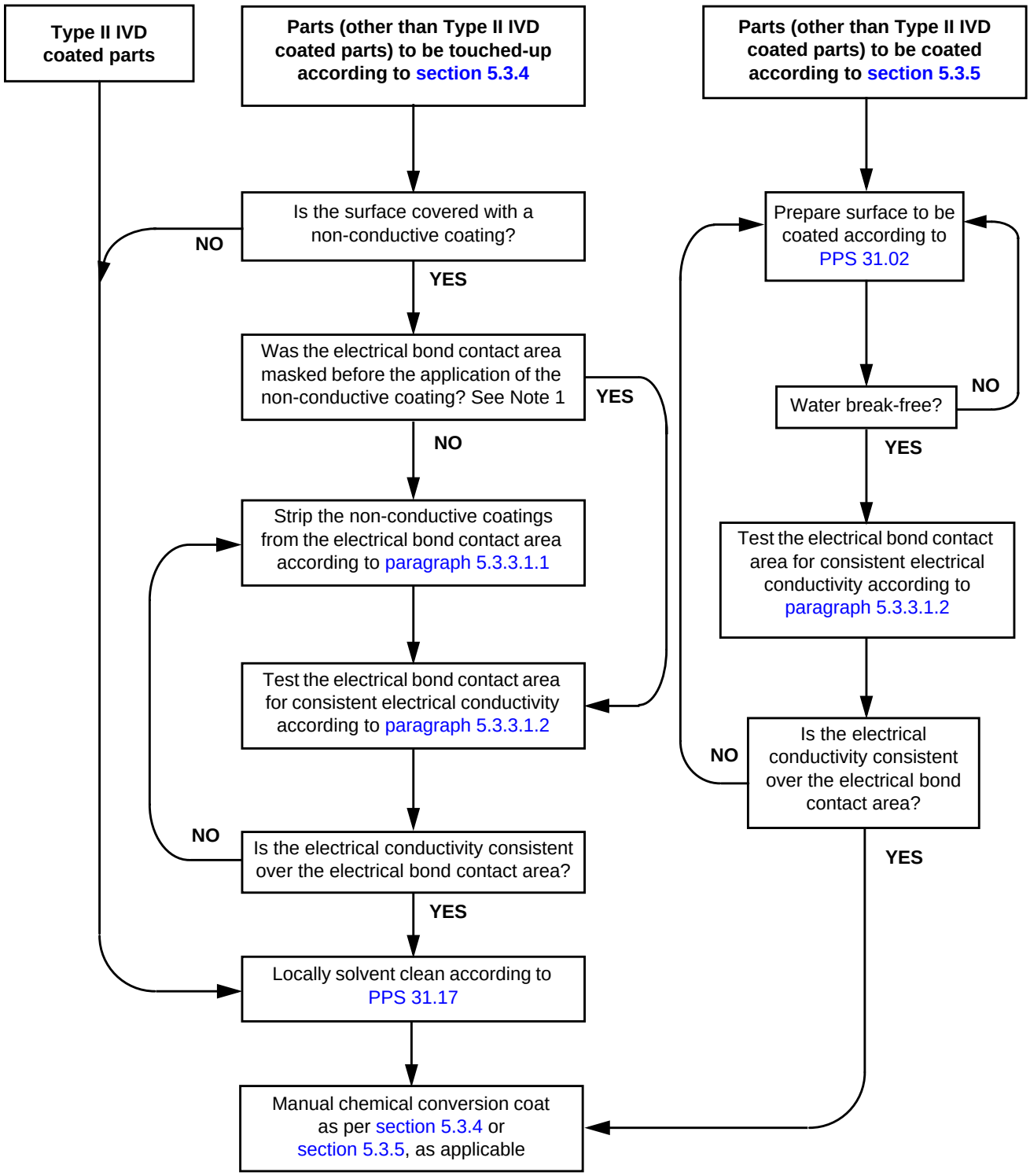
5.3.3.1 Prepare parts for manual chemical conversion coating according to Flow Chart 1.

5.3.3.1.1 Mechanically remove non-conductive coatings (i.e., oxides, anodic films, dichromate treatment, paint, primer, etc.) by hand abrading with abrasive paper. It is acceptable to use a spot facing tool (see paragraph 4.2.1.5) to remove the bulk of the non-conductive coating provided that final removal is performed by hand abrading. Take care at all times when using a spot facing tool or abrasive paper to remove only the non-conductive coating and avoid damaging the substrate. Keep the amount of metal removed during mechanical non-conductive coating removal to a minimum. Do not remove engineering drawing specified protective coating from metal surfaces (i.e., plating, cladding, etc.). If such protective coating has been removed, refer to MRB for disposition. After mechanically abrading the surface, use a tack rag to remove any dust or adhering particles. Chemical conversion coat as specified herein within 8 hours of removal of non-conductive coatings.

5.3.3.1.2 In areas where non-conductive coatings have been removed, verify that the electrical conductivity is consistent over the electrical bond contact area by placing both probes of an approved ohmmeter (see paragraph 4.2.1.6) on the stripped surface and measuring the resistance. The resistance between the two points should be no more than 2.5 milliohms. Check the electrical conductivity between several random pairs of points within the electrical bond contact area to ensure consistency. If the electrical conductivity is not consistent over the electrical bond contact area, remove the non-conductive coating according to paragraph 5.3.3.1.1 (parts to be touched-up according to section 5.3.4) or PPS 31.02 (parts to be coated according to section 5.3.5) and re-test the area.

