BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 27.04

PRODUCTION PROCESS STANDARD

Edge Finishing of Titanium Alloy Parts

Issue 7
- This standard supersedes PPS 27.04, Issue 6.
- 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) 375-4365.
- This PPS is effective as of the distribution date.

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

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for edge finishing of titanium alloy parts.

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. 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 (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 PPS 1.13 - Laser Cutting Titanium.

3.2 PPS 13.26 - General Subcontractor Provisions.

3.3 PPS 27.05 - Manual Edge Finishing Equipment.

3.4 PPS 27.07 - Vibratory Tumble Deburring.

4 Materials and Equipment

4.1 All materials and equipment used for edge finishing of titanium alloy parts shall be as specified in PPS 27.05 and PPS 27.07.

5 Procedure

5.1 General

5.1.1 For the purpose of this PPS, edge finishing shall be considered to include de-lugging, deburring, edge relief, edge face polishing and rounding. Refer to Flow Chart 1 for edge finishing sequence.

- **De-lugging** includes removal of tooling lugs and the subsequent blending of the de-lugged areas into the finished part contour.
- **Deburring** consists of removing upset metal (burrs) resulting from cutting operations during fabrication, in order to prevent personal injury and facilitate subsequent fitting and assembly. Deburring shall involve removal of the upset metal only, so as to leave a sharp, clean edge.
- **Edge relief** consists of chamfering or radiusing sharp edges to prevent stress cracking of structural aircraft parts.
- **Edge face polishing** consists of polishing edge faces to a smooth finish to prevent stress cracking and stretch form cracking of structural aircraft parts, and includes the blending-in of nicks and tool marks.
- **Chatter marks** are riblike markings caused by vibration (chattering) of the cutting tool against the surface of the work.
- **Rounding** of edges and corners consists of radiusing sharp edges and corners on parts to be shot peened to prevent rollover or bulging.

5.2 De-lugging

5.2.1 Unless tooling lugs are needed for subsequent assembly or fabrication operations, crop all tooling lugs after completion of part fabrication, before deburring or edge finishing. If tooling lugs are required for subsequent assembly or fabrication operations, crop the tooling lugs on completion of such operations.

5.2.2 Carry out de-lugging and blending of the de-lugged areas into the finished part contour according to PPS 27.05.

5.3 Deburring

5.3.1 On completion of all fabrication cutting operations, manually deburr the edges of all titanium alloy parts according to PPS 27.05.

5.3.2 Deburr tooling and fastener holes according to PPS 27.05 to remove standing burrs only. Do not use files or abrasive discs as resultant scratches on the surface of the parts could cause the part to crack during subsequent fabrication operations or in service. Remove folded in burrs by running a suitable size drill through the hole. Take care to avoid or minimize the amount of edge breaking resultant from the deburring operation.

5.4 Edge Relief

5.4.1 Except for final size fastener holes, edge relieve all titanium alloy parts to the chamfer/radius specified in Table 1. Edge relieve final size fastener holes only if specified by the engineering drawing or fastener PPS.

5.4.2 The preferred method of relieving edges is by means of vibratory tumble finishing according to PPS 27.07, as this process relieves edges and smooths edge faces in the shortest time. As a general guide, parts up to 30" by 3" can be satisfactorily edge relieved by vibratory tumbling. Manually edge relieve parts which are not suitable for tumble edge finishing due to their size or shape according to PPS 27.05.

Table 1 - Edge Relief

MATERIAL THICKNESS	EDGE CHAMFER/RADIUS
Up to 0.080"	Minimum - 0.005" Maximum - 25% of Thickness
Over 0.080"	0.015" ± 0.010"

5.5 Rounding of Edges and Corners

5.5.1 Unless otherwise specified by the engineering drawing, perform rounding of edges and corners on parts to be shot peened.

5.5.2 For parts to be shot peened, except for holes which will be opened up to their final size after shot peening, round all part edges to the following radius:

- For edges and corners where the part thickness is 0.100" or less at the part edge, round the edges and corners to a radius of approximately 25% of the part thickness.
- For edges and corners where the part thickness is greater than 0.100" at the part edge, round the edges and corners to a radius of 0.010" - 0.040".

5.5.3 Round edges and corners to the required radius by machining or by manual edge finishing according to PPS 27.05. The required part surface finish must also be maintained on rounded edges and corners.

