BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 10.46

PRODUCTION PROCESS STANDARD

APPLICATION OF DECORATIVE FILM

Issue 9
- This standard supersedes PPS 10.46, Issue 8.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS related questions to christie.chung@aero.bombardier.com or (416) 375-7641.
- This PPS is effective as of the distribution date.

Prepared By:	(Christie Chung)	June 4, 2014
	PPS Group	
Approved By:	(L.K. John)	June 4, 2014
	Materials Technology	
	(A. Gordon)	June 9, 2014
	Quality	

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1 SCOPE

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the application of decorative film to interior components.

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 PPS 10.35 - Fabrication of 250°F Cure Aramid Fibre Reinforced Epoxy Parts.

3.2 PPS 10.38 - Repair of Decorative Film Covered Components.

3.3 PPS 10.40 - Repairs to Pre-Impregnated Laminates and Sandwich Panels.

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 25.31 - Bonding using Bostik/Boscodur Adhesive.

3.8 PPS 25.55 - Bonding using DHMS A6.11 Type II Class 1 Adhesive.

3.9 PPS 31.17 - Solvent Usage.

4 MATERIALS, EQUIPMENT AND FACILITIES

4.1 Materials

4.1.1 Laminate (Film), plastic, interior, decorative to DHMS P1.28 (Colour to DS 82).

4.1.2 Abrasive paper, aluminum oxide, 120 to 180 grit.

4.1.3 Abrasive paper, aluminum oxide, 240 grit or finer.

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

4.1.5 Tack cloths (e.g., DSC 375-1).

4.1.6 Composite manufacture expendable materials to DSC 234 (refer to Table I).

TABLE I - LIST OF EXPENDABLE MATERIALS TO DSC 234

MATERIAL DSC 234	MATERIAL TYPE
-1	Nylon Vacuum Bagging Film, 250°F Cure Cycle
-9	Breather/Bleeder Cloth, Non-Woven Polyester, Max Pressure 50 psi.
-15	High Temperature Pressure Sensitive Tape
-17	Vacuum Bag Sealant

4.2 Equipment

4.2.1 Support tools (e.g., TS.298.XX.XX).

4.2.2 Vacuum press capable of maintaining a vacuum of up to 24" Hg (12 psi) and a temperature of up to 120 ± 5°C (250 ± 10°F). An oven with a separate vacuum supply may be used provided the vacuum and temperature requirements are met.

4.2.3 Heat guns capable of heating the decorative film to 100°C (212°F).

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

4.3 Facilities

4.3.1 This PPS has been identified as a “Critical or Special” process according to PPS 13.39 and as such only facilities specifically approved according to PPS 13.39 are authorized to perform the application of decorative film to interior components according to this PPS.

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

4.3.3 Facility approval shall be based on a facility report, a facility survey and completion of a qualification test program, if required. The facility report shall detail the materials and equipment to be used, the process sequence to be followed and the laboratory facilities used to show compliance with the requirements of this PPS. Any deviation from the procedure or requirements of this PPS shall be detailed in the facility report. Based upon the facility report, Bombardier Toronto Engineering may identify additional qualification and/or process control test requirements. During the facility survey, the facility requesting qualification shall be prepared to demonstrate their capability. Once approved, no changes to subcontractor facilities may be made without prior written approval from Bombardier Aerospace Supplier Quality Management.

4.3.3.1 For approval of subcontractor facilities to perform the application of decorative film to interior components according to this PPS, completion of a test program and submission of suitable test samples representative of production parts is required. Test samples shall meet the requirements specified in section 6.

5 PROCEDURE

5.1 General

5.1.1 Decorative film is commonly referred to as “Dec Lam”.

5.1.2 Apply decorative film only to components which have passed component manufacture inspection including spot filling of local surface imperfections according to PPS 10.40.

5.1.3 DHMS P1.28 film is used as a decorative facing material for aircraft interior components of composite construction. DHMS P1.28 film is constructed of several layers of plastic laminated together to form a thin, flexible film. DHMS P1.28 film is classified as follows:

- TYPE - Defines construction materials of the laminated film.
- CLASS - Refers to the adhesive system applied by the supplier:
  - CLASS 1 - no adhesive coating
  - CLASS 2 - heat activated adhesive coating (Superseded by CLASS 2A)
  - CLASS 2A - heat activated adhesive coating

5.1.4 The decorative film is called up on the engineering drawing, shop order and Bill of Material (BOM) by a DS 82 number. The rolls of decorative film are also identified by the applicable DHMS number, Class and Type.