5.3.3.1.3 Process parts in a continuous sequence.

FLOW CHART 1 - SURFACE PREPARATION SEQUENCE FOR MANUAL APPLICATION



Note 1. If possible, mask electrical bond contact area before the application of non-conductive coatings (e.g., paint, primer, etc.). This will avoid the possibility of removal of metal protective coating when mechanically cleaning according to paragraph 5.3.3.1.1.

5.3.4 Touch-Up Chemical Conversion Coating

5.3.4.1 When using Bonderite M-CR 1201 Aero or Bonderite M-CR 1000L Aero, touch-up parts with small surface areas with chemical conversion coating solution as follows:

Step 1. Prepare parts according to section 5.3.3.

Step 2. Check to ensure surface is water break-free (see Figure 1). Wipe surface with a clean lint-free cotton cloth to ensure complete removal of dislodged oxides.

Step 3. Check to ensure that the surface to be coated is dry.

Step 4. Apply Bonderite M-CR 1201 Aero or Bonderite M-CR 1000L Aero chemical conversion coating solution to the prepared surface using a pencil brush, small abrasive pad or foam tip applicator to fully cover the applicable area. Prevent excess solution from dripping onto the surrounding structure.

Step 5. Allow the solution to remain on the part surface for the time specified in Table II before washing off. Do not allow the solution to dry on the surface. Maintain a continuous wet surface. If drying does occur, re-wet the surface with solution before water rinsing.

Step 6. Remove all traces of solution by rinsing with clean water (see paragraph 5.3.1.6) or wiping with water-dampen cloths followed by wiping dry with clean lint-free cloth or blowing dry with clean oil-free compressed air.

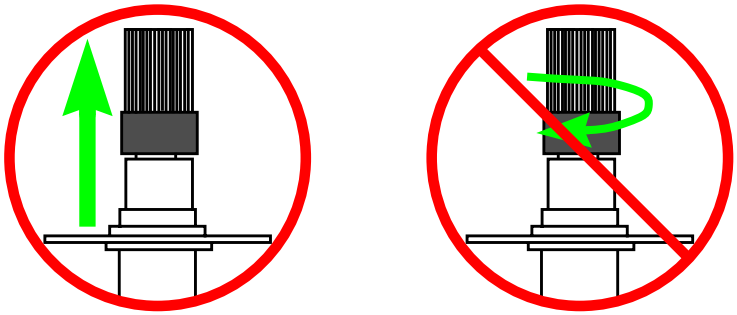
Step 7. Test chemical conversion coated surface for consistent electrical conductivity according to section 5.3.6.

5.3.4.2 If using Bonderite M-CR 1132 Aero Pens, touch-up parts with small surface areas as follows. Due to difficulties associated with puddling of the Bonderite M-CR 1132 Aero Pens when applied to small areas, Bonderite M-CR 1132 Aero Pen is not recommended on small surfaces less than half a square inch where low electrical resistance of < 2.5 milliohms is required (see paragraph 5.3.1.2.2). For such surfaces, touch-up according to paragraph 5.3.4.1.

Step 1. Prepare parts according to section 5.3.3.

Step 2. Check to ensure surface is water break-free (see Figure 1). Wipe surface with a clean lint-free cotton cloth to ensure complete removal of dislodged oxides.

Step 3. Remove protective cap. Do not twist.



Step 4. If necessary, the applicator tip can be cut to conform to any shape with a single edge razor blade.

Step 5. Hold unit with applicator tip down.

Step 6. To activate, press tip against a firm, clean test surface. This will open the valve allowing Bonderite M-CR 1132 Aero solution to reach the applicator tip. A new unit should charge in 30 to 45 seconds. When the solution wets the tip, release pressure. Unit is ready to use.

Step 7. Check to ensure that the surface to be coated is dry.

Step 8. Remove excess solution from the applicator tip by wiping excess off onto a solvent cleaned metal test piece or a clean lint-free cloth. The applicator tip should not be dripping or wet. The applicator tip should be damp to avoid pooling of solution or excessive amount of coating applied. Application should result in an even light coating.

Step 9. Apply Bonderite M-CR 1132 Aero Pens to the prepared surface with firm, smooth, even strokes. Be sure to cover edges. For best results, the initial coating should be applied in one direction using a 10 to 25% overlap on each pass. After allowing the first coat to dry for approximately 5 minutes, apply a second coat at right angles to the first coat with a 10 to 25% overlap. Do not allow the solution to puddle (puddling may result in improper drying leading to paint adhesion failures, flaking, etc.). If puddling does occur, lightly wick solution off the surface with a clean lint-free cotton cloth to remove excess solution, but do not touch the treated surface. Do not wipe surface to remove excess solution. Do not use “Q-Tips” to remove excess solution as residue chloride may react with the chemical conversion coating solution. To recharge the applicator tip, repeat Step 6 and Step 8. Replace cap when not in use.

Step 10. Allow the chemical conversion coating to air dry, force dry with warm air (e.g., hair dryer) or dry using a heat lamp (130°F maximum). ***Do not rinse***.

