BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 36.10

PRODUCTION PROCESS STANDARD

METAL BONDING OF BOMBARDIER PARTS TO BAC 5555 AND BAC 5514

Issue 8
- This standard supersedes PPS 36.10, Issue 7.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS related questions to PPS.Group@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 STRUCTURAL INTEGRITY AND TRANSPORT CANADA CERTIFICATION OF BOMBARDIER TORONTO 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 SHALL BE AUTHORIZED BY AN UNDERSIGNED TRANSPORT CANADA DESIGN APPROVAL DESIGNEE (DAD).**

(Ed Giovannetti, DAD 259) February 6, 2013

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies specific Bombardier Toronto procedures and requirements for the metal to metal and metal to metal honeycomb bonding of primary and secondary structural airframe parts in addition to the procedure and requirements specified in Revision AH of BAC 5514, Revision T of BAC 5514-589, Revision M of BAC 5514-5101 and Revision J of BAC 5555. Other revisions to these BAC specifications are not applicable to the procedure specified herein unless approved through a revision of this standard.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS shall be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

1.1.2 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. do not supersede the procedure or requirements specified in this PPS. Similarly, the procedure and requirements specified in this PPS are not applicable when use of a BAPS, MPS, LES or P. Spec. is specified.

2 HAZARDOUS MATERIALS

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

3 REFERENCES

3.1 The following documents and their references form part of this standard.

3.1.1 ASTM F25 - Procedure for the Determination of Particle Count Method.

3.1.2 BAC 5300 Rev. H - Forming, Straightening and Fitting Metal Parts.

3.1.3 BAC 5514 Rev. AH - Common Bonding Requirements for Structural Adhesives.

3.1.4 BAC 5514-589 Rev. T - Application of Corrosion Inhibiting Adhesive Primer.

3.1.5 BAC 5514-5101 Rev. M - Structural Bonding for 180°F Service Application (BMS 5-101).

3.1.6 BAC 5555 Rev. J - Phosphoric Acid Anodizing of Aluminum for Structural Bonding.

3.1.7 BSS 7202 Rev. D - Shear, Lap, Adhesive Bond.

3.1.8 BSS 7206 Rev. E - Peel, Metal to Metal, Adhesive Bonded.

3.1.9 BSS 7207 Rev. B - Peel, Honeycomb, Adhesive Bonded.

3.1.10 DHMS A6.03 - Modified Epoxy, Moderate Temperature Curing, High Strength Structural Adhesive System.

3.1.11 DHMS A6.06 - Core Splice, Expandable Film Adhesive.

3.1.12 DHMS P1.30 - Resin, Epoxy Base, Low Density, Honeycomb Core Filler.

3.1.13 DHMS S3.01 - Sealing Compound, Temperature Resistant, Integral Fuel Tanks, High Adhesion.

3.1.14 PPS 10.21 - Certification of Autoclaves.

3.1.15 PPS 10.22 - Preparation of Moulds.

3.1.16 PPS 10.28 - Assembly of Wire Thermocouples.

3.1.17 PPS 10.52 - Certification of Platen Presses.

3.1.18 PPS 13.26 - General Subcontractor Provisions.

3.1.19 PPS 17.02 - Abrasive Blasting.

3.1.20 PPS 17.03 - Saturation Shot Peening.

3.1.21 PPS 21.03 - Priming, Sealing & Repair of Integral Fuel Tanks.

3.1.22 PPS 21.21 - General Sealing Practices.

3.1.23 PPS 31.04 - Degreasing Processes.

3.1.24 PPS 31.07 - Cleaning and Stripping of Painted Surfaces.

3.1.25 PPS 31.17 - Solvent Usage.

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

4 MATERIALS AND EQUIPMENT

4.1 Materials

4.1.1 Except as noted below, all materials used in the procedure as specified herein shall be as specified in the applicable revisions (ref. section 3) of BAC 5514, BAC 5514-589, BAC 5514-5101 and BAC 5555.

- The DHMS A6.03 adhesive system, FM 73M adhesive film and BR 127 adhesive primer, shall be the only adhesive system used to bond parts according to this standard. Perform receipt testing and subsequent testing according to section 5.2.11 (Rev AH, BAC 5514, section 8.2.2).
- CytecFiberite FM410-1 to DHMS A6.06 or BMS 5-90 Type III shall be the only expandable film adhesive used. Perform receipt testing and subsequent testing according to section 5.2.11 (Rev AH, BAC 5514, section 8.2.2). Use CytecFiberite FM410-1 whenever the engineering drawing specifies use of DHMS A6.06 expandable film adhesive.
- Parting agents, Frekote 44 NC (DSC 234-13-3) or Frekote 700 NC (DSC 234-13-4).
- In addition to the temporary masking materials specified, 3M Scotch Brand No. 425 aluminum tape may be used for masking for phosphoric acid anodizing. When aluminum tape is removed, solvent clean the applicable part surfaces twice according to PPS 31.17 to remove residual tape adhesive.
- DHMS P1.30, Grade 2, 2A and 5, low density core filler as follows:

DHMS P1.30 CORE FILLER MIXING RATIOS

DHMS P1.30 RESIN (Note 1)	ADHESIVE COMPONENTS	MIXING RATIO PARTS/WEIGHT	POT LIFE (Note 2)	CURE TO HANDLE (@ 75 ± 5°F) (Note 3)	FULL CURE (@ 75 ± 5°F) (Note 4)
GRADE 2	Epocast 8623-A RESIN	100	50 to 70 minutes	6 hours (Note 5)	24 hours (Note 6)
	Epocast 9861 HARDENER	20			
GRADE 2A (Fast Cure)	Epocast 8623-A RESIN	100	12 to 18 minutes (50 gram mix)	3 hours	24 hours
	Epocast 946 HARDENER	14			
GRADE 5	Corfil 615 RESIN	100	30 to 120 minutes	6 hours (Note 7)	24 hours
	Corfil DTA HARDENER	7			

Note 1. Grade 2 and Grade 2A resin may be used interchangeably.
Note 2. The pot life is the time during which mixed adhesive remains suitable for application at 75 ± 5°F. The time indicated is for a 100 gram mix unless otherwise specified.
Note 3. Do not torque fastener inserts until the resin has cured according to the full cure schedule.
Note 4. If included as part of the lay-up, the resin will be fully cured during the lay-up cure.
Note 5. Alternatively, heat cure for 3 hours at 125 ± 5°F.
Note 6. Alternatively, heat cure for 5 hours at 125 ± 5°F.
Note 7. Alternatively, heat cure for 1 hour at 120 ± 5°F.

4.2 Equipment

4.2.1 Except as noted below, all equipment employed in the procedure as specified herein shall be as specified in the applicable revisions (ref. section 3) of BAC 5514, BAC 5514-589, BAC 5514-5101 and BAC 5555.

- Autoclave, certified according to PPS 10.21.
- Platen Press, certified according to PPS 10.52.

5 PROCEDURE

5.1 General

5.1.1 Metal bonding as specified herein shall consist of the following series of process operations:

Step 1. Clean and surface treat detail parts according to Rev. AH of BAC 5514. Changes and additional requirements to Rev. AH of BAC 5514 shall be as specified in section 5.2.

Step 2. Phosphoric acid anodize details according to Rev. J of BAC 5555. Changes and additional requirements to Rev. J of BAC 5555 shall be as specified in section 5.5.

