BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 17.03

PRODUCTION PROCESS STANDARD

Saturation Shot Peening

Issue 25
- This standard supersedes PPS 17.03, Issue 24.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- This PPS is effective as of the distribution date.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for saturation shot peening.

1.1.1 As an alternative to the procedure and requirements specified herein, it is acceptable to perform saturation shot peening according to BAPS 185-002.

- Perform saturation shot peening according to the procedure and requirements of either BAPS 185-002 or this PPS in their entirety; a piecemeal approach utilizing certain sections or portions of BAPS 185-002 and this PPS is **not** acceptable.
- Subcontractor facilities which have been approved by Bombardier to perform saturation shot peening according to BAPS 185-002 are considered approved to perform saturation shot peening according to this PPS without further approval needed.
- PPS Process Standard Deviations (PSD's) issued against this PPS are **not** applicable to BAPS 185-002. Likewise, requests for deviation (RFD's) allowed against BAPS 185-002 are not applicable to this PPS.
- When processing parts according to BAPS 185-002 as an alternative to processing parts according to PPS 17.03, deviations allowed by an approved RFD against BAPS 185-002 may be used unless a specific limitation regarding program applicability is specified by the RFD comments/restrictions.

1.1.2 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS (or BAPS 185-002, as referenced in para. 1.1.1) must be followed to ensure compliance with all applicable specifications and to fulfil the engineering design and reliability objectives. In general, if this PPS (or BAPS 185-002) conflicts with the engineering drawing, follow the engineering drawing.

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

2 Hazardous Materials

2.1 Before receipt at Bombardier Toronto (de Havilland), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Toronto (de Havilland) 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 (de Havilland) Environment, Health and Safety Department.

3 References

3.1 General

3.1.1 Unless a specific issue is indicated, the issue of the reference documents specified in this section in effect at the time of manufacture shall form a part of this specification to the extent indicated herein.

3.2 Bombardier Toronto (de Havilland) Specifications

3.2.1 PPS 13.26 - General Subcontractor Provisions.

3.2.2 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.2.3 PPS 17.02 - Abrasive Blast Cleaning.

3.2.4 PPS 27.02 - Edge Finishing Aluminum Alloy Parts.

3.2.5 PPS 27.04 - Edge Finishing of Titanium Alloy Parts.

3.2.6 PPS 27.10 - Edge Finishing Steel, Nickel and Copper Alloy Parts.

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

3.2.8 PPS 31.03 - Cleaning of Carbon and Low Alloy Steels.

3.2.9 PPS 31.05 - Surface Treatment of Corrosion Resistant Steel.

3.2.10 PPS 31.07 - Cleaning and Stripping of Painted Surfaces.

3.2.11 PPS 31.09 - Cleaning of Titanium and Titanium Alloys.

3.2.12 PPS 31.12 - Cleaning of Nickel and Nickel Alloys.

3.2.13 PPS 31.17 - Solvent Usage.

3.2.14 PPS 34.08 - Application of Epoxy -Polyamide Primer (F19 and F45).

3.3 Industry Specifications

3.3.1 AMS2430 - Shot Peening, Automatic.

4 Materials, Equipment and Facilities

4.1 Materials

4.1.1 Unless otherwise specified in this section, use only the materials specified; use of superseding or alternative materials is not allowed.

4.1.2 Almen test strips to SAE J442.

4.1.3 Cast steel shot to AMS-S-851, AMS 2431/1, AMS 2431/2 or SAE J827.

4.1.4 Cut wire shot to AMS 2431/3, AMS 2431/4, AMS 2431/8 or SAE J441.

4.1.5 Corrosion preventive compound (e.g., Esso Rust Ban 632 (MIL-C-6529 Type II) or Esso Rust Ban 392).

4.1.6 Expandable protective sleeving (e.g., Dupont VEXAR).

4.1.7 Glass shot to AMS 2431.

4.1.8 Polyethylene foam sheet, approximately 1/4" thick (e.g., Cellaire CA-250).

4.1.9 Maskant - Mask surfaces that are required to remain unpeened by means of tape or film of adequate thickness to protect the surfaces. Holes may be masked by means of rubber plugs or other means that provide adequate protection without interfering with the peening of adjacent areas.