Step 11. Test chemical conversion coated surface for consistent electrical conductivity according to section 5.3.6.

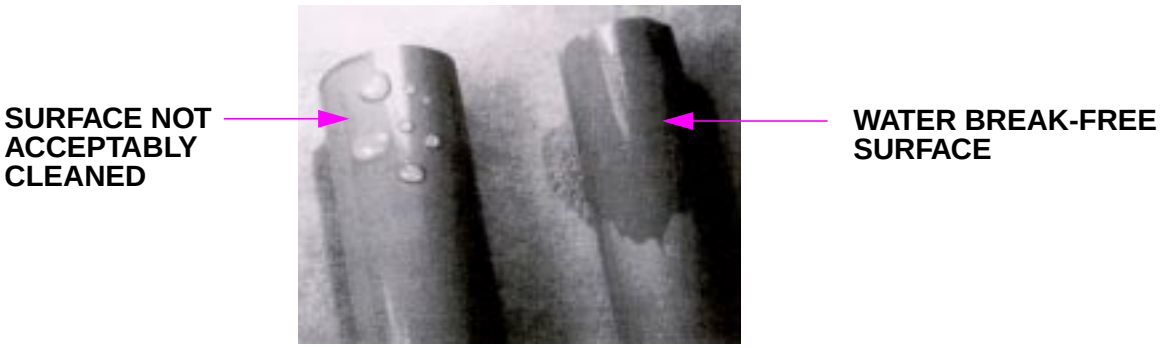


FIGURE 1 - WATER BREAK-FREE SURFACE

5.3.5 Manual Application of Chemical Conversion Coating

5.3.5.1 When using Bonderite M-CR 1000 Aero, apply chemical conversion coating solution to larger surface area of cleaned parts as follows:

Step 1. Prepare parts according to section 5.3.3.

Step 2. Check to ensure surface is water break-free (see Figure 1). Wipe surface with a clean lint-free cotton cloth to ensure complete removal of dislodged oxides.

Step 3. Apply chemical conversion coating solution to the surface from storage bottles using a clean cloth, brush or sponge. Maintain a continuous wet surface. Prevent excess solution from dripping onto the surrounding structure.

Step 4. Allow the solution to remain on the part surface for the time specified in Table II before washing off. Do not allow the solution to dry on the surface. If drying does occur, re-wet the surface with solution before water rinsing.

Step 5. Gently wipe all surfaces with a clean cloth soaked in the conversion coating solution just before rinsing.

Step 6. Rinse parts thoroughly with clean water (see paragraph 5.3.1.6). Chemical salts trapped under a paint film will eventually result in blistering or corrosion problems.

Step 7. Wipe all part surfaces dry using a clean lint-free cloth. Use clean oil-free compressed air to blow dry treated surfaces such as lap joints, seams, pockets, etc.

Step 8. Carefully inspect all treated surfaces and if necessary, re-apply the solution to bare or starved areas according to steps 1 through 5 in order to get the desired coating thickness. Ensure that the coating is not powdery.

Step 9. Test chemical conversion coated surface for consistent electrical conductivity according to section 5.3.6.

Step 10. If applicable, prime parts as soon as possible after drying. Allow applied chemical conversion coating to dry for approximately 4 hours before priming.

5.3.6 Testing of Chemical Conversion Coated Surfaces for Electrical Conductivity

5.3.6.1 Verify that the electrical conductivity is consistent over the electrical bond contact area by placing both probes of an approved ohmmeter (see paragraph 4.2.1.6) on the chemical conversion coated surface and measuring the resistance. The resistance between the two points should be no more than 5 milliohms.

5.3.6.2 Check the electrical conductivity between several random pairs of points within the electrical bond contact area to ensure consistency.

5.3.6.3 If the electrical conductivity is not consistent over the electrical bond contact area, action according to paragraph 6.2.1.1.

5.4 Stripping Chemical Conversion Coatings

5.4.1 If required, strip chemical conversion coatings according to PPS 31.02.

5.4.2 When immersion stripping according to PPS 31.02 is impractical or when minor localized stripping is required, hand abrade with an abrasive pad to remove the conductive conversion coating and obtain a water break-free surface.

6 REQUIREMENTS

6.1 Process Qualification

6.1.1 Test Panels for Qualification Testing

6.1.1.1 For process qualification, manual and/or immersion applications, process test panels through the full chemical conversion coating process (conversion coat all surfaces of the test panels) and submit for visual inspection, corrosion resistance testing, electrical resistance testing and paint adhesion testing as specified in Table III.

6.1.1.1.1 Separate panels are required for manual and immersion application. One set of test panels are required for each solution qualification. If a facility will only be applying C10 coating manually, then immersion qualification panels are not required.

6.1.1.2 Process qualification test panels must be submitted to a laboratory as specified in paragraph 4.3.3.2. Additional tests may be requested at any time at the discretion of Bombardier.