Step 3. Prepare and apply DHMS A6.03-1 BR 127 adhesive primer according to Rev. T of BAC 5514-589. Changes and additional requirements to Rev. T of BAC 5514-589 shall be as specified in section 5.3.

Step 4. Lay up parts for bonding according to Rev. AH of BAC 5514.

Step 5. Prepare and apply DHMS A6.03 FM 73M adhesive film according to Rev. M of BAC 5514-5101.

Step 6. Platen press or autoclave cure adhesive on bonded assemblies according to Rev. M of BAC 5514-5101. Changes and additional requirements to Rev. M of BAC 5514-5101 shall be as specified in section 5.4.

5.2 Changes and Additional Requirements to Rev. AH of BAC 5514

5.2.1 Replace existing Section 5.2, Parting Agents, with new Section 5.2 as follows:

5.2 PARTING AGENTS

a. Frekote 44 NC (DSC 234-13-3).

b. Frekote 700 NC (DSC 234-13-4).

5.2.2 Replace existing paragraphs 5.4b, 5.4c, 5.4i and 5.4j with new paragraphs as follows:

b. DSC 234 bagging material specified in the following table:

MATERIAL	MATERIAL TYPE
DSC 234-1	2 Mil Nylon Vacuum Bagging Film, 250°F Cure Cycle
DSC 234-3	2 Mil Nylon Tubular Vacuum Bagging Film, 250°F Cure Cycle
DSC 234-12-1	Parchment Paper
DSC 234-15	High Temperature Pressure Sensitive Tape
DSC 234-17	Vacuum Bag Sealant

c. Re-usable bagging materials to be approved by Bombardier Toronto before production use.

i. Tape, Flash Control:

- 3M Number 855 and 5498
- Richmond HS81781PS, Richmond Aircraft Products
- Flashbreaker Number 1, 1R, 2, 2R, 5 and 5R - Airtech International Inc.
- Flashstripper 1, 1R, 2, 2R, 5 and 5R - National Aerospace Supply Co.
- Wrightcast 8500 PS - Airtech International Inc.

j. Tape, Holding Details and Thermocouples:

- Permacel 733 - Permacel Division of Nitto Dento
- 3M Number 231
- Flashbreaker Number 1, 1R, 2, 2R, 5 and 5R - Airtech International Inc.
- Flashstripper 1, 1R, 2, 2R, 5 and 5R - National Aerospace Supply Co.
- Wrightcast 8500 PS - Airtech International Inc.

5.2.3 Replace existing Section 5.5, Bleeder Materials, with new Section 5.5 as follows:

5.5 BLEEDER MATERIALS

a. Cover the lay-up with the breather cloth specified in the following table. Place additional layers of breather cloth over protrusions, sharp edges, etc. to prevent puncturing of the bag.

CURE PRESSURE	AUTOCLAVE/PLATEN PRESS ATMOSPHERE	
	INERT	NON-INERT
50 psi or less	1 layer of DSC 234-9 breather cloth	1 layer of DSC 234-11 breather cloth
Greater than 50 psi	1 layer of DSC 234-10 breather cloth	2 layers of DSC 234-11 breather cloth

5.2.4 Replace existing Section 5.8, Material Storage Control, with new Section 5.8 as follows:

5.8 MATERIAL STORAGE CONTROL

a. Immediately on receipt, transfer adhesive to a storage freezer operating at 0°F or below. For DHMS A6.03-2 water based adhesive primer, store at 32 to 55°F. Do not allow water based adhesive primer to freeze.

b Issue adhesive material on a first in/first out basis but do not issue material to production if the storage life expiry date has passed or the maximum working/shop life has been exceeded.

c. Each container or roll shall contain the following information:

(1) BMS/DHMS Type, Class, Grade and Form (if applicable).

(2) Supplier's name, batch number, lot number, date of manufacture and date of shipment.

d. Protect film adhesives during shipping and storage from damage and loads other than their own weight. It is recommended that each roll be stored in the original shipping carton with all the material identification data and left in the airtight wrapper. Before returning to freezer storage, re-seal original wrapper or replace with film wrapper of equivalent weight and maintain a moisture proof seal.

e. Record adhesive validation expiration date and cumulative out of freezer time traceable to each roll of adhesive.

f. Kitting of film adhesive is permitted but shall meet the following requirements:

(1) The adhesive shall be at ambient temperature before kitting to prevent moisture condensation.

(2) Adhesive kits shall be sealed in 6 mil minimum polyethylene film and shall be traceable to the original container or roll from which it originated.

(3) An identification label shall accompany each kit that contains the information specified in item c. and item e.

5.2.5 Replace existing Table I, Cleaning Schedule, with new Table I as follows:

TABLE I - SCHEDULE FOR INSPECTION AND CLEANING WORK AREAS

ITEMS	MAXIMUM INSPECTION TIME INTERVAL	MAXIMUM CLEANING TIME INTERVAL	METHOD OF CLEANING
Tables	24 hours	24 hours	Re-cover with clean Kraft paper
Floors	24 hours	24 hours	Vacuum and damp mop
Equipment	24 hours	24 hours	Wipe with damp cloth
Walls from the floor to a height of 7 ft.	7 days	30 days	Wash with water
Walls above 7 ft. high, ceilings, beams, light fixtures, etc.	30 days	6 months	Wash with water
Air contamination levels	7 days	Continuous	Suitable air filters

5.2.6 Replace existing paragraph 6.1m. with new paragraph and figure as follows:

m. Maintain the temperature and relative humidity of the controlled contamination areas (CCA's) within the limits specified in Figure 5. Record the temperature and relative humidity of the CCA's on continuous chart recording equipment when parts are being processed for Bombardier Toronto. If the temperature or relative humidity fall outside the specified limits, suspend processing and vacuum bag partially completed parts and store them under a minimum vacuum of 24" Hg and take appropriate corrective action to restore the CCA's back to the acceptable specified limits.

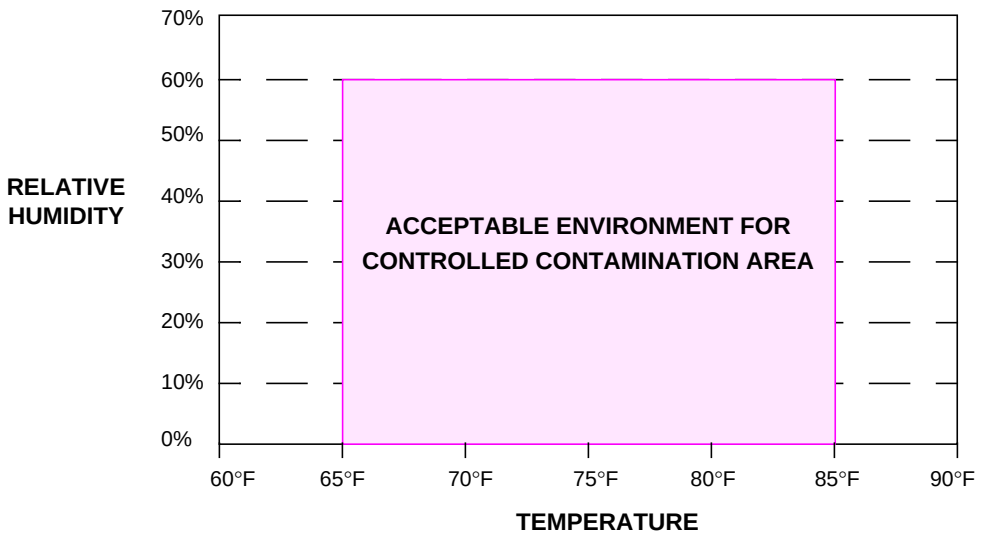


FIGURE 5 - TEMPERATURE AND HUMIDITY LIMITS FOR CONTROLLED CONTAMINATION AREA

5.2.7 Add the following to Section 6.1:

o. Air contamination shall not exceed 1000 particles larger than 5 microns each per cubic foot as determined according to ASTM F25.

p. The maximum interval between air contamination checks shall be as specified in Table I.

