BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 25.30

PRODUCTION PROCESS STANDARD

BONDING USING DHMS A6.09 EPOXY ADHESIVE

Issue 20
- This standard supersedes PPS 25.30, Issue 19.
- Deletions has been made at this issue and, therefore, detail changes have not been noted.
- Direct PPS related questions to christie.chung@aero.bombardier.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

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

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Issue 20 - 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.

- Deleted DHMS A6.09 FR7010.

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Tables

1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for bonding aircraft parts and assemblies using DHMS A6.09 epoxy adhesive.

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.

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 BAERD GEN-018 - Engineering Requirements for Laboratories.

3.2 SAE AMS 2491 - Surface Treatment of Polytetrafluoroethylene (PTFE), Preparation for Bonding.

3.3 PPS 13.13 - Personal Protective Respiratory Equipment.

3.4 PPS 13.26 - General Subcontractor Provisions.

3.5 PPS 13.28 - Storage Life of Adhesives, Sealants, Paints and Composite Products.

3.6 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.7 PPS 25.66 - Cleanliness Requirements for Application of Adhesives.

3.8 PPS 31.17 - Solvent Usage.

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

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 DHMS A6.09 epoxy adhesive, available in 2-component kits (including Semkits), pre-catalysed (frozen) extrusion cartridge form or pre-catalysed (frozen) sheet as follows:

- DHMS A6.09: Two-component kits (including Semkits)
- DHMS A6.09-1: Pre-catalysed frozen sheet, 0.005" minimum thickness
- DHMS A6.09-2: Pre-catalysed frozen cartridge
- DHMS A6.09-3: High temperature performance (up to 350°F) - Two-component kits (including Semkits)

4.1.2 Abrasive paper, aluminum oxide, 180 grit size or finer.

4.1.3 Caulking cord, Nortell Co. NAPA, Stock No. F-4 (4414).

4.1.4 Quick freeze spray, Miller-Stephen Chemical Co. #MS-242N-AS.

4.1.5 Scotch-Brite pads, Type A fine (maroon colour), 3M Canada Ltd.

4.2 Equipment

4.2.1 Weighing scales, capable of weighing to within ± 0.5 grams.

4.2.2 Disposable wax-free paperboard containers (e.g., MELO take-out food containers).

4.2.3 Bristle brush, mohair roller, wooden or plastic spatula.

4.2.4 Light duty neoprene gloves (e.g., DSC 422-5).

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

4.2.6 Refrigeration unit capable of maintaining 0°F (-18°C) or lower.

4.3 Facilities

4.3.1 This PPS has been categorized as a Controlled Critical Process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform bonding aircraft parts and assemblies using DHMS A6.09 epoxy adhesive 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 Materials Technology 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 Toronto Materials Technology.

4.3.3.1 For approval of subcontractor facilities to perform bonding aircraft parts and assemblies using DHMS A6.09 epoxy adhesive 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 Except as noted below, ensure that bonding of DHMS A6.09 adhesive is performed in a clean area as specified in PPS 25.66. If it is necessary to perform bonding (in a clean area) when the relative humidity is up to 80%, use Dynamold DMS 4-828 epoxy adhesive. Ensure that the relative humidity does not exceed 80% until the adhesive is cured according to section 5.5.

5.2 Preparation of Parts

5.2.1 Ensure that the bonding surfaces of aluminum alloy and cadmium plated parts have been primed with F19 according to PPS 34.08.

5.2.2 Immediately before applying adhesive, prepare the bonding surfaces of each part according to Table I.

5.2.3 Do not touch prepared surfaces with bare hands nor contaminate the surface. Wear clean lint-free cotton gloves at all times when handling prepared bonding surfaces.

TABLE I - PREPARATION OF PARTS FOR BONDING

MATERIAL	CLEANING PROCEDURE
All F19 primed parts	Solvent clean according to PPS 31.17.
All F21 primed parts	Step 1. Lightly scuff F21 primed surfaces with a Scotch Brite pad to remove **only** the glossy appearance. Do not completely remove the F21 primer (i.e., No bare metal should be visible). Bare metal areas must be touched-up with F21 primer according to PPS 21.03 prior to bonding. Step 2. Solvent clean according to PPS 31.17.
All F24 painted parts (Note 1)	Step 1. Remove F24 topcoat by abrading using 180 grit abrasive paper or finer. Do not sand through the primer coating. Step 2. Solvent clean according to PPS 31.17.
Unprimed thermoset laminates including fibreglass, Kevlar and graphite composites	Step 1. Lightly scuff the bonding surfaces with 180 grit abrasive paper or finer. Do not scuff surfaces covered with peel ply. Step 2. Solvent clean according to PPS 31.17.
Parts protected with peel ply	Step 1. Remove peel ply. Step 2. Solvent clean according to PPS 31.17.
Teflon	Step 1. Ensure that the Teflon surface to be bonded has been treated (etched) in the bond area according to the requirements of SAE AMS 2491. Step 2. Solvent clean the treated (etched) bond area according to PPS 31.17.
Note 1. After bonding, locally re-apply F24 over exposed primer according to PPS 34.03.	