TABLE III - PROCESS QUALIFICATION TESTING REQUIREMENTS

<table>
<tr><th>TEST</th><th>TESTING PROCEDURE (NOTE 1)</th><th>TEST SPECIMENS</th><th>NUMBER OF PANELS</th></tr>
<tr><td>Visual Inspection</td><td>According to section 6.2.1</td><td colspan="2">Examine panels submitted for corrosion resistance and paint adhesion testing as specified below</td></tr>
<tr><td>Corrosion Resistance</td><td>According to paragraph 6.2.2.2</td><td rowspan="3">LAB 064-7 or MIL-DTL-5541 (0.032" thick minimum)</td><td rowspan="3">5</td></tr>
<tr><td>Electrical Contact Resistance Without Salt Spray Exposure</td><td rowspan="2">According to section 6.1.2</td></tr>
<tr><td>Electrical Contact Resistance After Salt Spray Exposure</td></tr>
<tr><td>Paint Adhesion</td><td>According to paragraph 6.2.2.3</td><td>LAB 066-1 or MIL-DTL-5541 (0.032" thick minimum)</td><td>2</td></tr>
<tr><td colspan="4">Note 1. Refer to the appropriate sections for details regarding test requirements.</td></tr>
</table>

6.1.2 Electrical Resistance Testing

6.1.2.1 Corrosion resistance test panels prepared as specified in paragraph 6.1.1.1 must have the contact electrical resistance of the coating determined for conformance to paragraph 6.1.2.1.1. Test equipment and circuitry as shown in Figure 2 and Figure 3 must be used for measuring the electrical resistance. The applied load must be within one percent of the calculated 200 psi applied pressure. The contacting electrodes must be copper or silver-plated copper with a finish not rougher than that obtained by the use of 000 metallographic abrasive paper. The electrodes must be flat enough so that when the load is applied without a specimen between them, light will not be visible through the contacting surface. The area of the upper electrode must be one square inch and the area of the lower electrodes must be larger. Ten measurements must be made on each panel in the areas shown in Figure 4.

6.1.2.1.1 When tested as specified herein, the contact electrical resistance of the panels under an applied electrode pressure of 200 psi must be not greater than 5 milliohms per square inch as applied and 10 milliohms per square inch after corrosion resistance testing according to paragraph 6.2.2.2. Individual readings not greater than 20 percent in excess of the specified maximums must be acceptable, provided that the average of all readings does not exceed the specified maximum resistance.