5.2.8 Add the following new paragraph to Section 7, Definitions:

Water break-free - A surface on which a continuous water film will remain continuous for a period of at least 30 seconds without discontinuity or breaks.

5.2.9 Replace existing Section 8.1.2, Application of Parting Agents, with new Section 8.1.2 as follows:

8.1.2 APPLICATION OF PARTING AGENTS

8.1.2.1 Apply parting agents according to PPS 10.22.

5.2.10 Replace existing Section 8.1.3, Adhesive Storage, with new Section 8.1.3 as follows:

8.1.3 ADHESIVE/ADHESIVE PRIMER STORAGE

Store DHMS A6.03 adhesive film and primer according to the requirements specified as follows:

a. Immediately on receipt, transfer adhesive film and primer to a storage freezer operating at 0°F or below. For DHMS A6.03-2 water based adhesive primer, store at 32 to 55°F. Do not allow water based adhesive primer to freeze.

b Issue adhesive material on a first in/first out basis but do not issue material to production if the storage life expiry date has passed or the maximum working/shop life has been exceeded.

c. Each container or roll shall contain the following information:

(1) DHMS Number (including dash number, if applicable).

(2) Supplier's name, batch number, lot number, date of manufacture and date of shipment.

d. Protect film adhesives during shipping and storage from damage and loads other than their own weight. It is recommended that each roll be stored in the original shipping carton with all the material identification data and left in the airtight wrapper. Before returning to freezer storage, re-seal original wrapper or replace with film wrapper of equivalent weight and maintain a moisture proof seal.

e. Record adhesive validation expiration date and cumulative out of freezer time traceable to each roll of adhesive.

f. Kitting of film adhesive is permitted but shall meet the following requirements:

(1) The adhesive shall be at ambient temperature before kitting to prevent moisture condensation.

(2) Adhesive kits shall be sealed in 6 mil minimum polyethylene film and shall be traceable to the original container or roll from which it originated.

(3) An identification label shall accompany each kit that contains the information specified in item c. and item e.

5.2.11 Replace existing Section 8.2.2 as follows:

8.2.2 ADHESIVE RECEIPT TESTING AND SUBSEQUENT TESTING

8.2.2.1 DHMS A6.03 Adhesive/Adhesive Primer

a. Perform receipt testing on a sample from each roll of adhesive film and each lot of adhesive primer upon receipt from the manufacturer before using the material for production parts. Receipt test according to DHMS A6.03.

(1) Receipt testing of each sample of adhesive film shall consist of 1 metal to metal peel test panel, 1 lap shear panel and, if the bonding facility performs metal to metal honeycomb bonding, 1 honeycomb peel test panel, prepared and tested according to Section 8.2.2c.

(2) Receipt testing of each sample of adhesive primer shall consist of 1 metal to metal peel test panel and 1 lap shear test panel, prepared and tested according to Section 8.2.2c.

b. Conduct intermediate testing of adhesive film and primer 4 months from the date of shipment (i.e., 4VS). Also, for primer, perform a second intermediate test 7 months from date of shipment (i.e., 7VS). Perform all testing according to Section 8.2.2.1a. Shelf life extension testing beyond the storage life (i.e., 6 months from date of manufacture (i.e., 6VM) for adhesive film and 9VM for primer) shall be as follows:

- The first storage life extension will extend the storage life for another 90 days. The second storage life extension will extend the storage life for another 60 days. Subsequent extensions require Bombardier Toronto MRB authorization and are subject to Bombardier Toronto Materials Technology approval.

If any of the test results are unacceptable, dispose of the representing lot.

(1) For each shelf life extension, record the total accumulated time out of the storage freezer at each storage life extension and current total accumulated time out of the storage freezer for that material at the time of shelf life extension testing.

(2) When requesting shelf life extensions beyond the storage life, include with the request all applicable previous test results (i.e., receipt testing, 4 months shelf life testing, 7 months, 1st shelf life extension, 2nd shelf life extension, etc.).

c. Test panels shall be prepared and tested as follows:

(1) Prepare and test honeycomb peel test panels at 70 to 90°F according to BSS 7207 Type I or DHMS A6.03.

(2) Prepare and test metal to metal peel test panels at 70 to 90°F according to BSS 7206 Type I or DHMS A6.03.

(3) Prepare and test lap shear test panels at 70 to 90°F according to BSS 7202 Type I or DHMS A6.03.

d. Test panels shall meet the applicable shear or peel requirements as specified in DHMS A6.03.

(1) If specimens fail to meet the peel torque or tensile shear requirements, record the nature of the failure (i.e., adhesive, cohesive or contact) and the percentage of bond area affected by each type of failure and refer the adhesive/adhesive primer to Bombardier Toronto MRB or Bombardier Toronto delegated MRB for disposition.

8.2.2.2 CytecFiberite FM410-1 to DHMS A6.06/BMS 5-90 Type IIII Expandable Film Adhesive

a. Perform receipt testing on a sample from each lot of expandable film adhesive upon receipt from the manufacturer before using the material for production parts. Receipt test according to DHMS A6.06 or BMS 5-90.

b. Shelf life extension testing beyond the storage life (i.e., 6 months from date of receipt, 6VR) shall be as follows:

- The first storage life extension will extend the storage life for another 90 days. The second storage life extension will extend the storage life for another 60 days. Subsequent extensions require Bombardier Toronto MRB authorization and are subject to Bombardier Toronto Materials Technology approval.

For shelf life extension testing of DHMS A6.06/BMS 5-90 Type III expandable film adhesive, perform thickness expansion testing according to DHMS A6.06 or to BMS 5-90.

If any of the test results are unacceptable, dispose of the representing lot.

(1) For each shelf life extension, record the total accumulated time out of the storage freezer at each storage life extension and current total accumulated time out of the storage freezer for that material at the time of shelf life extension testing.

(2) When requesting shelf life extensions beyond the storage life, include with the request all applicable previous test results (i.e., receipt testing, 1st shelf life extension, 2nd shelf life extension, etc.).

5.2.12 Replace existing paragraphs 8.2.3c and 8.2.3d with new paragraphs as follows:

c. Vapour degrease according to PPS 31.04 before any secondary bonding operations such as core stabilization or core splicing. After secondary bonding, protect honeycomb core against contamination by carefully wrapping in neutral Kraft paper or polyethylene storage bags until lay-up. If required, solvent clean surface by solvent wiping according to PPS 31.17.

d. Removal of protective wrapping shall be performed in the controlled contamination area just before lay-up and only handle the core with clean cotton gloves.