5.1.5 Locate work areas for the application of decorative film away from machinery operations or conditions which would generate dust or other contaminating particles.

5.1.6 Apply decorative film according to Flow Chart 1.

5.2 Preparation of Decorative Film

5.2.1 Prepare decorative film as follows:

Step 1. Remove the appropriate roll of decorative film from its storage tube and place it on a clean, flat surface.

Step 2. Unroll the material, decorative face up, and check for defects. Do not use areas of film containing defects to cover a component. Ensure that the film is uniform in quality, colour and condition and free from streaks, lumps, delamination or any other imperfection or foreign matter that would adversely affect its appearance or serviceability. Do not use sections of decorative film flagged by the supplier to cover a component; discard such areas of film.

Step 3. Cut off a piece of film large enough to cover the part surface leaving a 2" surplus all around while ensuring, if applicable, that the pattern orientation is as specified by the engineering drawing.

Step 4. Return the unused portion of the roll of film to its storage tube.

Step 5. For DHMS P1.28, Class 1, decorative film, prepare and apply one coat of Bostik/Boscodur adhesive according to PPS 25.31, to the contact side of the decorative film. For DHMS P1.28 Class 2A decorative film, simply remove the backing paper from the film; it is not necessary to apply adhesive to the contact side of DHMS P1.28 Class 2A film.

5.3 Preparation of Components

5.3.1 Prepare window reveals according to paragraph 5.3.2. Prepare components other than window reveals as follows:

Step 1. Lightly scuff the bond surface with 240 grit, or finer, aluminum oxide abrasive paper to remove the gloss only.

Step 2. Solvent wipe the scuffed area according to PPS 31.17.

5.3.2 Prepare window reveals as follows:

Step 1. Drill 1/64" diameter air bleed holes in the window reveal at all locations where air may be entrapped during the vacuum forming process. Ensure that the holes penetrate completely through the part, including the inner skin on honeycomb panels. A 1/4" spacing is typical for deep draw or sharp bend areas, while a spacing of 3" - 4" may be sufficient in shallow draw or gentle bend areas (see Figure 1).

Step 2. Scuff the surface of the component with 120 - 180 grit abrasive paper.

Step 3. Remove fuzz caused by drilling of air bleed holes from the surface using abrasive paper.

Step 4. Wipe the component with a clean, dry wiping cloth and then tack-rag the surface.

Step 5. Prepare and apply one coat of Bostik/Boscodur adhesive according to PPS 25.31, to the bonding surface of the component. This applies regardless of the class of film to be applied or the method of bonding. Do not solvent wash the component before applying adhesive as solvent may become entrapped, particularly in honeycomb cells, causing blistering of the decorative film during application. Avoid heavy brush marks as they will show through the decorative film.

Step 6. During the adhesive air drying period, puncture all air bleed holes with a pin as they will have become plugged with adhesive.