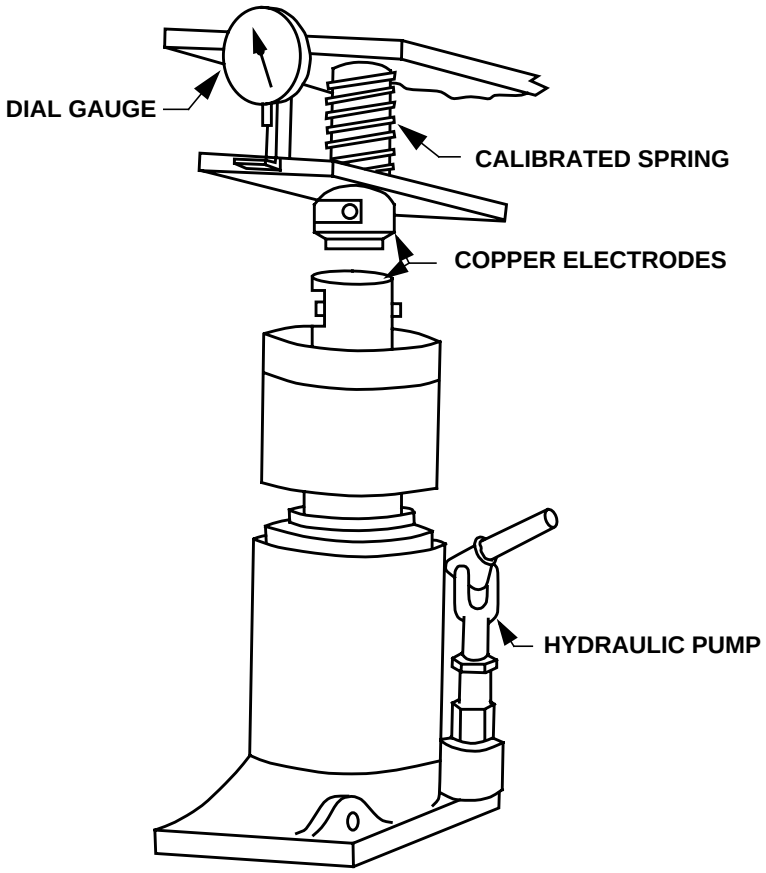


FIGURE 2 - EQUIPMENT FOR MEASURING ELECTRICAL RESISTANCE OF CHEMICAL FILM

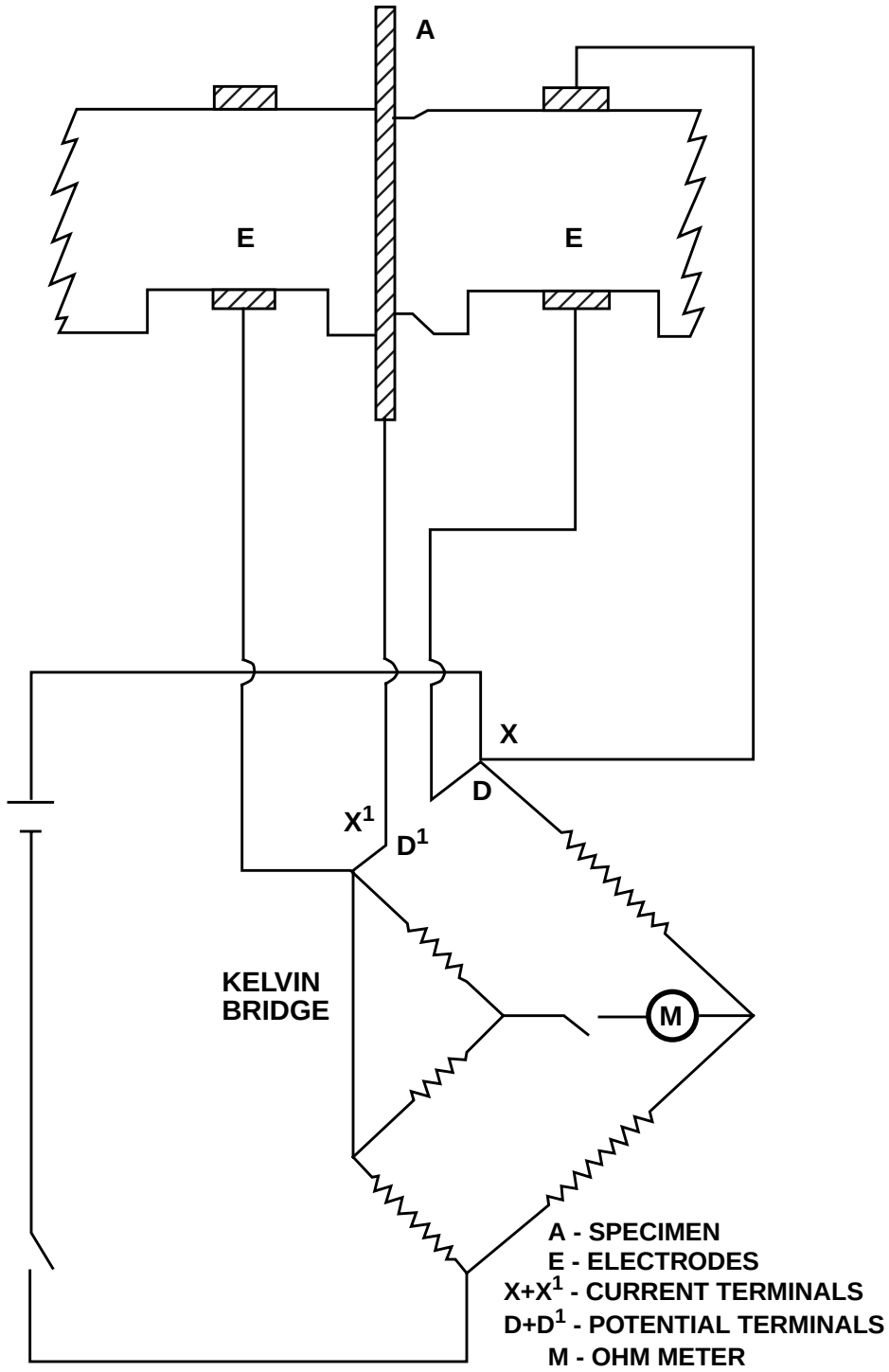


FIGURE 3 - CIRCUIT DIAGRAM FOR CONTACT RESISTANCE MEASUREMENTS

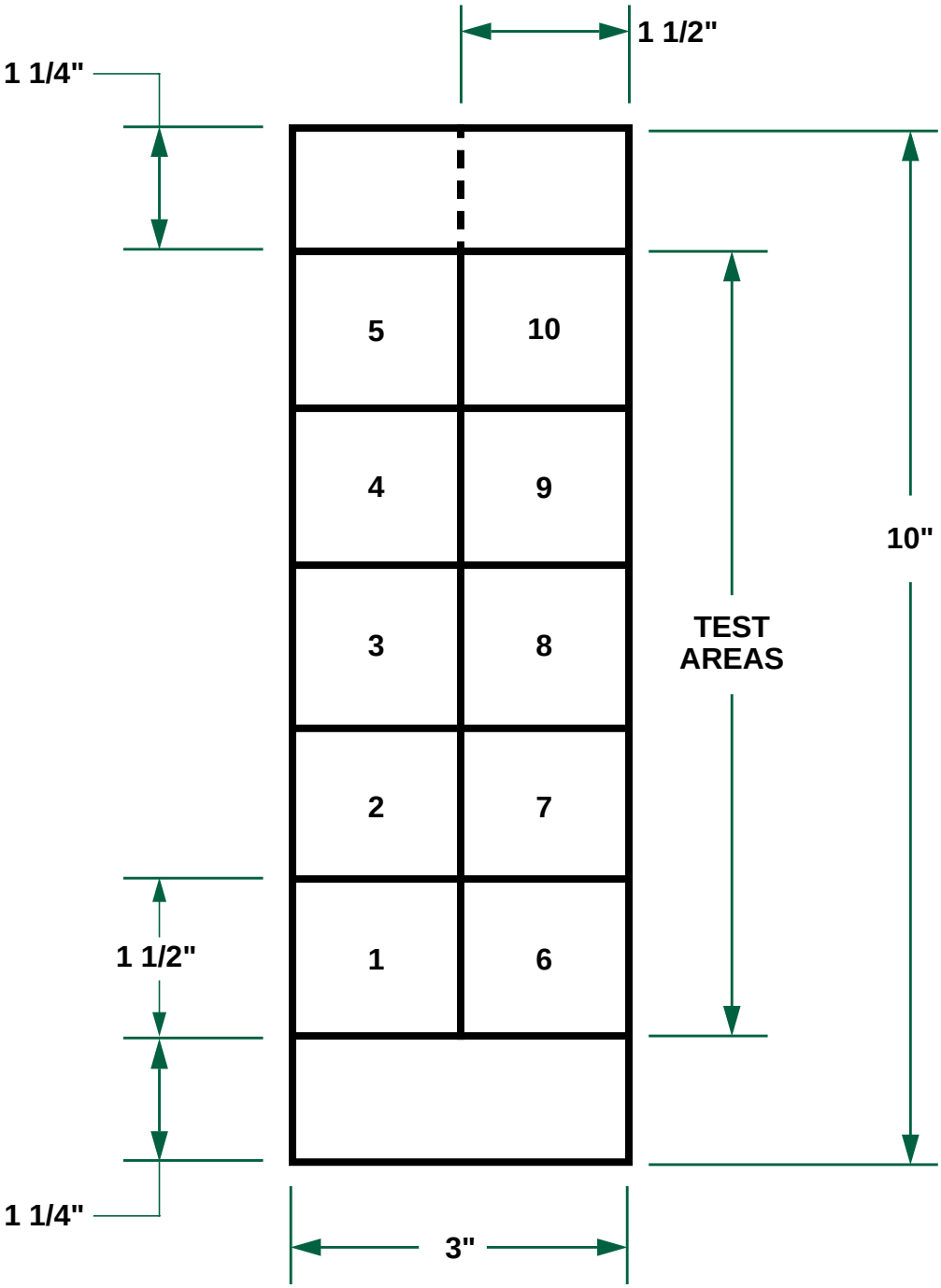


FIGURE 4 - AREAS OF MEASUREMENTS OF ELECTRICAL RESISTANCE ON TREATED PANELS

6.2 Production Parts

6.2.1 Visual Inspection

6.2.1.1 Conversion coating on production parts must be continuous (i.e., the treated surfaces must be free from bare or starved areas) and free from powder, imperfections and excessive blotches. If a coating fails to meet the requirements after initial processing, remove the coating by one of the following methods before reprocessing and re-inspecting the parts:

- according to paragraph 5.3.3.1.1 (for parts to be touched-up according to section 5.3.4)
- according to PPS 31.02 (for parts to be coated according to section 5.3.5)
- according to section 5.4 (for parts to be immersion coated according to section 5.2)

If a coating fails to meet the requirements a second time after having already been stripped and re-processed once, determine the cause of failure and correct before stripping, re-processing and re-inspecting. If a coating fails to meet the requirements a third time after having already been stripped and re-processed twice, refer the part to MRB for disposition.

6.2.2 Test Panels for Immersion Chemical Conversion Coating

6.2.2.1 Process test panels through the conversion coating cycle for corrosion resistance and paint adhesion testing as specified in paragraph 6.2.2.2 and paragraph 6.2.2.3 at least once a month. Maintain records of all test results. All testing must be performed by a laboratory as specified in paragraph 4.3.3.2.