4.2 Equipment

4.2.1 Automated and manual shot peening machines capable of consistently reproducing the required shot peening intensities. Shot peening machines must include a separator for the continuous removal of broken shot during shot peening.

4.2.2 Almen strip deflection measurement gauge (e.g., as specified by SAE J442).

4.2.3 Almen test strip holding fixtures to SAE J442. For roto peening, use a magnetic Almen strip holder suitable for determining roto peen intensity.

4.2.4 Tungsten carbide shot bonded roto peening flap assemblies to MIL-W-81840 (e.g., 3M Type TC330, 9/16" x 1 1/4" and 1" x 2" flap sizes). Before use on production parts, condition new flaps for one minute using a suitable piece of scrap metal similar to the parts to be peened. Replace flaps when 3 or more shots have been lost.

4.2.5 Roto peening mandrels (e.g., 3M 7210 and 7211 for use with 9/16" x 1 1/4" and 1" x 2" flap sizes, respectively).

4.3 Facilities

4.3.1 This PPS has been categorized as a “Controlled Critical Process” according to PPS 13.39. Except as noted in para. 4.3.1.1, only facilities specifically approved according to PPS 13.39 are authorized to perform saturation shot peening according to this PPS.

4.3.1.1 Facilities approved to perform saturation shot peening according to BAPS 185-002 are also considered approved to perform saturation shot peening according to this PPS without further approval needed (i.e., approval according to PPS 13.39 is not required).

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 shall 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 (de Havilland) 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 Aerospace Supplier Quality Management.

4.3.3.1 Unless otherwise specified by Bombardier Aerospace Supplier Quality Management, for approval of subcontractor facilities to perform saturation shot peening 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.

5 Procedure

5.1 General

5.1.1 For the purposes of this PPS, the following definitions apply:

Coverage - 100% coverage is defined as uniform and complete obliteration of the original part surface with overlapping dimples, as viewed under at least 10X magnification, after shot peening. Coverage over 100% is measured in terms of multiples of time “t” (e.g., if the engineering drawing specifies 200% coverage, this requires that the part be shot peened for at least twice as long as required for 100% coverage or “2t”).

“t” - The time required to achieve 100% coverage when processing actual parts.

“T” -The time required to achieve Almen strip saturation.

Almen Strip Saturation -The earliest point in a curve representing almen strip arc height versus peening time where doubling the peening time will result in not more than a 10% increase in the arc height.

Rollover - Rollover is an edge condition in which metal is deformed such that the edge starts to curl or fold over.

Bulging - Bulging is an edge condition in which the metal is deformed such that material adjacent to the edge is forced out of the surface plane. Evidence of bulging is observed visually as areas of raised metal (ridges) along an edge.

5.1.2 Saturation shot peening of metal parts is generally carried out in order to induce residual compressive stresses in specified surfaces for the purpose of increasing the fatigue strength and resistance to stress corrosion cracking. The degree of residual stress is expressed in terms of intensity and is determined by measuring the deflection (longitudinal arc) induced in a specific test strip by the saturation shot peening operation.

5.1.3 Only perform saturation shot peening if it is specified by the engineering drawing.

5.1.4 Before saturation shot peening, ensure that all parts meet the dimensional requirements specified by the engineering drawing.

5.1.5 Unless otherwise specified by the engineering drawing, for automated processes the total required shot peening time is the longer of the time required for 100% coverage ("t") or the time required for Almen strip saturation ("T"). For manual processes, the total required shot peening time is the longer of "2t" or "2T". For automated processes, if the engineering drawing specifies more than 100% coverage (e.g., 200%) the total required shot peening time is the longer of the time required for the required coverage (e.g., "2t") or the time required for Almen strip saturation ("T").

5.1.6 Unless otherwise specified by the engineering drawing, ensure that the following operations (as applicable) are completed before saturation shot peening.

- all heat treatment
- forming (including shot peen forming)
- straightening
- machining
- polishing
- magnetic particle inspection
- fluorescent penetrant inspection
- removal of all gouges, dents, scratches, or burrs
- proper forming and breaking of fillets
- breaking part edges

5.1.7 Use an automated process to saturation shot peen parts (i.e., move the work by mechanical means through the shot stream in either translation or rotation). Only use manual shot peening equipment when approved by Engineering.