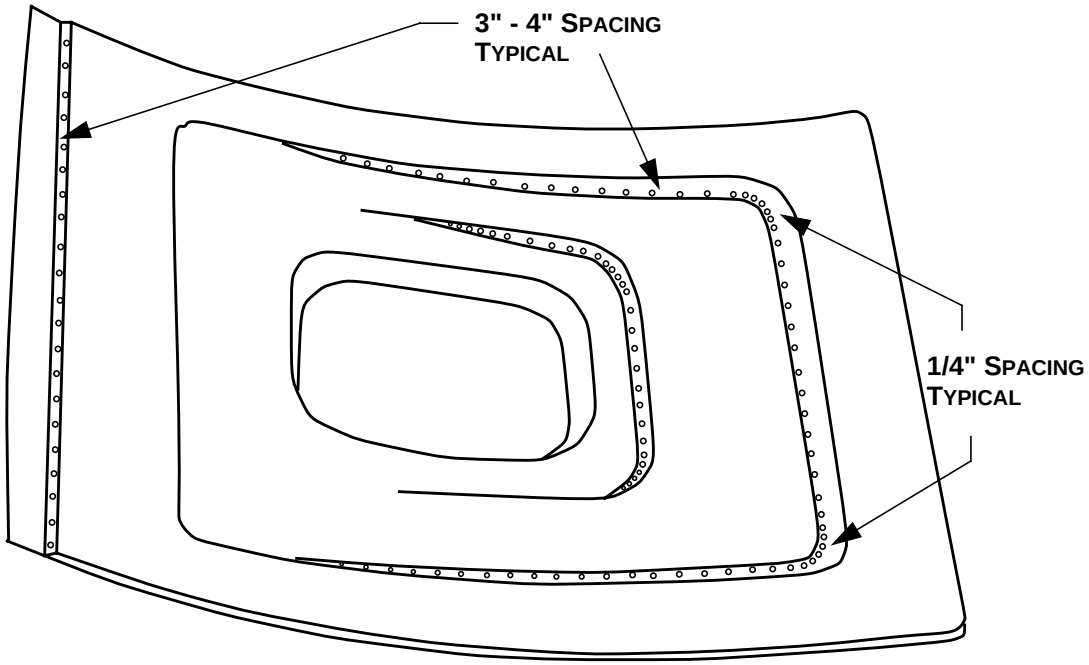

FIGURE 1 - AIR BLEED HOLES

5.4 Application of Decorative Film

5.4.1 Apply decorative film as follows:

Step 1. If a support tool is to be used, place a layer of DSC 234-9 breather cloth on the tool and then place the component on the breather cloth.

Step 2. Position the decorative film on the component, ensuring that the pattern orientation, if applicable, is as specified on the relevant engineering drawing.

Step 3. Trim the decorative film 1" to 2" around component profile.

Step 4. In deep draw areas, such as the window reveal panels, it is necessary to cut a hole in the film, again leaving 1" to 2" extra. Provided that the cut-out is smooth, this hole reduces the possibility of tearing during forming.

Step 5. If a support tool is being used, tape the corners of the film to the tool using DSC 234-15 high temperature pressure sensitive tape. If no support tool is being used, heat tack the corners of the film to the part using a heat gun.

Step 6. On deep draw components, or components with severe double curvatures, it may be necessary to heat tack the edges in position to minimize bridging and wrinkling. In some cases it may be advantageous to fold over the edges by hand before thermoforming.

5.5 Application of Heat and Pressure

5.5.1 General

5.5.1.1 The vacuum press procedure specified herein is applicable to the OLD ACRE vertical lift vacuum press, but would be equally applicable, with slight modifications, to any vacuum table with overhead heaters.

5.5.1.2 Apply heat and pressure to the assembly by the vacuum press (standard or alternative method) according to section 5.5.2, vacuum bagging according to section 5.5.3 or by hand lay-up according to section 5.5.4, to thermoform the decorative film to the part contour and to reactivate the adhesive.

5.5.1.3 If the decorative film fails to bond in the area of a radius employ the procedure specified in section 5.5.5.

5.5.1.4 Do not carry out bonding when the humidity exceeds 60% or when the temperature is greater than 30°C (85°F) or lower than 16°C (60°F).

5.5.2 Vacuum Press Methods

5.5.2.1 All parts to be thermoformed on the vacuum press require a support tool, including flat parts which require a flat base plate, as the vacuum press bed is not flat.

5.5.2.2 When using the standard method, pressure is applied to the part by the vacuum diaphragm. The heat lamps are then lowered to heat up the decorative film, adhesive and component. This provides the necessary film to substrate contact pressure and heat to thermoform the film (where applicable on compound curvatures) and reactivate the adhesive.

5.5.2.3 Since the standard method provides a longer heat soak cycle, it is preferred for deep draw forming. However, it also necessitates perfectly matched back-up support tooling to prevent component distortion under high heat. In addition, surface defects such as telegraphing of core splices, doublers, inserts and foam edging may develop.

5.5.2.4 When using the alternate method, the vacuum diaphragm is heated with the heat lamps before being lowered onto the component. The diaphragm and lamps are lowered simultaneously, but the heat lamps are removed as soon as full vacuum is achieved and cooling is initiated. This provides the necessary film to substrate contact pressure as well as sufficient heat to reactivate the adhesive. Since little heat is transferred to the component using the alternative method, distortion is minimized. This method can be used where perfect match tooling is not available.