6.2.2.2 For corrosion resistance testing, expose 5 LAB 064-7 test panels or 5 test panels meeting the requirements of MIL-DTL-5541 (0.032" thick minimum) to a 5% salt spray according to ASTM B117 or DHLPM Procedure No. 6011, except the test surface must be inclined 6° from the vertical. Expose the panels for 168 hours and examine them for corrosive attack. Evidence of corrosive attack exceeding the following specified limits is not acceptable:

- There must 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 must 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).

6.2.2.3 Subject two chemically converted LAB 066-1 test panels or test panels meeting the requirements of MIL-DTL-5541 (0.032" thick minimum) to wet tape adhesion testing 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 and cure for 7 days at room temperature (60 to 90°F).

Step 2. Immerse the test panels in de-ionized water for 24 hours.

Step 3. Wipe dry and within 5 minutes test for adhesion of the F19 primer according to DHLPM Procedure No. 3055 Method III, Class 3, or ASTM D3359 Method B. The coating must have a minimum adhesion level of 3B.

6.2.2.4 If any of the test specimens fail to meet the corrosion resistance or paint adhesion requirements, suspend the conversion coating process, establish the cause of the failure and take corrective action before re-testing as specified herein. Refer any lots processed with unacceptable test panels to MRB for disposition.

7 SAFETY PRECAUTIONS

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

7.2 Wear protective rubber or neoprene gloves (see paragraph 4.2.1.3), aprons and boots and Bombardier approved chemical splash goggles while carrying out chemical conversion coating operations.

7.3 Ensure adequate ventilation is supplied to the areas where the chemical conversion coating process is being carried out. Avoid breathing the fumes or vapours during application.

7.4 Take care to prevent the powder from being distributed into the air. Air borne powder is a serious health hazard. Wear protective respiratory equipment according to PPS 13.13 when handling conversion coating chemicals.