5.1.8 Take care to avoid excessive peening which could result in rollover or bulging of part edges or erosion.

5.1.9 Use Almen test strips once. Once an Almen strip has been peened and removed from the fixture, it cannot be re-used.

5.2 Preparation of Parts

5.2.1 Prepare parts for shot peening as follows:

Step 1. Ensure that all part edges and corners have been edge finished (i.e., rounded) according to PPS 27.02, PPS 27.04 or PPS 27.10, as applicable.

Step 2. Strip areas to be saturation shot peened of all protective coatings (paint, primer, chemical conversion coating, etc.) according to PPS 31.07.

Step 3. Clean the parts according to PPS 31.02, PPS 31.03, PPS 31.05, PPS 31.09 or PPS 31.12, as applicable.

Step 4. Mask off all areas which do not require saturation shot peening.

5.3 Set-Up Procedure

5.3.1 Before processing an initial batch of parts, use the set-up procedure specified below to establish the correct nozzle distance, air pressure (or wheel speed, table travel, or rotation speed), shot size, and shot peening time to produce the desired intensity. If the engineering drawing does not specify a maximum shot size or intensity range, refer to Table 3 for a list of recommended shot sizes and intensities. Obtain engineering approval before using a shot size or intensity not listed on the engineering drawing.

Step 1. Mount the appropriate number of Almen test strips in holding fixtures suitably placed (e.g., on a part verification tool (PVT)) so as to simulate the surface of the parts to be saturation shot peened. If specified by the engineering drawing, mount the test strips directly on an equivalent scrap part. If the engineering drawing specifies particular positions for the placement of Almen strips, ensure that those particular locations are included in the placement of Almen strips; if the Almen strip locations specified by the engineering drawing do not represent all the surfaces to be shot peened, ensure that additional Almen strips are placed along with those specifically indicated by the Engineering drawing so as to simulate the entire surface of the part.

Step 2. Set the shot peening machine to a suitable distance and air pressure (or wheel speed).

Step 3. Select the shot. When saturation shot peening fillets, ensure that the nominal diameter of the shot used is less than 1/2 the fillet radius. If the shot must pass through recesses or apertures, ensure that the nominal diameter of the shot used is less than 1/4 of the width of the opening. It is acceptable to use cut wire shot in place of cast steel shot provided that the following conditions are met:

- The size of cut wire shot used must be equivalent to the size of cast steel shot specified.
- Cut wire shot must be “conditioned” before use on production parts (i.e., cut edges must be pre-rounded by suitable means before shot use).
- All other requirements of this PPS or the engineering drawing must be met (e.g., coverage, intensity, shot uniformity control, etc.).

Step 4. Establish a saturation curve (e.g., as shown in Figure 1) for each surface orientation by shot peening a series of Almen strips for increasing periods of time. Determine the saturation point using a "best fit" curve with a minimum of four points besides the origin. At least one of the Almen strips used to establish each saturation curve must have been shot peened for at least double the time of the indicated saturation point. As applicable, arc height versus displacement speed or arc height versus number of passes may be used instead of arc height versus time.

Step 5. Use the process parameters determined above to shot peen an actual part. Alternatively, a piece of material of the same alloy and heat treat condition and similar configuration as the parts to be processed may be used. Determine the time, "t", required to achieve 100% coverage. If you are peening an actual part and the time required for Almen strip saturation ("T" - as determined in Step 4) is longer than the time required for 100% coverage ("t"), continue to peen the part until time "T" is reached.