5.5.2.5 Apply heat and pressure using the standard vacuum press method as follows:

Step 1. Place the assembly, with its support tool, onto the vacuum press bed.

Step 2. Place a layer of DSC 234-9 breather cloth over the decorative film covered component.

Step 3. Lower the vacuum diaphragm and lock it into position.

Step 4. Apply a vacuum of 2" Hg to 5" Hg and visually check the assembly to ensure that the vacuum diaphragm is properly forming over the part.

Step 5. Lower the heat lamps.

Step 6. Follow the applicable heat/pressure cycle shown in Figure 2 or Figure 3, as applicable.

Step 7. When the part has cooled to 45°C (113°F), release the vacuum, raise the vacuum diaphragm, and remove the component.

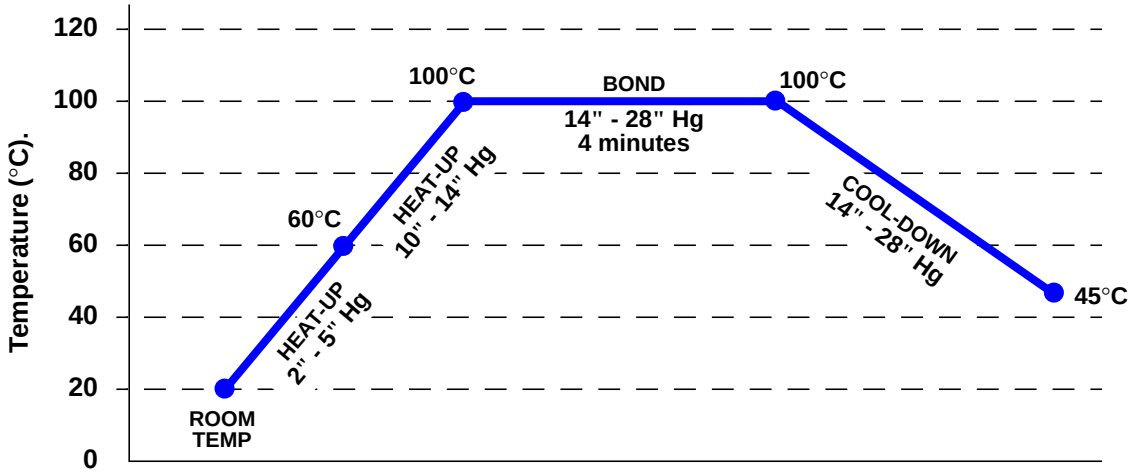

FIGURE 2 - VACUUM PRESS STANDARD METHOD CURE CYCLE DHMS P1.28 TYPES 8 & 10

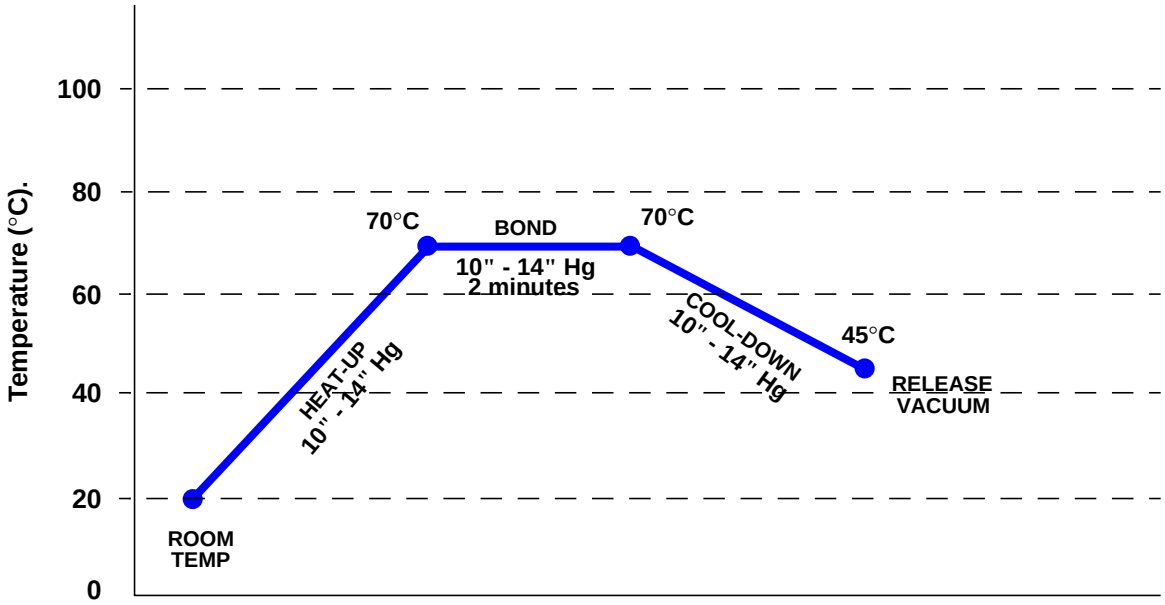

FIGURE 3 - VACUUM PRESS STANDARD METHOD CURE CYCLE FOR DHMS P1.28 TYPES OTHER THAN 8 & 10

5.5.2.6 Apply heat and pressure using the alternate (quick-draw) vacuum press method as follows:

Step 1. Place the assembly, with its support tool, onto the vacuum press bed.

Step 2. Place a layer of DSC 234-9 breather cloth over the decorative film covered component.

Step 3. With the heat lamps and the vacuum diaphragm in the raised position, heat the vacuum diaphragm to the temperature shown below. The monitor thermocouple must be attached to the diaphragm.

- DHMS P1.28 All Types except 8 & 10 - 95°C (203°F)
- DHMS P1.28 Types 8 & 10 - 120°C (248°F)

Step 4. Lower the vacuum diaphragm, together with the heat lamps, and apply a vacuum of 10" Hg to 14" Hg.

Step 5. As soon as the desired vacuum pressure is reached raise the heat lamps and commence cooling.

Step 6. When the part has cooled to 45°C (113°F), release the vacuum, raise the vacuum diaphragm, and remove the component.

5.5.3 Vacuum Bag Method

5.5.3.1 Apply heat and pressure using the vacuum bag method as follows:

Step 1. Cover the face of the component with DSC 234-9 breather cloth. When the component is not on a support tool, also cover the back of the component with DSC 234-9 breather cloth.

Step 2. Seal the assembly (component, film and, where applicable, support tool) with DSC 234-1 vacuum bagging film and DSC 234-17 vacuum bag sealant.

Step 3. Apply 2" Hg to 5" Hg of vacuum.

Step 4. Transfer the bagged assembly to an oven or the vacuum press bed.