7.5 Avoid skin contact with chemical conversion coating. If skin contact occurs, wash the affected area immediately with large quantities of water. If irritation of the skin occurs, contact the Health Centre immediately.

7.6 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.

7.7 Avoid ingestion of chemicals or solutions. If ingestion occurs, do not induce vomiting. Drink large amounts of water or milk of magnesia, but never give anything by mouth to an unconscious person. Immediately contact the Health Centre and a physician.

7.8 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 additional personnel requirements. Certified and/or qualified personnel must have a good working knowledge of the following, as applicable:

- function of chemical conversion coating
- importance of proper solution preparation and control
- requirements of surface cleaning, pre-treatment, and the effects of improperly cleaned part surfaces on the performance of the coating
- methods of applying conversion coatings
- restrictions on various alloys with reference to this process
- theory behind the coating application procedure
- material and part handling requirements
- how to use all processing parameter controls to produce acceptable production parts
- relevant safety equipment and precautions
- engineering drawing notations regarding chemical conversion coatings
- procedure and requirements for the preparation of surfaces for chemical conversion coatings
- how to process production parts
- how to use the digital low resistance ohmmeter specified in paragraph 4.2.1.6 to carry out electrical conductivity testing according to paragraph 5.3.3.1.2 and section 5.3.6
- how to identify and process required test specimens
- Engineering requirements for immersion chemical conversion coating appearance, paint adhesion properties, and corrosion resistance and how these properties are evaluated and measured
- how to identify processed test specimens
- requirements specified in this PPS and the references
- operation of the complete process line and the function of the individual process tanks
- proper part racking procedures and crane operation
- operation of the individual process tanks involved in this process

9 MAINTENANCE OF SOLUTIONS

9.1 Once weekly, take samples of the immersion conversion coating bath, warm de-ionized water rinse and tap water rinse for chemical analysis. Ensure that the solutions are thoroughly mixed immediately before taking samples. Verify that the solutions meet the requirements specified in Table IV.

TABLE IV - CONTROL OF SOLUTIONS FOR IMMERSION PROCESS

SOLUTION	CONTROL LIMITS						ANALYSIS FREQUENCY (NOTE 1)
	CONCENTRATION			pH	TEMPERATURE	CONDUCTIVITY	
	IMPERIAL UNIT	METRIC UNIT	U.S. UNIT				
IMMERSION CHEMICAL CONVERSION COATINGS (NOTE 2)							
Chromicoat L-25	4.8 - 8.0 fl oz./gal$_{IMP}$	31 - 50 mL/L	4.0 - 6.6 fl oz./gal$_{US}$	1.6 - 1.8	80 - 120°F	—	Standard: Weekly Extended: Monthly
Bonderite M-CR 1200 Aero	2.6 -3.2 wt oz/gal$_{IMP}$	16 - 20 g/L	2.1 - 2.6 wt oz/gal$_{US}$	1.5 - 2.1	60 - 90°F	—	
RINSE WATER							
Tap Water Rinse Tank	—	—	—	5.0 - 8.0	70 - 90°F	2000 µ-mhos maximum	Standard: Weekly Extended: Monthly
Warm Tap Water Rinse Tank	—	—	—	5.0 - 8.0	100 - 130°F	2000 µ-mhos maximum	
De-ionized Water Rinse	—	—	—	5.0 - 8.0	110 - 130°F	600 µ-mhos maximum	

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. Nitric acid (see paragraph 4.1.3) may be added to the bath, as required, to lower the pH levels to the range specified.

9.2 When the conversion coating bath’s effectiveness is reduced, keep 1/4 of the old solution and make up the remaining volume according to section 5.2.2.

9.3 If the conversion coating bath becomes too contaminated, dispose of the coating solution according to section 10.4, clean the tank thoroughly and a make a fresh bath according to section 5.2.2.

9.4 Prepare and maintain records of all solution tests (e.g., 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.

10 ADDITIONAL INFORMATION

10.1 Handling of Processed Parts

10.1.1 Do not handle treated surfaces within one hour of removal from the chemical solution or while the parts are still wet. Handle parts only with clean lint-free cotton gloves.

10.1.2 Allow chemical conversion coating to dry at room temperature for approximately 4 hours before priming.

10.1.3 Allow chemical conversion coating to dry at room temperature for approximately 8 to 24 hours before further working the part.

10.1.4 For parts to be transported for further processing or to be held for more than 24 hours, wrap the parts completely or interlace with Kraft paper to ensure that the conversion coated surfaces are not exposed to contamination. Coated parts that are to be primed within 24 hours do not require protective wrapping but must be kept free from contamination and be handled only while wearing clean cotton gloves.

10.2 Defective Coatings

10.2.1 One or more of the following conditions may be the cause of abnormal amounts of powder being encountered:

- The parts were improperly cleaned.
- Deposits from the cleaning solutions remained on the work.
- The chemical concentration is too high.
- The chemical dwell time was too long.
- The pH is not within the specified limits.

10.3 Storage

10.3.1 Always use the oldest stock first (i.e., first in/first out (FIFO) basis).

10.3.2 Store Bonderite M-CR 1201 Aero at above 32°F to avoid freezing. However, if the chemical did freeze, thaw it in a warm place and stir before application.