Step 6. Prepare and maintain a technique sheet for each part. The technique sheet must, as a minimum, contain the following information:

- Part number, Issue date and revision number.
- Alloy, temper, and material specification of the part.
- Part description as called out on the drawing.
- Intensity.
- Shot peen machine set-up (i.e., air pressure or wheel speed, travel or rotation speed of table, number of nozzles, nozzle positions, nozzle sizes, etc.).
- The time required for Almen strip saturation (time "T")
- The time required to reach 100% visual coverage (time "t").
- The total required shot peening time. Unless otherwise specified by the engineering drawing, for automated processes this is the longer of the time required for 100% coverage ("t") and the time required for Almen strip saturation ("T"). For manual processes, this is the longer of "2t" or "2T".
- Machine number
- Sequence of operations.
- Any fixtures required to hold the part during peening.
- Any areas to be masked during peening.
- Shot size, type, and hardness.
- Sketches showing peening set-up (i.e. almen strip placement, peen pattern, nozzle wheel set-up, impingement angle, etc.)

Step 7. Maintain technique sheets for each part number and machine used. Revise technique sheets if the configuration of the part changes or machine modifications are made. Follow the procedure specified above to validate the revisions.

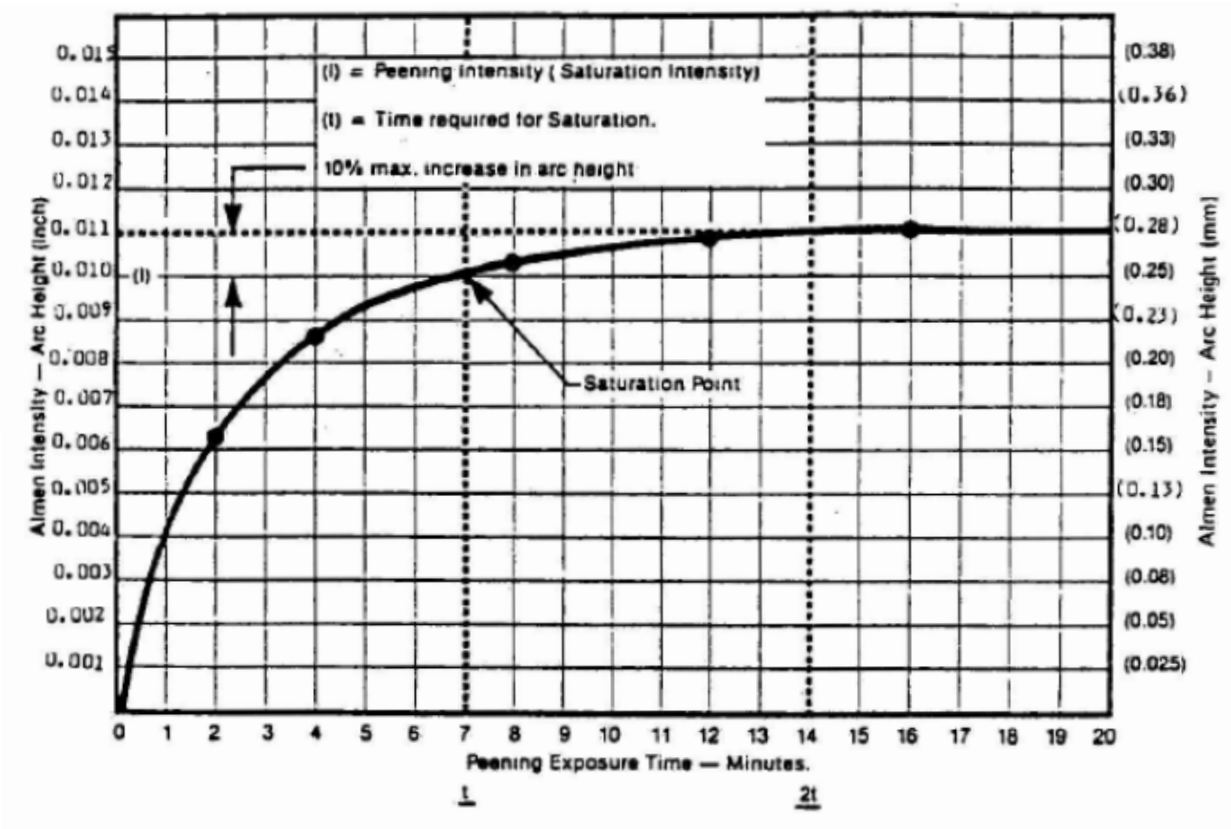


Figure 1 - Example of Saturated Peening Determination

5.4 Saturation Shot Peening of Production Parts

5.4.1 Unless otherwise specified by the engineering drawing, do not shot peen close tolerance holes and holes smaller than 1/2" in diameter.