5.6 Edge Face Polishing

5.6.1 Except as noted below, edge face polish parts manually according to PPS 27.05 to achieve a surface finish of 64 - 125 RMS. Parts which have undergone a vibratory tumble finishing operation do not require edge face polishing. If the part has been laser cut or edge cracking has occurred during stretch forming, edge face polish the edges manually according to PPS 27.05 to produce a surface finish of 32 - 64 RMS. When edge face polishing, ensure that grit lines run longitudinally along the edge. It is recommended that a suitable comparator/shop aid be used to ensure the required surface finish (i.e., 64 - 125 RMS or 32 - 64 RMS).

5.6.2 Isolated machining marks (including chatter marks) on polished edges are acceptable provided they are smoothly blended (note that it is not necessary to totally remove all visual indication of the machining or chatter marks).

6 Requirements

6.1 All titanium alloy parts shall be edge finished in the sequence specified in Flow Chart 1.

6.2 Upon completion of edge finishing operations, the chamfer/radius on the edges of the titanium alloy parts shall be meet the requirements specified in Table 1.

6.3 Except for laser cut parts or parts upon which edge cracking has occurred, after edge finishing operations the surface finish on all edges shall be 64 - 125 RMS. The surface finish on edges of titanium parts which have been laser cut or on which edge cracking has occurred must have a surface finish of 32 - 64 RMS. Isolated machining marks on polished edges are acceptable provided that they are smoothly blended. It is not necessary to remove all visual indication of such marks.

6.4 Unless otherwise specified by the engineering drawing, all edges and corners of parts to be shot peened (except for holes which will be opened up to their final size after shot peening) shall have been rounded to the dimensions specified in paragraph 5.5.2.

6.5 Grit lines must run longitudinally along the edge. Finishing marks running perpendicular to the edges on polished faces are not acceptable.

6.6 Parts having burned edges resulting from edge finishing as specified herein (as evidenced by discolouration) are not acceptable and must be referred to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

7 Safety Precautions

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

7.2 Wear protective gloves when handling sheet metal.

8 Personnel Requirements

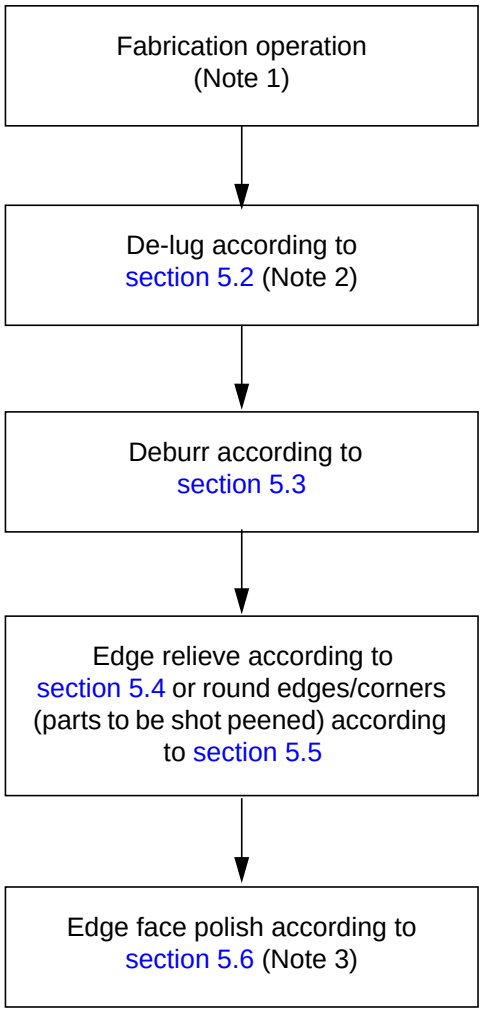
8.1 Personnel responsible for edge finishing of titanium alloys must have a good working knowledge of the procedure and requirements as specified herein and must have exhibited their competency to their supervisor.

9 Additional Information

9.1 A surface finish of 64 - 125 RMS is an average grade machine finish typical of smooth hand filing.

9.2 A surface finish of 32 - 64 RMS is a very fine machine finish typical of surface grinding.

Flow Chart 1 - Edge Finishing Sequence



Note 1. For the purpose of this PPS, fabrication includes machining, drilling, nibbling, laser beam profiling, blanking, shearing, piercing, sawing, etc.

Note 2. Crop tooling lugs before deburring or edge finishing, unless such lugs are required in order to carry out a subsequent fabrication operation such as forming.

Note 3. Parts which have been edge relieved by means of vibratory tumble finishing do not require edge face polishing.