10.3.3 Store Bonderite M-CR 1132 Aero Pens away from incompatible materials. Bonderite M-CR 1132 Aero Pens contains chromate. Protect from freezing. Do not tamper with packaging and do not try to refill used markers. Unopened markers has a shelf life of 24 months.

10.4 Disposal of Chemical Wastes

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

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

10.4.3 Dispose of used Bonderite M-CR 1132 Aero Pens by re-packaging used markers and mail back to supplier for disposal (mailing label is supplied in original packaging).

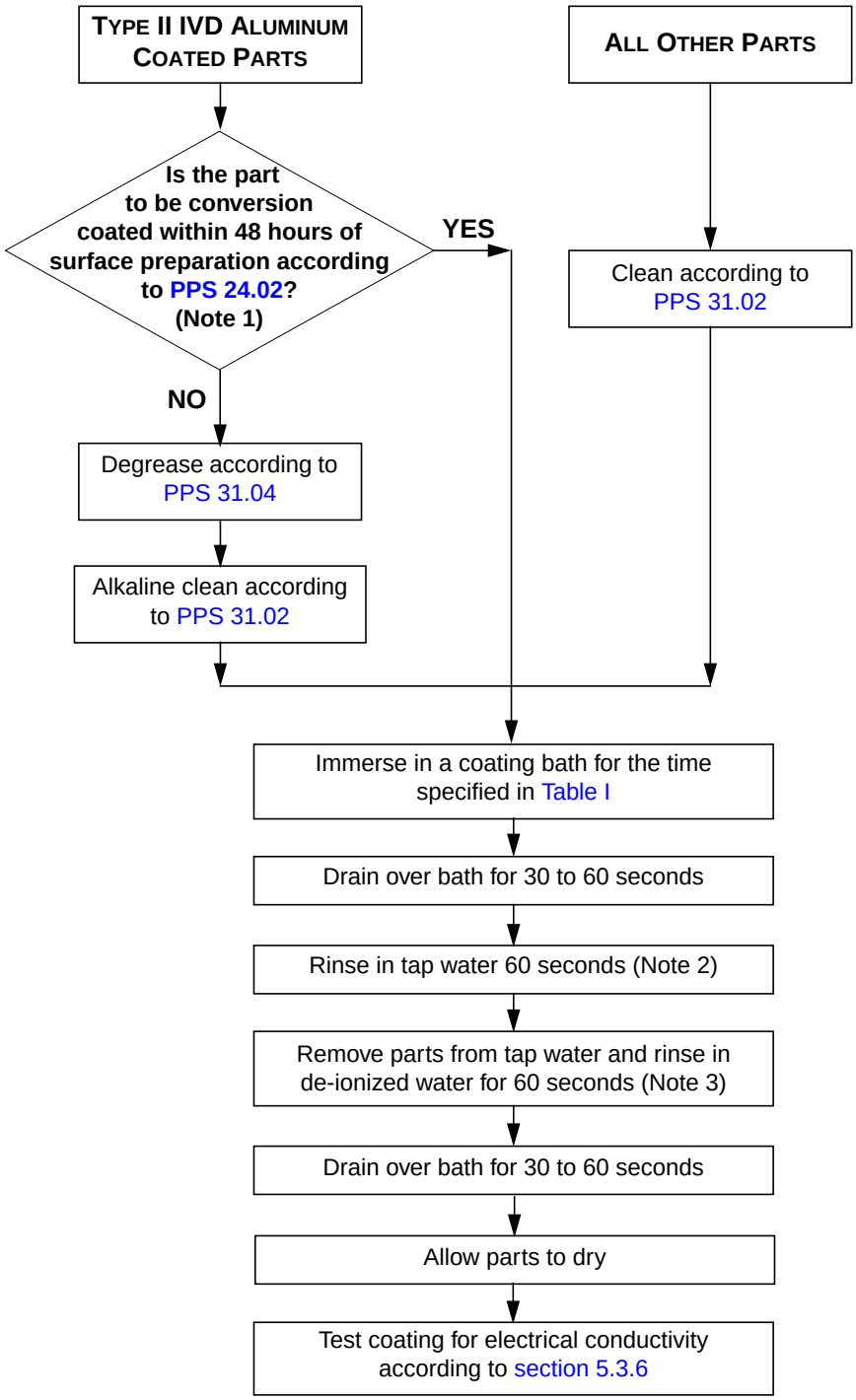
11 MAINTENANCE OF EQUIPMENT

11.1 Ensure that ohmmeter testers used for resistance measurement as specified in paragraph 5.3.3.1.2 and section 5.3.6 are re-calibrated every 4 months according to the manufacturer’s instructions.

11.2 Keep test equipment clean and dry at all times.

11.3 Take care when handling the test leads and probes to avoid damage to components, aircraft or equipment.

FLOW CHART 2 - CHEMICAL CONVERSION COATING BY IMMERSION



Note 1. If conversion coating is not performed immediately following surface preparation, protect such parts from contamination by wrapping with Kraft paper

Note 2. Parts may be rinsed by either immersion or spray rinsing. When spray rinsing, take care to ensure complete removal of conversion treatment solution.

Note 3. De-ionized water rinse is optional provided that the tap water rinse completely removed all trace of the conversion treatment solution.