5.4.2 Use hard shot (i.e. 55 - 65 Rc) to shot peen steel parts which have been heat treated to 200 ksi or above.

5.4.3 For parts being shot peened using an automated process, check the first, last, and every tenth part for 100% visual coverage after peening using at least 10X magnification. If a part fails the 100% coverage requirement, adjust the process parameters before processing any further parts. Refer all parts which were shot peened between the last successful coverage determination and the first failure to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

5.4.4 If a production batch requires more than eight hours of continuous operation, shot peen two sets of Almen test strips as specified in Steps 2 through 4 of para. 5.4.5 to represent each eight hours of continuous operation.

5.4.5 Saturation shot peen production parts as follows:

Step 1. Set-up the shot peening machine using the machine settings specified on the technique sheet.

Step 2. Shot peen one set of Almen test strips to time “T” (as determined in Step 4 of para. 5.3.1). Measure the arc height of each Almen strip using a suitable Almen strip deflection measurement gauge (e.g., as specified by SAE J442). The arc height of each Almen strip must be within ±0.0015" of the arc height obtained for the same position and time on the saturation curves of the technique sheet.

Step 3. Shot peen a second set of test strips for twice as long (i.e., to time “2T”). Measure the arc height using a suitable Almen strip deflection measurement gauge (e.g., as specified by SAE J442).

Step 4. Verify that the difference in arc height between the two sets of test strips is less than 10%. If the difference in arc height is greater than 10%, determine and rectify the cause of failure before processing any parts. Record the results of this pre-production intensity test in the log book.

Step 5. Suitably mount and shot peen the parts to the intensity specified by the engineering drawing for the shot peening time listed on the technique sheet.

Step 6. If manually shot peening parts, verify that the parts exhibit 100% coverage. If the part does not exhibit 100% coverage, continue to peen the part until 100% coverage is obtained. Take care to avoid excessive peening which could result in rollover of part edges or erosion.

5.5 Post Shot Peening Procedure

5.5.1 After shot peening, clean and protect the parts as follows:

Step 1. Remove all maskant.

Step 2. Clean the parts as specified in PPS 31.02, PPS 31.03, PPS 31.05, PPS 31.09 or PPS 31.12 as applicable.

Step 3. Apply a thin coat of corrosion preventive compound to parts which are to be shipped or stored.

Step 4. Protective wrap the shot peened parts as specified in Table 2.

5.6 In Situ Repair

5.6.1 Perform in situ repairs of scratches or dents on parts already located on the aircraft as specified herein only when authorized by Liaison Engineering. For in situ repair using manual shot peening equipment, refer to para. 5.6.1.1. For in situ repair of flat areas using roto peen flap assemblies, refer to para. 5.6.1.2. Use the shot size and shot peening intensity specified by Liaison Engineering.

5.6.1.1 Perform in situ repair using manual shot peening equipment as follows:

Step 1. Set-up the shot peening machine using the procedure specified in section 5.3.

Step 2. Solvent clean the area to be shot peened as specified in PPS 31.17.

Step 3. Mask off the boundary of the area to be shot peened.

Step 4. Form an enclosure to contain loose shot during the shot peening operation.

Step 5. Saturation shot peen the rework area at the intensity specified by Liaison Engineering and determine the time, “t”, required to achieve 100% coverage.

Step 6. If the time required to achieve 100% coverage (“t”) is greater that the time required for Almen strip saturation (“T” - as determined in section 5.3), continue to saturation shot peen the rework area until the time “2t” is reached. If “T” is greater than “t”, continue to saturation shot peen the rework area until the time “2T” is reached.

Step 7. Record the time required to achieve 100% coverage (i.e., “t”) and the actual peening time (i.e., “2t” or “2T”) on the shop traveller or work order.

Step 8. Remove all maskant.

Step 9. Use glass bead to decontaminate the shot peened area according to PPS 17.02.

Step 10. After decontamination of aluminum substrates, perform the steel shot detection test specified in PPS 31.02. If there is embedded shot present, repeat the decontamination process.