5.2.13 Replace existing Section 8.3.2, Prefit Requirements, with new Section 8.3.2 as follows:

8.3.2 PRE-FIT REQUIREMENTS

a. Pre-fit and check all surfaces to be joined for mating tolerances and pre-fit according to BAC 5300. Burrs on faying surfaces of metal details shall not exceed 0.002". Do not steel-stamp details.

b. Check details to ensure that only light hand pressure is required to give uniform contact over:

(1) All surfaces to be bonded. If acceptable fit-up cannot be accomplished with hand pressure, use methods according to fit-up forces of BAC 5300.

(2) Heavy or rigid details such as spars, extrusions, etc., and sculptured or contoured core shall obtain a maximum gap of 0.005" between surfaces to be bonded.

c. Pre-fit requirements may be waived, if specified on the Work Order, for uncomplicated assemblies which require no filing, trimming, hole drilling, etc. at the pre-fit stage. Reject parts which do not mate properly at the final lay-up stage.

5.2.14 Replace existing Section 8.4.3.1, Deoxidizing Aluminum Details, with new Section 8.4.3.1 as follows:

8.4.3.1 DEOXIDIZING ALUMINUM DETAILS

a. Immerse in Solution 1 (Section 9.2.1), Solution 2 (Section 9.2.2) or Solution 5 (Section 9.2.3) for 12 to 15 minutes. Do not agitate solutions while parts are immersed. Maximum accumulated immersion time (initial plus reprocess) is 35 minutes. If a reprocess would exceed the total immersion time, refer parts to Bombardier Toronto MRB or Bombardier Toronto delegated MRB for approval to reprocess.

b. Cold (90°F maximum) water rinse for 5 to 15 minutes.

c. Check to ensure surface is water break-free. If surface is not water break-free, reprocess according to section 8.4.3.1a.

5.2.15 Add new paragraph 8.6.4.1f.(4)(a) as follows:

(a) If a heat point tool is used to trim the adhesive film, it shall have a minimum point radius of 0.030" and shall not be allowed to dwell on the parts such that overheating or penetration of the primer occurs.

5.2.16 Add new paragraph 8.6.4.1g as follows:

g. When bonding details which are clad on 1 side only, ensure that the non-clad side is the adhesive side.

5.2.17 Add new paragraph 8.6.4.2.1c as follows:

c. Use CytecFiberite FM410-1 expandable film adhesive to DHMS A6.06 or BMS 5-90 Type III for core splicing.

5.2.18 Add Section 8.7.5 as follows:

8.7.5 PROCESS CONTROL TEST ASSEMBLIES

a. In addition to re-validation tests for recharging process tanks, conduct a process control test for every load of parts processed through the clean/anodize line. The clean/anodize line consists of alkaline cleaning, surface treatment and phosphoric acid anodizing of details.

b. The Clean/Anodize Line Process Control Test shall consist of 1 crack extension test panel (5 test pieces per panel) of 2024 T3 bare aluminum alloy (QQ-A-250/4), prepared according to Section 12.2.1 and, after being processed with the clean/anodize line load, tested according to Section 12.2.2.

c. The maximum allowable crack extension for each test piece is 0.30".

d. Production parts from the same clean/anodize line load as a failed test piece are not acceptable.

5.2.19 Replace existing Section 8.8.2.1, Thermocouple Requirements, with new Section 8.8.2.1 as follows:

8.8.2.1 THERMOCOUPLE REQUIREMENTS

a. Prepare thermocouples according to PPS 10.28.

b. Using tape, secure the bare ends of the thermocouple wires to the assembly at the glue line or to the jig as close to the glue line as possible. Do not use silicone tape.

c. Position thermocouples to represent the minimum and maximum rate of heating of assemblies being bonded. On honeycomb panels, place thermocouples on both upper and lower glue lines.

d. Record the temperature measurement from each thermocouple during the entire cure cycle at intervals of not more than 10 minutes.

e. The number of thermocouples to be used shall be as follows:

NUMBER OF ASSEMBLIES	NUMBER OF THERMOCOUPLES
1 - 3 assemblies in one autoclave bag	2 per assembly (2 - 6 total)
4 - 9 assemblies in one autoclave bag	1 per assembly (4 - 9 total)
10 or more assemblies in one autoclave bag	1 for each 2 assemblies (5 minimum)
1 load on an autoclave table	4 minimum
Platen press load	1 for each 2 assemblies (4 minimum)
Test panel work tray in autoclave or platen press	2 per work tray

5.2.20 Replace existing Section 8.9, Adhesive Flash Removal, with new Section 8.9 as follows:

8.9 ADHESIVE FLASH CONTROL

8.9.1 GENERAL CONTROL OF EXCESS ADHESIVE FLASH

a. The following requirements apply on all surfaces of bonded panels:

(1) Remove excess adhesive flash if it exceeds the height of adjacent bonded details in fuel tank areas and if it exceeds a height of 0.003" above adjacent bonded details in all other areas (see Figure 7-A).

(2) Remove all loose adhesive flash (see Figure 7-B).

(3) Remove excess adhesive flash if it protrudes more than 0.003" beyond net trim lines (net skin edges) of bonded panels (see Figure 7-C).

(4) Remove sharp edges or ridges of adhesive flash (see Figure 7-D).

(5) Strings of flash due to bag wrinkles or perforations in the bleeder cloth are acceptable, provided that they are a maximum of 0.020" in height, unless they occur in critical areas specified in Section 8.9.2.

8.9.2 CONTROL OF EXCESS ADHESIVE FLASH IN CRITICAL AREAS

a. In addition to the general requirements specified in Section 8.9.1, remove excess adhesive flash if it exceeds allowable dimensions in areas designated as critical for subsequent manufacturing operations or mating part fit-up.

b. Critical areas and the maximum dimensions of flash allowed in such areas shall be as specified on the engineering drawing. If the engineering drawing does not specify critical areas or the maximum allowable flash dimensions, such areas and dimensions shall be as determined during the tool proving program (see Section 10.2.1).

8.9.3 REMOVAL OF EXCESS ADHESIVE FLASH

a. Accomplish adhesive flash removal mechanically in such a manner as to prevent damage to the skin or bonded joint. Do not use chemical strippers.

(1) Damage to the BR 127 primer resulting from flash removal is acceptable within the limits specified in Rev. T of BAC 5514-589 and shall be repaired according to Section 8.10.2 of Rev. T of BAC 5514-589.