Step 5. Heat the bagged assembly to 70°C (158°F) for 4 to 6 minutes while maintaining a vacuum of 10" Hg to 14" Hg.

Step 6. Remove the part from the oven or vacuum press bed and allow it to cool to 45°C (113°F) prior to releasing the vacuum.

5.5.4 Hand Lay-Up Methods

5.5.4.1 The hand lay-up method is used to apply heat and pressure to flat, single curvature, or very mildly contoured components in those instances in which it is not possible to use the vacuum press or vacuum bag methods. Apply the heat and pressure necessary to achieve a bond using a heat gun and rubber roller or by “pressing” with a clothes iron.

5.5.4.2 When heating with a heat gun, direct the heat onto the decorative film long enough to heat the film and the adhesive on the surface of the component to 70°C to 100°C (158°F to 212°F), while applying pressure with the roller. When using an iron, set the heat at slightly over 100°C (212°F) and move the iron so that the temperature of the film and the adhesive on the surface of the component reaches 70°C to 100°C (158°F to 212°F). To protect the surface of the decorative film it is necessary to place a layer of DSC 234-9 bleeder cloth over the film to prevent direct iron contact with the film surface. If necessary, use remote temperature sensing equipment to verify that the bond line has been heated to the appropriate temperature.

5.5.4.3 Apply heat and pressure using the hand lay-up method as follows:

Step 1. Position the film on the component, matching the patterns if required.

Step 2. Starting at the center of one edge, bond the film to the component. If pattern matching is required, start bonding at that edge.

Step 3. Work outwards from the center, progressively heating a small section at a time. Check each section, immediately after rolling or ironing, for blisters (entrapped air) and wrinkles. Remove any blisters by, if possible pushing them with a roller to the nearest edge while heating a path with the heat gun, by pricking the blister at one end and pushing the air towards the hole with the roller, or, if there is no other choice, by de-bonding the film back to the blister using a heat gun and then re-bonding. Remove wrinkles by de-bonding the film back to the wrinkle using a heat gun and then re-bond. Use a heat gun and appropriately shaped rubber rollers to form the film over mild contours. Heat cure each section at 70°C (158°F) for 3 to 4 minutes.