Step 11. Remove all loose shot from the aircraft and surrounding area.

5.6.1.2 Perform in situ repair on flat areas using a roto peen flap assembly as follows:

Step 1. If Liaison Engineering did not specifically specify the repair method (i.e., roto peen or manual peen), refer to the following table to convert the Standard Almen “A” intensity specified by Liaison Engineering to the required roto peen intensity. Conversion is necessary since the Almen strip will bend more when using the roto peen strip holder.

Almen “A” Intensity Specified	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Required Roto Peen Intensity	3	4	5	6	7	10	12	14	15	17	18	20	22	23	25	26	28	30

Note 1. The intensities specified above represent the intensity expressed in multiples of 0.001'' for the test strip type specified (e.g., an Almen “A” intensity may be expressed as either 10A or 0.010A)

Step 2. Determine the appropriate flap size required based on the specific repair need. For example:

- for larger flat areas with no obstructions or restrictions, use of a 1" X 2" flap assembly is recommended
- for smaller flat areas, use of a 9/16" X 1 1/4" flap assembly is recommended
- in restricted areas, use whichever size fits; if necessary, it is acceptable to cut the flaps narrower with scissors.

Step 3. Set the mandrel to the desired speed using a non-contacting or strobe light tachometer while the flap is in contact with the surface of a piece of suitable scrap material. Refer to the following table for the recommended mandrel speed:

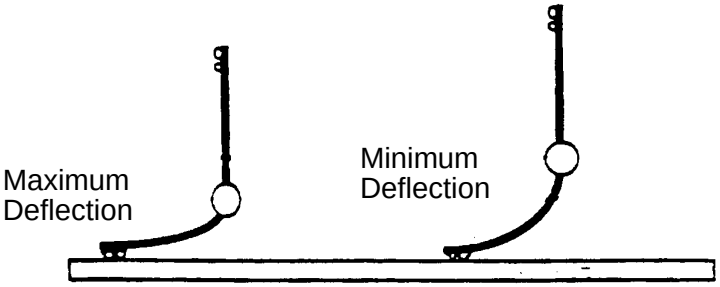
REQUIRED ALMEN “A” INTENSITY	**FLAP SIZE**		**REQUIRED ALMEN “A” INTENSITY**	**FLAP SIZE**	
	9/16" X 1 1/4"	**1" X 2"**		**9/16" X 1 1/4"**	**1" X 2"**
8	3200 RPM	2100 RPM	15	6500 RPM	3800 RPM
9	3600 RPM	2400 RPM	16	6800 RPM	3900 RPM
10	4300 RPM	2700 RPM	17	7300 RPM	4200 RPM
11	4600 RPM	2800 RPM	18	7600 RPM	4300 RPM
12	5100 RPM	3100 RPM	19	8100 RPM	4600 RPM
13	5400 RPM	3200 RPM	20	8700 RPM	4800 RPM
14	6000 RPM	3500 RPM			

Note 1. The mandrel RPM recommended in this table is based on an Almen strip saturation time “T” of 2 minutes (120 seconds) and should only be used as a guide. Tool and operator variability may require speed adjustments to obtain the required intensity. For longer Almen strip saturation times, a lower mandrel RPM is recommended.

Note 2. For cut down flaps, increase the mandrel speed accordingly.

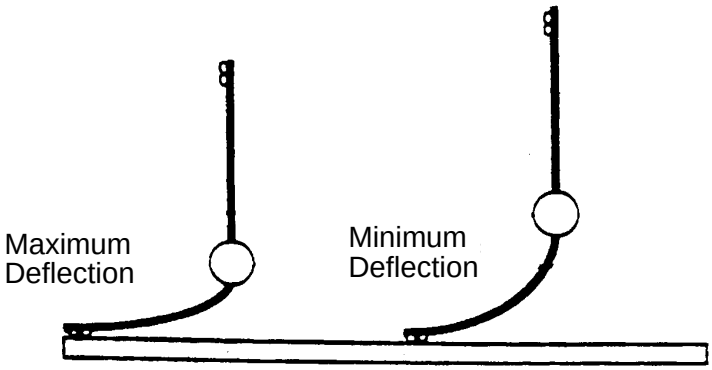
Step 4. Mount an unpeened Almen test strip on a special magnetic Almen strip holder suitable for determining roto peen intensity. Do not use a standard Almen strip holder.