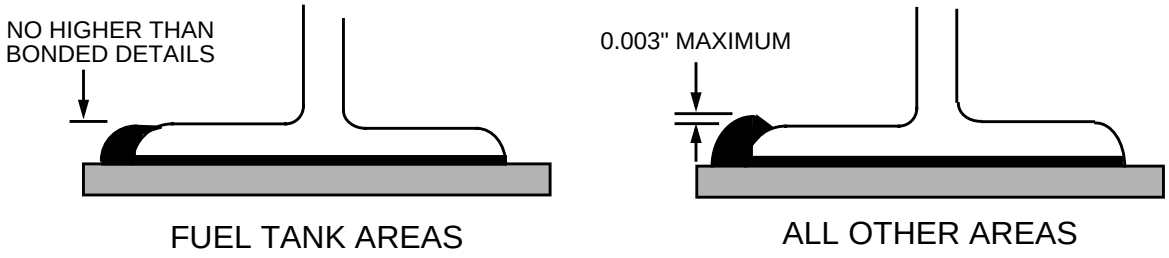


FIGURE 7-A

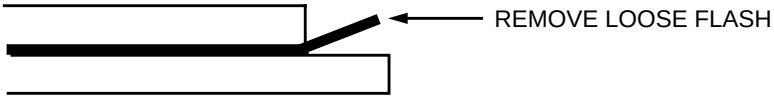


FIGURE 7-B

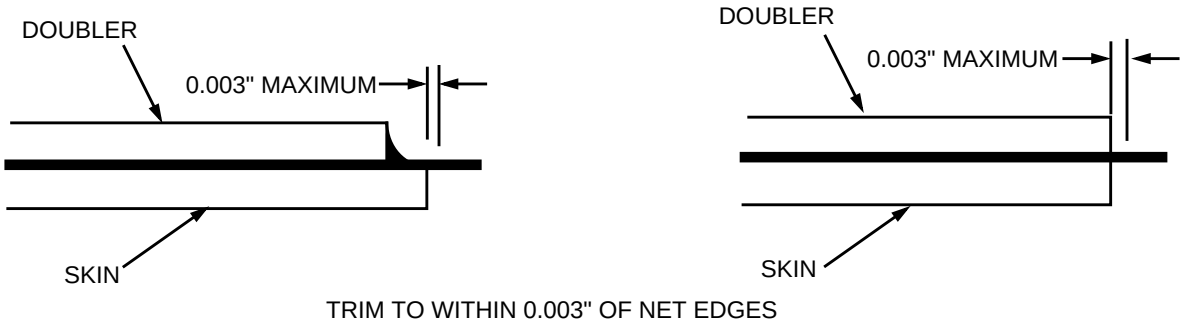


FIGURE 7-C

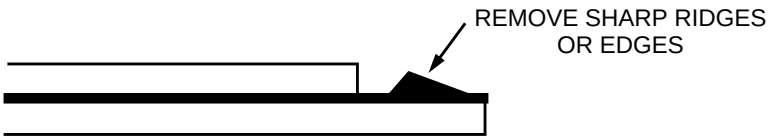


FIGURE 7-D

FIGURE 7 - ADHESIVE FLASH LIMITS

5.2.21 Replace existing Section 10.2, Part Fit-Up Evaluation, with new Section 10.2 as follows:

10.2 PART FIT-UP EVALUATION

10.2.1 VERIFICATION (TOOL PROVING) FILM TEST METHOD

a. Complete all fabrication operations, including drilling and de-burring, before assembling parts for tool proving.

b. Parts shall be free of shop swarf, metal chips, etc. and may be vapour degreased according to PPS 31.04 to remove shop oils or grease.

c. Process assemblies through the complete cure cycle using FM 643 tool proving film. The thickness of the tool proving film shall correspond to the thickness of the adhesive film to be used on production parts. As an alternative to FM 643 tool proving film, the adhesive film to be used for the assembly in production, laminated between approved non-perforated parting films (maximum thickness of 0.002" each), may be used as tool proving film.

d. Evaluate fit, cure pressure, time cycle and bondline thickness on the results of inspection of the tool proving film.

e. Measure the thickness of the film, to within 0.001", at enough locations to establish an adequate profile of the bondline thickness.

f. Based upon inspection of the verification film, bondline thickness for 0.005" film shall be 0.002" to 0.010", bondline thickness for 0.007" film shall be 0.002" to 0.015" and bondline thickness for 0.010" and 0.015" film shall be 0.002" to 0.020". The bondline thickness shall vary no more than 0.008" per inch of bondline in any direction.

g. Submit tool proving test results to Bombardier Aerospace Quality for approval before commencing bonding on the assembly. Maintain a record of all test results.

5.2.22 Replace existing paragraphs 10.4b. and 10.4b.(1) with new paragraphs as follows:

b. Inspect all parts to the requirements of Section 10.4b.(1), (2), (3) and (4).

(1) Visually inspect bonded assemblies to ensure that adhesive flash is continuous along faying surface edges. Voids on the glue line edge of metal to metal honeycomb bonded assemblies are not acceptable, refer such assemblies to Bombardier Toronto MRB or Bombardier Toronto delegated MRB for disposition.

5.2.23 Replace existing paragraph 10.4b.(4) with new paragraph as follows:

(4) Inspect bonded assemblies for internal flaws such as voids, blisters and delaminations using portable or stationary ultrasonic inspection equipment. Calibrate NDT instruments used for inspecting bond integrity of assemblies against a standard void panel and the instrument adjusted to detect minimum defects equivalent in area to a 3/8" diameter circle. All assemblies showing individual voids or delaminations larger than the area noted, below stringers, waffle doublers and doublers, shall be rejected and appropriate corrective action taken. Ultrasonic inspection results shall be verified by Bombardier Aerospace Quality.

5.2.24 Add new Sections 10.4.1 and 10.4.2 as follows:

10.4.1 RE-BONDING DUE TO EXCESSIVE VOIDS OR POOR FIT (METAL TO METAL BONDS)

a. If bonded assemblies fail to meet the inspection requirements specified herein, and Bombardier Toronto MRB or Bombardier Toronto delegated MRB has authorized the repair, assemblies shall be re-bonded by qualified personnel according to section 8 of PPS 36.10.

b. Using a wedge with radiused edges, carefully delaminate the detail to be removed, beginning along its leading edge.

c. If no void in the bondline exists to use as a starting point for inserting the wedge, locally chill the starting point, by packing with dry ice, to facilitate disbonding of the adhesive.

d. Take extreme care to avoid damaging the adhesive primer coat while removing bonded details.

e. Inspect detail parts to the dimensional and surface finish requirements of the engineering drawings and, if acceptable, shall be re-used in the re-bonded assembly.

f. Except as noted below, it is not necessary to remove cured adhesive from the bond faying surfaces before re-bonding.

(1) If a detail has been removed due to incorrect positioning, reduce any adhesive flash at the original glue line edge which will interfere with correct fit-up for re-bonding to a maximum thickness as that of the cured bondline adhesive by sanding with 240 - 280 grit aluminum oxide abrasive paper (see Figure 8). If detail parts were severely mismatched, it may be necessary to fair the cured glue line edge toward the surrounding structure to prevent voids during re-bonding.

(2) Removal of adhesive flash by chemical means is prohibited.

(3) Take extreme care to avoid removing the adhesive primer coat or damaging the surface of the surrounding structure while removing flash.

(4) Solvent wipe the bondline area and surrounding structure according to PPS 31.17 to remove sanding residue.

g. If cured adhesive comes completely away from a bond faying surface, visually inspect the substrate for evidence of adhesive primer removal. Single areas from which the primer has been removed or if bare metal exists, refer such parts to MRB for disposition.

h. Reprocess parts/details to be rebonded through the clean line and process according to paragraph 5.1.1 of PPS 36.10.