Step 4. Roll down any bubbles present after heat curing (indicative of solvent entrapment) with a rubber roller or by needle pricking, provided no appearance defect will result.

5.5.5 Bonding Difficult Radii

5.5.5.1 Bond difficult radii as follows:

Step 1. Apply vacuum locally.

Step 2. Heat the area with a heat gun to a temperature of 70°C to 100°C (158°F to 212°F). If necessary, use remote temperature sensing equipment to verify that area has been heated to the appropriate temperature.

Step 3. Use a teflon wedge to press the decorative laminate into the radius.

Step 4. Allow the area to cool to 45°C (113°F) before releasing the vacuum.

5.6 Finishing Edges

5.6.1 After film application has been completed, it is normally necessary to fold the film back over the edges. Refer to the engineering drawing for specific details. Finish edges as follows:

Step 1. Trim off excess decorative film leaving sufficient for fold back to the dimensions shown on the drawing, normally approximately 3/8" (see Figure 4).

Step 2. At corners it will be necessary to notch or slit the film as shown in Figure 4.

Step 3. Apply a thin uniform coat of DHMS A6.11 Type II Class I adhesive, prepared and applied according to PPS 25.55, to both the decorative film and the component in the fold back area.

Step 4. Allow the adhesive to air dry until it becomes tacky but does not transfer to the fingers when lightly touched.

Step 5. Fold the film over and press down firmly (see Figure 4). If the adhesive has dried too long, reactivate it with a heat gun. A heat gun may also be used to assist in forming the film.

Step 6. Trim off the excess foldback as required (see Figure 5).