Step 5. Roto peen the Almen test strip in the holder. To ensure proper flap deflection, maintain the height of the mandrel above the surface of the test strip as shown below. If the mandrel is too high, there will be an uncomfortable vibration or bounce to the tool. To ensure uniform peening coverage, use a circular or oscillating motion from side to side over the entire area.



For 9/16" X 1 1/4" flap assemblies, maintain the mandrel approximately 3/16" above the surface to be roto peened

9/16" X 1 1/4" FLAP ASSEMBLY



For 1" X 2" flap assemblies, maintain the mandrel approximately 5/16" above the surface to be roto peened

1" X 2" FLAP ASSEMBLY

Note: If the mandrel is too high, there will be an uncomfortable vibration or bounce to the tool.

Step 6. Check for saturation according to Figure 1. Always check the intensity using the Almen gauge on the unpeened side of the Almen strip.

Step 7. Based on the requirements specified by Liaison Engineering, determine the surface area size of the repair.

Step 8. Determine the total peening time for the repair area using the following formula:

$$T_p = (T_s \times A_r)/A_s$$

where: T_p is the peening time required for the repair area in seconds
T_s is the time required to peen the Almen strip to saturation in seconds
A_r is the repair area in square inches
A_s is the surface area of the Almen strip (2.25 sq. in.)

Therefore, if the time to peen the Almen strip is held to 120 seconds the formula becomes:

$$T_p = (120 \times A_r)/2.25 = 53.3 \times A_r$$

Step 9. Solvent clean the area to be shot peened as specified in PPS 31.17.

Step 10. Mask off the boundary of the area to be shot peened.

Step 11. Roto peen the repair area for the time determined in Step 8. To ensure proper flap deflection, maintain the height of the mandrel above the surface of the repair area as specified in Step 5. To ensure uniform peening coverage use a circular or oscillating motion over the entire repair area.

5.7 Post Shot Peening Surface Finishing

5.7.1 If required, improve the surface roughness of shot peened parts by lightly honing, lapping, hand sanding, or abrasive belt polishing them to meet the minimum surface roughness specified by the engineering drawing.

5.7.2 During surface roughness improvement, do not remove more than 10% of the nominal Almen A intensity to which the part was shot peened.

6 Requirements

6.1 Process Control

6.1.1 Ensure that the machine settings are verified (as specified in steps 2 through 4 of para. 5.4.5) before processing each batch of parts. Refer parts shot peened between the last successful determination of intensity and the first failure to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

6.1.2 Shot peen additional test strips as specified in steps 2 through 4 of para. 5.4.5:

a) After each adjustment in machine setting.

b) After eight hours of accumulated machine operation.

6.1.3 If requested, technique sheets shall be submitted to Bombardier Toronto (de Havilland) Engineering or Quality.

6.2 Shot Control

6.2.1 Use only one size of shot in the shot peening machine at any one time. Perform a check for shot size and shape whenever the size or type of shot in the machine is changed. Additionally, perform a check for shot size and shape during machine operation according to the frequency specified in Table 1. Maintain shot size and shape according to AMS2430.

Table 1 - Shot Control Frequency Requirements

SHOT TYPE	MAXIMUM ACCEPTABLE ACCUMULATED MACHINE OPERATION BETWEEN SHOT CONTROL CHECKS	
	MACHINES WITH BUILT-IN SCREEN CLASSIFIER	MACHINES WITHOUT BUILT-IN SCREEN CLASSIFIER
cast steel	40 hours	8 hours
glass beads	8 hours	2 hours
cut wire, carbon steel	80 hours	16 hours
cut wire, stainless steel	120 hours	24 hours

6.3 Production Parts

6.3.1 Shot peened surfaces of production parts which do not exhibit 100% coverage as defined in para. 5.1.1 are not acceptable.