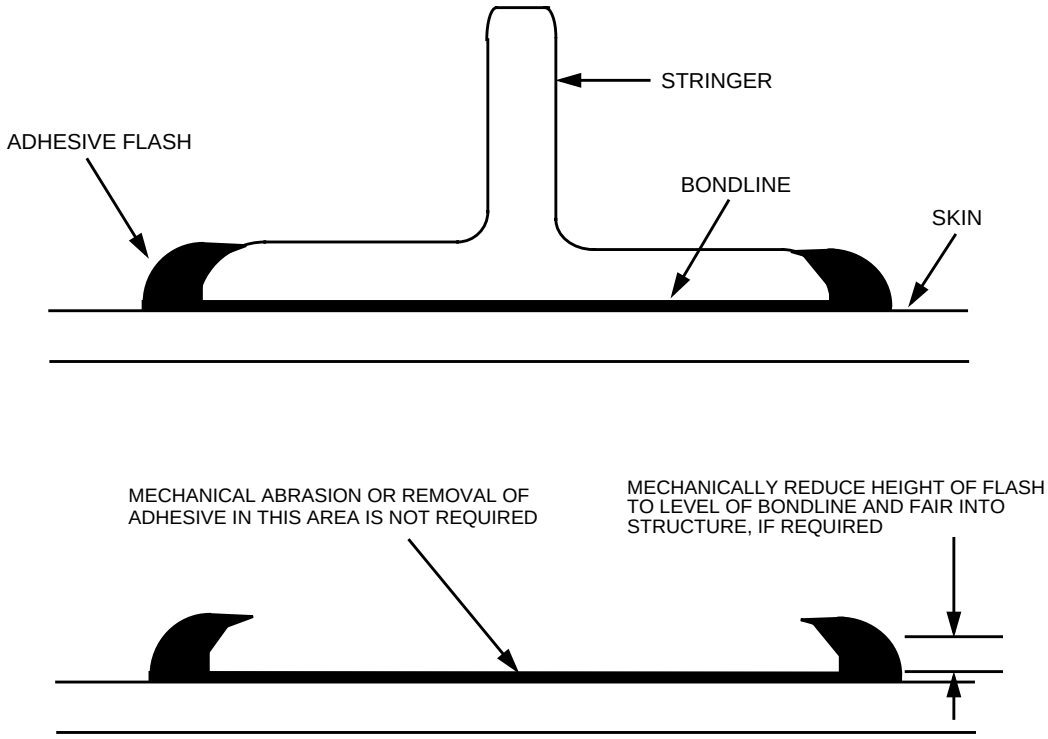


FIGURE 8 - REMOVAL OF ADHESIVE FLASH FOR REPOSITIONING DETAILS

10.4.2 BOND REPAIR OF DAMAGED MACHINED ALUMINUM ALLOY PARTS

a. If authorized by Bombardier Toronto MRB or Bombardier Toronto delegated MRB, use the following procedure to repair machining defects detected in aluminum alloy parts.

b. Perform all manufacturing operations, including machining, non-destructive testing, shot peening, etc. before preparing part surfaces for repair bonding.

c. If applicable, locally strip parts of primer according to Section 10.4.2.1 before preparing surfaces for repair bonding.

10.4.2.1 STRIPPING OF PRIMED SURFACES FOR REPAIR BONDING

a. Mask-off the repair bond area of primed parts, plus approximately 1 inch around the entire perimeter of the surface to which a doubler will be bonded, with masking tape.

b. Locally strip the masked-off surfaces of F19 primed parts according to PPS 31.07.

c. Strip the masked-off surfaces of F21 primed parts by abrasive blasting using glass bead media according to PPS 17.02.

(1) Take care to avoid scratching the base metal during removal of the primer.

(2) Lightly abrade the exposed metal surface using fine aluminum oxide Scotch-Brite, blending any minor scratches caused by mechanical primer removal.

d. Ensure that primer is completely removed to the masking tape border to provide a clear line between primed and bare surfaces.

e. If required for phosphoric acid anodizing per Section 10.4.2.2, strip electrical contact points of primer as specified above.

10.4.2.2 SURFACE PREPARATION FOR REPAIR BONDING

a. Remove masking tape applied according to paragraph 10.4.2.1a, if applicable.

b. If specified by Bombardier Toronto MRB or Bombardier Toronto delegated MRB, shot peen repair areas of machined parts according to PPS 17.03.

c. Clean and phosphoric acid anodize the surfaces of machined parts and repair doublers according to BAC 5555.

d. Include process control test panels, according to Section 8.7.5, with each load of parts processed for repair bonding.

e. Before applying bonding primer to bare areas of previously primed parts, mask off the same area specified in paragraph 10.4.2.1a to avoid overlapping existing primer with bonding primer.

f. Apply BR 127 primer, according to Section 8.6.2, to all surfaces of bare machined parts and repair doublers and to bare surfaces of previously primed parts.

10.4.2.3 REPAIR BONDING

a. After curing of the bonding primer, apply 0.060 lb/ft^2 FM 73M film adhesive according to Section 8.6.4.

b. Local vacuum bagging of repair areas only on rigid machined parts is acceptable.

c. Attach two thermocouples to each repair area. Attach to extreme ends of the repair area. On sandwich structures, attach one thermocouple per bond line if both bond lines are accessible.

d. Cure assemblies according to Section 8.8.

10.4.2.4 POST REPAIR BONDING PROCEDURE

a. Only remove adhesive flash from bondlines of fuel tank parts, according to Section 8.9, to an extent which will allow the bondline to be completely fillet sealed according to paragraph 10.4.2.4c.

b. Prime parts with F19 primer according to PPS 34.08 or with F21 primer according to PPS 21.03, as applicable.

c. Seal bondlines of repair bonded fuel tank parts using DHMS S3.01 PR 1422 B sealant according to PPS 21.03.

5.2.25 Replace existing Section 10.5.5, Destructive Testing Requirements for First Part Qualification, with new Section 10.5.5 as follows:

10.5.5 DESTRUCTIVE TESTING REQUIREMENTS FOR FIRST PART QUALIFICATION

a. Measure the bondline thickness as follows:

(1) Measure bondlines in areas of minimum and maximum bondline thickness as indicated by the verification film test.

(2) Bondline thicknesses shall be accurate to within ± 0.001".

b. Perform destructive tests (i.e., lap shear, peel or crack extension test) on all first article bonded assemblies. Submit a first part qualification test plan and test results to Bombardier Toronto for approval before the commencement of production.

(1) Test panels shall be cut from the part in an area specified by Bombardier Toronto, DAD Structures.

(2) Lap shear and peel test requirements shall be according to DHMS A6.03.

(3) Crack extension test requirements shall be according to paragraph 8.7.5c.

c. Visually inspect the assembly by dismantling and inspecting to the requirements of Section 10.4 and Section 10.5.1.1.

5.2.26 Replace existing paragraph 12.2.1c with new paragraph 12.2.1c as follows:

c. Apply 0.045 lb/ft^2 DHMS A6.03 adhesive and cure according to BAC 5514-5101 to the configuration shown in Figure 4.