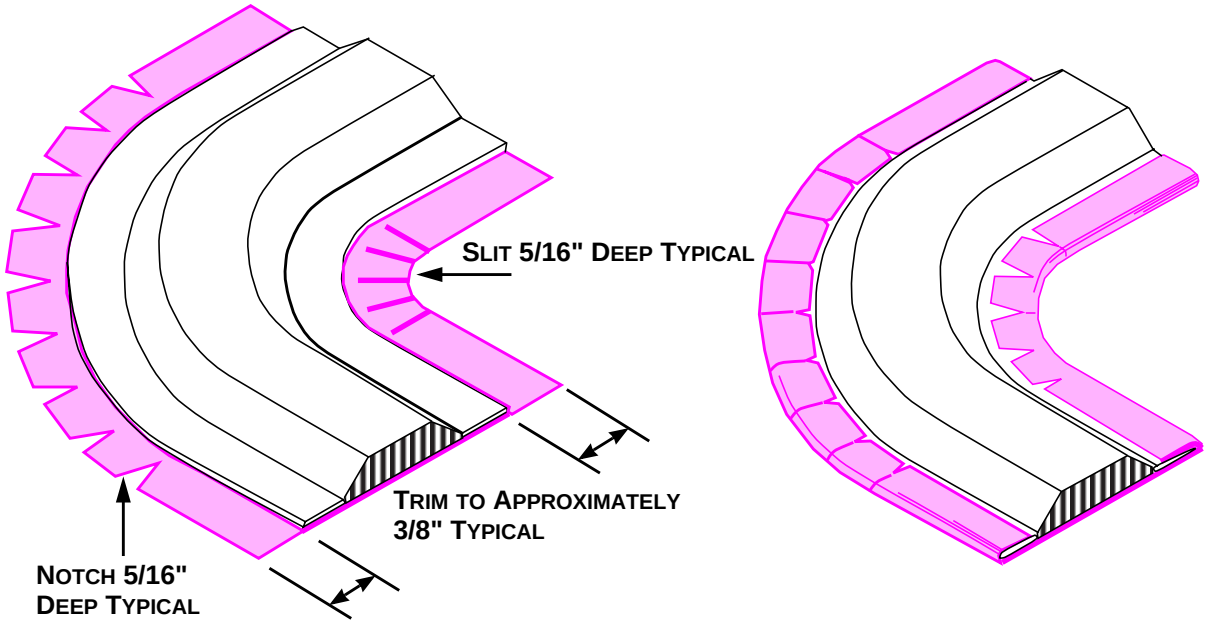

FIGURE 4 - EDGE FOLD-BACK

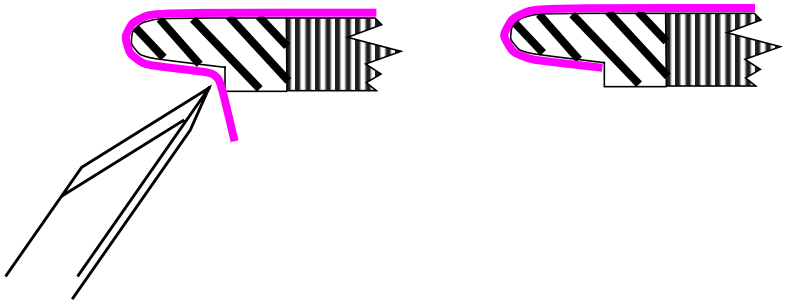

FIGURE 5 - TRIMMING EXCESS FOLD-BACK

5.7 Clean-Up

5.7.1 Clean up after bonding and finishing as follows:

Step 1. Remove dirt, fingerprints, etc. from decorative film using warm water and detergent.

Step 2. Remove excess adhesive from decorative film by solvent wiping according to PPS 31.17. Test the solvent on a scrap piece of film before using.

5.7.2 Remove adhesive from tools and work area by solvent cleaning according to PPS 31.17.

6 REQUIREMENTS

6.1 Except as is noted below, the decorative film shall be uniform in quality, colour and condition. It shall be free from streaks, lumps, delamination or any other imperfection or foreign matter that would adversely affect its appearance or serviceability. Examine the decorative film for specks, under a minimum 35 foot candles of lighting intensity at the surface of the decorative film and from a distance of 3 feet with the material in a vertical position; specks on the decorative film are acceptable provided that the following conditions are met:

- no speck is 1/32" or greater in diameter or length
- no more than 3 specks per 9 square feet
- the specks do not appear as perforations
- no speck disrupts the pattern of the laminate
- the specks do not form a single conspicuous spot
- the specks do not form a line

6.2 Refer defects in the panel visible through the decorative film, such as telegraphing of core cell walls, inserts, foam edges, core splices, hardpoints, etc., which exceed the acceptable limits, as specified in PPS 10.35, to Bombardier Toronto MRB or Bombardier Toronto delegated MRB for repair authority and authority to remove the decorative film. If repair is authorized, repair using the procedure specified by MRB.

6.3 Ensure that the maximum warpage of the panel is no more than 0.025" per foot length of the panel.

6.4 Ensure that the completed assembly is free of wrinkles, stains (not removable by washing), cuts or tears (completely through film), surface scratches or abrasions (partially through film), bumps (contamination entrapped on glue line), lack of adhesion on edges, entrapped air, blisters, voids or delaminations. Repair defects according to PPS 10.38. On low visibility items, such as dado panels and sidewall panels below the window reveals, bumps (contamination entrapped on glue line), within the following limits, do not require repair:

- maximum diameter - 1/8"
- maximum height - 0.020"
- maximum 2 per panel

7 SAFETY PRECAUTIONS

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

8 PERSONNEL REQUIREMENTS

8.1 This PPS has been categorized as a “Critical or Special Process” according to PPS 13.39. Refer to PPS 13.39 for personnel requirements.

9 STORAGE OF DECORATIVE LAMINATE MATERIAL

9.1 Store DHMS P1.28 decorative laminate at 24 ± 3˚C (75 ± 5˚F) and 30 to 70% relative humidity.

9.2 Store unused decorative laminate in its original manufacturer’s packaging.

9.3 Ensure DHMS P1.28 Class 2 decorative laminate are protected with a release liner of such construction that the adhesive is not affected.

9.4 Refer to PPS 13.28 for the storage life of DHMS P1.28 Class 2 and Class 2A decorative laminate. As DHMS P1.28 Class 1 does not have an adhesive coating, storage life requirements as specified in PPS 13.28 are not applicable. However, ensure that the decorative laminate manufacturer’s storage life has not been exceeded.

9.5 Issue decorative laminate material on a first in/first out basis but do not issue material to production if the storage life expiry date has passed.

FLOW CHART 1 - APPLICATION OF DECORATIVE FILM