5.3 Preparation of Adhesive

5.3.1 Prepare DHMS A6.09 and DHMS A6.09-3 Semkits (Dual Cartridges) according to the manufacturer's instructions.

5.3.2 Prepare DHMS A6.09 and DHMS A6.09-3 two-component kit adhesive as follows:

Step 1. Remove the adhesive components from the refrigerated storage facility.

Step 2. In order to prevent condensation on the adhesive, allow the containers to warm to room temperature (such that no condensation appears on the containers) before opening them.

Step 3. Thoroughly stir the resin and hardener to a uniform consistency in their original separate containers.

Step 4. Weigh the resin into a disposable mixing container in 100 gram increments or fractions thereof. Prepare only sufficient material for the job at hand or which will be used up within the pot life of the material as specified in Table II. Do not mix very large quantities since dangerous heat and toxic fume buildup can occur when mixing adhesive components.

Step 5. Add the required amount of hardener directly to the resin on the weighing scale. Mixing ratios must be as specified in Table II. Do not weigh the hardener in a separate container.

Step 6. Stir the resin/hardener mixture thoroughly to obtain a homogeneous air-free mix.

5.3.3 Pre-catalysed adhesive is available from the supplier in frozen sheets (minimum thickness of 0.005") or in an extrusion cartridge form.

TABLE II - DHMS A6.09 ADHESIVE MIXING DATA

DHMS A6.09 ADHESIVE	ADHESIVE COMPONENTS	MIXING RATIO PARTS/WEIGHT	POT LIFE (Note 1)	CURE TO HANDLE (@ 75 ± 5°F)	FULL CURE (@ 75 ± 5°F)
Loctite EA 934NA Aero	EA 934 NA-A - RESIN	100	40 minutes	24 hours	5 days (Note 2)
	EA 934 NA-B - HARDENER	33			
Loctite EA 9394 Aero (Note 3)	EA 9394 A - RESIN	100		24 hours	5 days (Note 2)
	EA 9394 B - HARDENER	17			
Dynamold DMS 4-828	DMS-4-828-A - RESIN	100		4 to 5 hours	8 to 9 hours (Note 4)
	DMS-4-828-B - HARDENER	14.4			

Note 1. 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 2. Alternatively, heat cure for 1 hour at 150 ± 5°F.
Note 3. Loctite EA 9394 Aero is qualified to both DHMS A6.09 and DHMS A6.09-3 epoxy adhesive. This adhesive is also available as Semkits (Dual Cartridges), Loctite EA 9394S Aero. The Semkit differs from Loctite EA 9394 Aero as it has 1 part less thixotrope in the Part B to aid packaging.
Note 4. Alternatively, heat cure for 2 hours at 125 ± 5°F.

5.4 Application of Adhesive

5.4.1 General

5.4.1.1 Perform bonding of composites in a clean area according to PPS 25.66.

5.4.1.2 Prepare part bonding surfaces according to Table I.

5.4.2 DHMS A6.09 and DHMS A6.09-3 Two-Component Kits (Including Semkits)

5.4.2.1 When using DHMS A6.09 or DHMS A6.09-3 epoxy adhesive in the two-component kit or Semkit (dual cartridge), apply the adhesive to the bonding surface as follows:

Step 1. Apply a thin uniform coat (0.002" to 0.008") of adhesive to both bonding surfaces using a suitable bristle brush, mohair roller or spatula.

Step 2. Immediately following the application of the adhesive, assemble the parts to be bonded in the correct alignment and apply pressure by clamps, platen press or masking tape to ensure intimate contact over the full bonding area.

5.4.3 DHMS A6.09-1 Pre-Catalysed Frozen Sheets

5.4.3.1 When using DHMS A6.09-1 pre-catalysed frozen sheets, apply the epoxy adhesive as follows:

Step 1. Remove the sheet from the freezer.

Step 2. Remove the release paper from one side of the pre-catalysed sheet while it is still cold.

Step 3. Allow the pre-catalysed adhesive sheet to thaw to room temperature. The material will quickly become tacky and slight condensation, if any, will form and evaporate. Upon removal from the freezer, the pre-catalysed sheet can usually be applied to the surface within 30 minutes. The time for the material to thaw will vary with the ambient temperature.

Step 4. After the pre-catalysed sheet has thawed to room temperature, apply the sheet by bringing one end of the strip into contact with the surface and gently rolling the strip onto the surface. The rolling motion minimizes air entrapment. Use very light pressure when applying the strip. It is sometimes helpful to attach a small piece of adhesive tape to one end of the release paper to act as a handle.

Step 5. Remove the second piece of release paper by quickly cooling the surface using quick freeze spray. As the surface of the material cools and loses its tackiness, the release paper can be removed easily. After the release paper has been removed, the pre-catalysed sheet will quickly become tacky again and will be ready for assembly.

Step 6. Immediately following the application of adhesive, assemble the parts to be bonded in the correct alignment and apply pressure by clamps, platen press or masking tape to ensure intimate contact over the full bonding area.