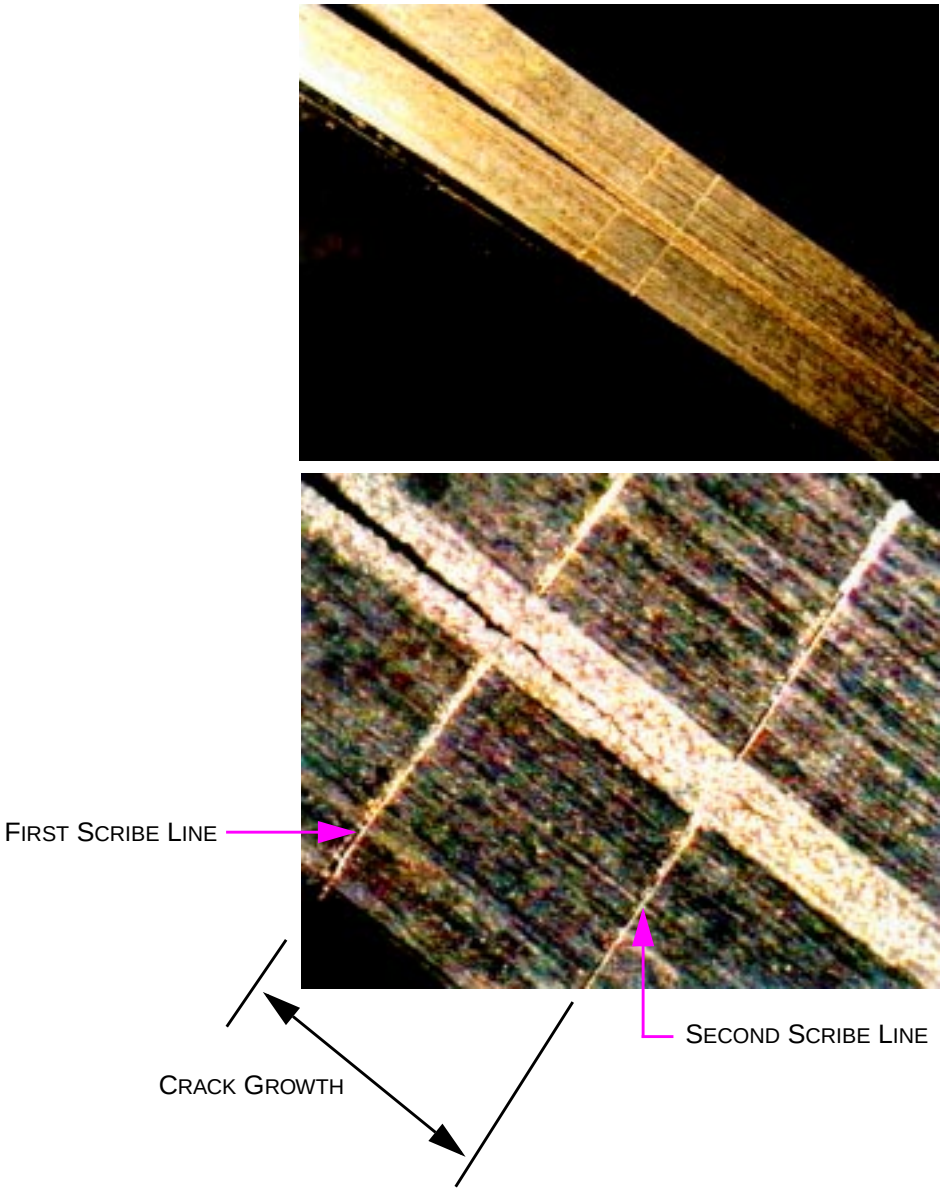
5.2.27 Replace existing paragraph 12.2.2c with new paragraph 12.2.2c as follows:

c. Locate the tip of the initial crack and mark it on both sides of the test piece using a fine line (First Scribe Line).

5.2.28 Replace existing paragraphs 12.2.2e and 12.2.2f with new paragraphs 12.2.2e and 12.2.2f as follow:

e. Locate the tip of the crack and mark it on both sides of the test piece using a fine line (Second Scribe Line).

f. Measure the increase in crack length, on both sides of the test piece, resulting from the humidity exposure within 2 hours after removal using 5 to 30 power magnification to locate the crack tip. If applicable, record the mode of failure (i.e., adhesive, cohesive or contact). Refer to the following pictures on how to determine where the crack begins (i.e., not where resin lightens in colour but at the actual crack).



5.2.29 Add Table VIII as follows:

TABLE VIII - FIRST PART QUALIFICATION AND PRODUCTION PART TESTING SCHEDULE

TEST	QUALIFICATION TESTING (NOTE 1)			PRODUCTION TESTING		
	BAC 5514 SECTION	METAL TO METAL BONDS	HONEYCOMB BONDS	BAC 5514 SECTION	METAL TO METAL BONDS	HONEYCOMB BONDS
Tool Proving (Note 2)	10.5.3b	Yes	Yes	10.2.1	1 assembly after 50 cycles in autoclave on any 1 tool	1 assembly after the 25th and 100th cycle and 1 assembly every 100th cycle thereafter in autoclave on any 1 tool
Visual	10.5.3a	Yes	Yes	10.4	100%	100%
Non-Destructive	10.5.4	Yes	Yes	10.4b.(4)	100%	100%
Lap Shear	8.2.2c and 8.2.2d	2 test panels per assembly	N/A	N/A	N/A	N/A
Peel	8.2.2c and 8.2.2d	2 test panels per assembly	3 test panels per assembly			
Destructive	10.5.5	First-off each assembly (Note 3)		10.5.5	Any assembly if specified by Bombardier Aerospace Quality	

Note 1. Except as noted below, qualification testing is applicable as follows unless otherwise specified by Bombardier Aerospace Quality:

- First-off each new assembly.
- First-off each modified assembly.
- First-off assembly on each new bonding tool.
- First-off assembly on each modified bonding tool.
- First-off after process change, including new process bath make-ups.

Multiple Use Tool: If 2 or more similar assemblies (e.g. left and right hand assemblies, flat stock, etc.) are bonded on a common bonding tool, the group of assemblies may be qualified by testing 1 representative assembly from the group, provided that prior written approval has been obtained from Bombardier Aerospace Quality.

Note 2. The thermal profile shall be performed during the verification process and shall involve locating a minimum of 12 thermocouples dispersed around accessible bondlines. The part shall be subjected to a cure cycle representative of the drawing requirement, and, areas of ramping heat up rate shall be determined. If the tool is not capable of meeting cure cycle requirements, the tool shall be modified as required. Locations for leading/lagging thermocouple placement shall be determined and thermocouple placement shall follow the requirements of Section 8.8.2.1 e.

Note 3. The first part evaluation procedure shall include a proposed test plan which shall be approved by Bombardier Toronto, DAD Structures and Bombardier Aerospace Quality. In addition, a thermal profile for each tool shall also be provided.

5.3 Changes and Additional Requirements to Rev. T of BAC 5514-589

5.3.1 Replace existing Section 5.6, Adhesive Primers and Adhesives, with new Section 5.6 as follows:

5.6 ADHESIVE PRIMERS AND ADHESIVES

DHMS A6.03-1 BR 127 adhesive primer is the only adhesive primer to be used for processing to this PPS.

5.3.2 Add the following to paragraph 8.6.2.3g as follows:

Measure primer thickness coating at a minimum of 5 locations on each skin or detail, and shall be recorded on the process control card.

5.4 Changes and Additional Requirements to Rev. M of BAC 5514-5101

5.4.1 Replace existing Section 5.6, Adhesive Primers and Adhesive Films, with new Section 5.6 as follows:

5.6 ADHESIVE PRIMERS AND ADHESIVES FILMS

a. DHMS A6.03-1 BR 127 adhesive primer is the only adhesive primer to be used for processing to this PPS.

b. DHMS A6.03 FM 73M adhesive film is the only adhesive film to be used for processing to this PPS.

DHMS A6.03 ADHESIVE FILM DATA

DHMS DESIGNATION	NOMINAL FILM WEIGHT	NOMINAL FILM THICKNESS	CARRIER
A6.03	0.030 lb/ft^2	0.005"	Polyester (Random Mat)
	0.045 lb/ft^2	0.007"	
	0.060 lb/ft^2	0.010"	
	0.085 lb/ft^2	0.015"	

5.4.2 Add new paragraphs 8.8.1h to 8.8.1i as follows:

h. The total accumulated time that aluminum detail parts and assemblies may be exposed to cure temperature (including primer force cure, verification film cure and production autoclave cure) is 5.5 hours.

i. Prepare a cure chart and cure plot (if available) for each autoclave and platen press load. Ensure that the cure chart shows each of the following readings recorded every 10 minutes or less.