6.3.2 Unless otherwise specified by the engineering drawing, the shot peened area shall be within +0.125" and -0.000" of the boundaries specified by the engineering drawing.

6.3.3 Refer parts with stray shot impressions in a masked area to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

6.3.4 If fade out is specified by the engineering drawing, the intensity shall diminish to zero across the fade out area.

6.3.5 Shot peened parts shall be free of erosion and part edges shall be free of rollover and excessive bulging. Bulging less than 0.002" is permitted provided it does not occur along the part faying surfaces.

7 Safety Precautions

7.1 The safety precautions specified herein are specific to Bombardier Toronto to meet Canadian Federal and Provincial government environmental, health and safety regulations. It is recommended that other facilities consider these safety precautions; however, suppliers, subcontractors and partners are responsible for ensuring that their own environmental, health and safety precautions satisfy the appropriate local government regulations.

7.2 Observe general shop safety precautions when performing the procedure specified herein.

8 Personnel Requirements

8.1 This PPS has been categorized as a “Controlled Critical Process” by PPS 13.39. Refer to PPS 13.39 for personnel requirements.

9 Additional Information

9.1 Keep the shop area free of excessive amounts of shot.

9.2 Except as noted in para. 9.2.1 or para. 9.2.2, do not subject shot peened parts to processing temperatures above the following limits:

Aluminum Parts - 200°F (93°C)
Steel Parts - 475°F (246°C)
Titanium Parts - 600°F (315°C)

9.2.1 Shot peened aluminum parts which are to be F19 primed may be subjected to a maximum of two oven curing cycles at 215°F ± 15°F (102°C ± 8°C) for 5 - 6 minutes according to PPS 34.08.

9.2.2 If the engineering drawing specifies subjecting shot peened parts to processing temperatures in excess of those specified in para. 9.2, the engineering drawing shall govern.

Table 2 - Protective Wrapping

PART TYPE	PROTECTION
Small, lightweight parts.	Place the parts in individual polyethylene bags and tape the bags closed with masking tape.
Cylindrical or tubular machined parts.	Wrap polyethylene foam around the part to overlap approximately 1" and secure with masking tape OR Cut a suitable size of expandable protective sleeving to length and slide it over the part.
Flat machined parts.	Separate parts in a transport box with a sheet of polyethylene foam between each part OR Wrap polyethylene foam around the part to overlap approximately 3" and secure with masking tape.

Table 3 - Shot Sizes and Shot Peening Intensities

MATERIAL	MATERIAL THICKNESS	MAXIMUM SHOT SIZE		INTENSITY	
		CAST STEEL	GLASS	CAST STEEL	GLASS
Aluminum	< 0.050"	NOT RECOMMENDED			
	0.050" - 0.059"	CS230 or CS280	GP100	0.008N - 0.012N	0.004N - 0.008N
	0.060" - 0.069"			0.010N - 0.014N	0.004N - 0.008N
	0.070" - 0.079"			0.012N - 0.016N	0.006N - 0.010N
	0.080" - 0.089"	CS230 or CS280	GP100	0.004A - 0.007A	0.007N - 0.011N
	0.090" - 0.114"	CS230 or CS280	N/A	0.005A - 0.008A	N/A
	0.115" - 0.139"			0.006A - 0.009A	
	0.140" - 0.164"			0.007A - 0.011A	
	0.165" - 0.189"			0.008A - 0.012A	
	≥ 0.190"			0.009A - 0.013A	
Steel Under 200,000 PSI	< 0.090"	NOT RECOMMENDED			
	0.090" - 0.200"	CS330	N/A	0.010A ± 0.002A	N/A
	0.200" - 0.375"	CS550			
	> 0.375"			0.014A ± 0.002A	
Steel Over 200,000 PSI	< 0.090"	NOT RECOMMENDED			
	0.090" - 0.200"	CS330	N/A	0.008A ± 0.002A	N/A
	> 0.200"	CS550			

Note 1. This table is only to be used as a guideline. Obtain authorization from the Materials and Processes Engineering department before shot peening parts using the shot size or intensity range specified in this table.

Note 2. This table specifies maximum shot size. Smaller shot sizes may be used provided that the intensity values specified on the engineering drawing are met.