5.4.4 DHMS A6.09-2 Pre-Catalysed Frozen Cartridges

5.4.4.1 When using pre-catalysed extrusion frozen cartridges of DHMS A6.09-2 epoxy adhesive, apply the adhesive as follows:

Step 1. Remove the cartridge from the freezer and allow the adhesive to thaw to room temperature.

Step 2. Extrude the adhesive onto both bonding surfaces. Spread the adhesive to a thin uniform coating (0.002" to 0.008") on each bonding surface using a suitable bristle brush, mohair roller or spatula.

Step 3. Immediately following the application of adhesive, assemble the parts to be bonded in the correct alignment and apply pressure by clamps, platen press or masking tape to ensure intimate contact over the full bonding area.

5.4.5 If the engineering drawing specifies potting using DHMS A6.09 adhesive and the formation of a temporary dam for adhesive injection, use the caulking material as specified in paragraph 4.1.3 for the dam and refer to the assembly manual for the applicable potting instructions. Do not use DHMS A6.09-1 for this application.

5.4.5.1 Allow the adhesive to cure for a minimum of 12 hours before removing the caulking material. Allow the adhesive to fully cure before any further working of the assembly.

5.5 Curing

5.5.1 Bonded Assemblies

5.5.1.1 Allow bonded assemblies to cure according to Table II before further handling.

5.5.1.2 If further working of the bonded assembly is required, allow the bonded assembly to fully cure according to Table II before any further working.

5.5.1.3 If an accelerated cure was used, record the date, time and curing temperature on the work order adjacent to the curing operation.

5.5.2 Potted Assemblies

5.5.2.1 After applying the adhesive and if no further working is required, allow the adhesive to cure for a minimum of 12 hours before handling the assembly.

5.5.2.2 Allow the adhesive to fully cure for at least 7 days at 75 ± 5°F and 50 ± 5% relative humidity or at least 2 hours at 160 ± 5°F before any further working of the assembly.

5.5.2.3 If an accelerated cure was used, record the date, time and curing temperature on the work order adjacent to the curing operation.

5.6 Clean-Up

5.6.1 Remove uncured adhesive from tools and equipment by solvent cleaning according to PPS 31.17.

6 REQUIREMENTS

6.1 Bonded parts must have intimate contact over the full bonding surface.

6.2 The bond is not acceptable if visual examination indicates poor adhesion.

6.3 Bonded parts must be cured according to section 5.5 before being further worked or installed into the aircraft.

7 SAFETY PRECAUTIONS

7.1 Keep adhesives and adhesive components away from fire and other sources of ignition.

7.2 Wear protective gloves when handling adhesive or adhesive components. Do not use protective hand cream which may cause contamination.

7.3 Avoid eye contact with adhesive and adhesive components. 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 complete irrigation of all eye and lid tissue. Contact the Health Centre and a physician.

7.4 Avoid skin contact with adhesive and adhesive components. If skin contact occurs, wash the affected area thoroughly with soap and water.

7.5 Avoid ingesting adhesive or adhesive components. If ingestion occurs, immediately contact the Health Centre and a physician.

7.6 Wear protective respiratory equipment according to PPS 13.13 when applying adhesive.

7.7 Ensure adequate ventilation is supplied when applying adhesives in confined areas.

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

7.9 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 Critical Process according to PPS 13.39. Refer to PPS 13.39 for personnel requirements.

9 STORAGE

9.1 If adhesive components was stored below room temperature, allow the containers to warm to room temperature (such that no condensation appears on the containers) before opening them.

9.2 The storage life of DHMS A6.09 adhesives must be as specified in DHMS A6.09.

9.2.1 When the storage life expires for a particular batch of two-component kit adhesives, the storage life may be extended if the shear strength on aluminum test panels results meets the requirements of DHMS A6.09 (i.e., 2500 psi minimum). Prepare and test the aluminum test panel according to DHMS A6.09. The shear strength test result must be based on the average of five (5) overlap shear specimens.

9.2.1.1 The first storage life extension will extend the storage life another 6 months. The second storage life extension will extend the storage life for a another 3 months. Subsequent extensions require MRB authorization and are subject to Bombardier Toronto Materials Technology approval. When requesting storage life extensions beyond the second storage life extension, include with the request all previous test results (i.e., receipt testing, 1st shelf life extension, 2nd shelf life extension, etc.).

9.2.2 Shelf life extension is not allowed for pre-catalysed adhesives (i.e., DHMS A6.09-1 and DHMS A6.09-2). Discard pre-catalysed frozen adhesives exceeding its shelf life.

9.3 Refer to PPS 13.28 for further receipt inspection and storage life requirements of DHMS A6.09 adhesive.

9.4 Always issue oldest stock first (i.e., first in/first out (FIFO) basis).

9.5 Clearly mark the containers of resin and hardener with storage life expiry date.

9.6 Keep adhesive component containers tightly closed when not in use.

9.7 Store adhesive components according to the precautions necessary for flammable materials.