- Temperature reading of each thermocouple.
- Vessel temperature and pressure.
- Vacuum/pressure monitor system readings or vacuum/pressure check readings (if applicable).

If curing in an autoclave or platen press which is not equipped with a vacuum/pressure monitor system, ensure that the cure chart shows the vacuum/pressure under the bag recorded at the start of the cure period, in the middle of the cure period and at the end of the cure period. Close the vacuum lines for 30 seconds before the vacuum/pressure check and re-open them after the check.

Ensure heat-up rate and cool down rate is also recorded for each cure load. Cure charts, cure plots (if available) and recorded heat-up/cool down rates shall be readily available upon Bombardier Toronto's request for review.

5.4.3 Replace existing Section 8.8.3, Cure Temperature Requirements, with new Section 8.8.3 as follows:

8.8.3 CURE TEMPERATURE REQUIREMENTS

Raise the autoclave temperature to 240 to 260°F at a rate of not less than 2°F per minute and not more than 10°F per minute, measured at 10 minute intervals. The minimum cure period shall be 90 minutes at 240 to 260°F. Do not allow the temperature of the aluminum alloys to exceed 260°F. Monitor the temperature to assure that this limit is not exceeded.

5.4.4 Replace existing paragraph 8.8.4(i) with new paragraph 8.8.4(i) as follows:

(i) The cure pressure shall be within the range of 35 to 100 psi. Before curing, perform leak testing of vacuum bagged assemblies as follows:

Step 1. Connect the vacuum outlets to their applicable connectors.

Step 2. Slowly apply a minimum vacuum of 24" Hg to the bagged assembly. Adjust the bag while it is evacuating by pleating and folding to ensure complete contact and even pressure on the lay up.

Step 3. When the vacuum is achieved, shut off the vacuum supply and check for leaks by observing the pressure gauge. The maximum acceptable leak rate is 1" Hg per minute over a 5 minute period.

Step 4. If the leak rate is greater than 1" Hg per minute over a 5 minute period, repair the leaks (or re-vacuum bag, if necessary) and re-test for leaks according to this section.

5.4.5 Replace existing paragraph 10.1 with new paragraph 10.1 as follows:

10.1 CONTROL OF ADHESIVES

Verify that DHMS A6.03 and DHMS A6.06/BMS 5-90 adhesives are stored in accordance with section 8.2.1 and re-tested in accordance with section 8.2.2.

5.5 Changes and Additional Requirements to Rev. J of BAC 5555

5.5.1 Replace existing paragraph 8.1b with new paragraph 8.1b as follows:

b. Agitate solutions to ensure homogeneity after prolonged standing and after every addition of water or chemicals. Only when part shape and contours cause entrapment of gas bubbles and poor anodizing, shall agitation/rotation be allowed during anodizing for those affected parts. Otherwise, do not agitate the anodizing solution during anodizing.

5.5.2 Replace existing paragraph 8.1e with new paragraph 8.1e as follows:

e. Perform the spray rinse of parts using a **fine** spray which produces misty streams of water **falling** on the part. Course and heavy spray jets producing concentrated streams over long distances are not acceptable. Parts shall be water break-free following rinsing after alkaline cleaning, deoxidizing, and anodizing.

5.5.3 Add the following new paragraph to Section 8.1, General Requirements, as follows:

k. Verify clean line process parameters for individual runs (i.e., immersion times, transfer times between tanks, temperature, any specific requirements for agitation, voltage, etc.) at the end of each run.

5.5.4 Replace existing Note 1 of Section 8.2 with new Note 1 of Section 8.2 as follows:

1/ Process parts in a continuous sequence from Section 8.2c. through 8.2i. Parts shall be recycled as required through Section 8.2c. and 8.2d. to obtain a visually clean, water break-free surface. Parts may be recycled once through Section 8.2e. and 8.2f. without MRB approval. Parts shall be referred to Bombardier Toronto MRB or Bombardier Toronto delegated MRB for approval to reprocess further.

5.5.5 Add Section 12.2.1 as follows:

12.2.1 PROCESS CONTROL TEST ASSEMBLIES

a. In addition to re-validation tests for recharging process tanks, conduct a process control test for every load of parts processed through the clean/anodize line.

b. The Clean/Anodize Line Process Control Test shall consist of 1 crack extension test panel (5 test pieces per panel) of 2024 T3 bare aluminum alloy (QQ-A-250/4), prepared and tested according to BAC 5514.

c. The maximum allowable crack extension for each test piece is 0.30".

d. Production parts from the same clean/anodize line load as a failed test piece are not acceptable.

6 REQUIREMENTS

6.1 First part qualification and production part testing shall be according to the schedule specified in Table VIII.

6.2 Requirements for parts and assemblies processed according to the procedure specified herein shall be according to Rev. AH of BAC 5514.

7 SAFETY PRECAUTIONS

7.1 Safety precautions applicable to the materials and procedure specified herein shall be defined by the subcontractor performing such work for Bombardier Aerospace.

8 PERSONNEL REQUIREMENTS

8.1 The procedure specified herein has been classified as a critical operation and, therefore, certification and/or qualification of personnel is required. Certified and/or qualified personnel shall have a good working knowledge of the following, as applicable.

8.2 Upon completion of training for operation of the clean line, trainees shall have a good working knowledge of how to operate the clean line equipment.

8.3 Upon completion of training for laying up and vacuum bagging aluminum alloy metal parts, trainees shall have a good working knowledge of the following, as applicable:

- engineering drawing and work order notes regarding the lay up and vacuum bagging of aluminum alloy metal parts
- sections in the specifications regarding the lay up and vacuum bagging of aluminum alloy metal parts
- equipment used in the lay up and vacuum bagging of aluminum alloy metal parts (i.e., cutting tools, radiused Teflon and nylon blocks, vacuum gauges, leak detector gun, etc.)
- role and purpose of lay up and vacuum bagging materials (i.e., release film, vacuum bag, vacuum bag sealant, breather cloth, etc.)
- purpose of potting cells
- placement of thermocouples in bondlines
- why vacuum outlet placement is important
- significance of leak testing
- purpose of pleating the vacuum bag
- purpose of vacuum monitoring

8.4 Upon completion of training for spray coating aluminum alloy metal parts, the trainees shall have a good working knowledge of the following, as applicable:

- adhesive system used
- thickness requirements of the cured film
- how to adjust the equipment and/or method of application used for spray coating

8.5 Upon completion of training for curing aluminum alloy metal parts, the trainees shall have a good working knowledge of the following, as applicable:

- significance of cure temperature, pressure and time limits
- why the heat-up rate varies between certain parts in the same load
- significance of the heat-up and cooling rates
- effect of temperature and pressure on laid up aluminum alloy metal parts
- properties and characteristics of platen press and autoclave curing
- how to prepare a cure chart
- how to set up and operate the platen press and autoclave
- which parts have to be equipped with thermocouples
- cure charts and know which readings shall be recorded
- procedure for attaching thermocouple leads to connectors
- when to connect vacuum outlets to vacuum monitors
- limits on the heat-up and cool down rates
- 250°F, 280°F and 350°F cure cycles
- engineering drawing notes, PPS's, BAC's and shop orders