BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 1.21

PRODUCTION PROCESS STANDARD

MACHINING PROCESSES FOR METALLIC PARTS

Issue 2
- This standard supersedes PPS 1.21, Issue 1.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS 1.21 related questions to michael.wright@aero.bombardier.com.
- This PPS is effective as of the distribution date.

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

Prepared By:	*Michael Wright*	(Michael Wright)	August 25, 2015
	PPS Group		
Approved By:	*Ken Quon*, for	(Emma Donlin)	August 28, 2015
	Materials Technology		
	Anthony Assivero, for	(David Dawe)	August 28, 2015
	Quality		

Table of Contents

Sections **Page**

Tables

1 Scope

1.1 This Production Process Standard (PPS) specifies machining processes for metallic parts.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction and the procedure specified 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 Site), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier (Toronto Site) 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 Site) 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 Site) Specifications

3.2.1 PPS 13.26 - General Subcontractor Provisions.

3.3 Industry Specifications

3.3.1 Machining Data Handbook.

4 Materials and Equipment

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 For the machining processes as referenced in Table 3, refer to the applicable PPS for materials requirements. For machining processes other than those referenced in section 3, ensue that lubricants and/or coolants used in conjunction with machining will have no detrimental effect on parts.

4.2 Equipment

4.2.1 For the machining processes as referenced in Table 3, refer to the applicable PPS for equipment requirements. For machining processes other than those listed in Table 3, machining equipment must be capable of machining parts to meet all engineering drawing requirements.

5 Procedure

5.1 General

5.1.1 Unless otherwise specified by the engineering drawing, the following minimum material shall be removed from stock surfaces:

- Steel parts that require magnetic particle inspection and are fabricated from bar, plate or billet stock shall be machined on all surfaces as specified in Table 1, unless stock size is specified on drawing for final dimension. This requirement is intended to provide surfaces which are free from decarburization, seams, laps, tears, cracks, pits, and other injurious surface imperfections. Table 1 does not apply to steel stock supplied turned, ground, or polished.
- For aluminum alloys, minimum material removal from stock surfaces shall be as specified in Table 2.
- Titanium stock for parts that require ultrasonic inspection and are fabricated from bar, plate or forging shall be machined on all surfaces to remove ultrasonic deadzone. This shall be a minimum of 0.120'' unless otherwise stated on the engineering drawing or in an approved Process Control Document (PCD).

5.1.1.1 In cases where minimum stock removal from stock material specified by the engineering drawing is not possible, refer to Liaison Engineering for disposition.

5.1.2 Refer to the applicable PPS as specified in Table 3 for the procedure and requirements for the machining processes specified. For the procedure for conventional machining (e.g., milling, NC routing, etc.) for which a PPS is not specified, refer to section 5.2.

Table 1 - Minimum Material Removal from Steel Stock Surfaces

THICKNESS OR DIAMETER	MINIMUM STOCK REMOVAL
< 0.501"	0.030" per side
0.501" - 0.750"	0.045" per side
0.751" - 1.000"	0.060" per side
1.001" - 1.500"	0.075" per side
1.501" - 2.000"	0.090" per side

THICKNESS OR DIAMETER	MINIMUM STOCK REMOVAL
2.000" - 2.500"	0.125" per side
2.501" - 3.500"	0.156" per side
3.501" - 4.500"	0.187" per side
4.501" - 6.000"	0.250" per side

Table 2 - Minimum Material Removal from Aluminum Stock Surfaces (Notes 1, 2 & 3)

THICKNESS OR DIAMETER	MINIMUM STOCK REMOVAL
0.250" - 0.999"	0.04" per side
1.000" - 1.999"	0.08" per side
2.000" and greater	0.12" per side

Note 1. When the amount of material removed is more than the minimum, it should then be removed evenly on each face to avoid distortion.
Note 2. Not applicable to sheet stock and extruded shapes.
Note 3. For aluminum alloys 0.500" thick and over, if the engineering drawing specifies ultrasonic quality the minimum material removal is 0.12" per side on all thicknesses.

Table 3 - Machining Processes (Note 1)

MACHINING PROCESSES	APPLICABLE METALS	PPS
General Machining		
Chemical Milling of Aluminum and Aluminum Alloys	Aluminum Alloys	PPS 42.01
Chemical Milling of Titanium and Titanium Alloys	Titanium Alloys	PPS 42.06
Electrical Discharge Machining	Ferrous and Non-Ferrous	PPS 1.18
Electropolishing	300 and 400 series corrosion resistant steels	PPS 31.15
Laser Cutting	Aluminum, Nickel, Stainless Steel and Titanium Alloy	PPS 1.13
Limitations on Shearing, Blanking and Piercing Aluminum and Magnesium Alloy Sheet	Aluminum and Magnesium Alloy Sheet	PPS 18.01

Note 1. For machining other than that specified in this table (e.g., conventional milling, NC routing, etc.) refer to the procedure specified in section 5.2

Table 3 - Machining Processes (Note 1)

MACHINING PROCESSES	APPLICABLE METALS	PPS
Limitations on Shearing and Punching Titanium Alloys	Titanium Alloys	PPS 18.04
Machining, Re-Lubrication, Packaging and Installation of Sintered Porous Bearings (Bushings)	Sintered Porous Bearings (Bushings)	PPS 12.01
Machining of Titanium Alloy	Titanium Alloys	PPS 1.35
Notching of Aluminum Channel Edge Trim	Aluminum Alloy Channel Edge Trim	PPS 1.11
Roller Burnishing	Ferrous and Non-Ferrous	PPS 1.16
Set-Up and Operation of Hand Routers	Ferrous and Non-Ferrous	PPS 1.47
Set-Up and Operation of Rivet Shavers	Ferrous and Non-Ferrous	PPS 1.48
Set- Up and Operation of the Waterjet	Ferrous and Non-Ferrous	PPS 10.20
Tolerance Requirements for “Cut to Size” Material	Ferrous and Non-Ferrous	PPS 18.05
Drill/Riveting		
Countersinking for Flush Head Fasteners	Ferrous and Non-Ferrous	PPS 1.33
Drill/Countersinking for Flush Head Fasteners	Ferrous and Non-Ferrous	PPS 1.31
Drilling and Reaming	Ferrous and Non-Ferrous	PPS 1.09
Set-Up and Operation of Air-Operated, Hydraulically Controlled, Portable Drillmotors for Automatic Drilling and Countersinking of Fastener Holes	Ferrous and Non-Ferrous	PPS 1.37
Set-Up and Operation of the APS Model 705 Automatic Drill Riveter	Ferrous and Non-Ferrous	PPS 1.20
Set-Up and Operation of the Craco Automatic Drill Riveter	Ferrous and Non-Ferrous	PPS 1.41
Set-Up & Operation of Drivmatic Drill Riveters	Ferrous and Non-Ferrous	PPS 1.43
Set-Up and Operation of Nut Plate Drillmotors	Ferrous and Non-Ferrous	PPS 1.40
Set-Up and Operation of Spacematic Drillmotors Model 1600 and 6000	Ferrous and Non-Ferrous	PPS 1.32
Edge & Surface Finishing		
Automatic Belt and Rotary Disc Deburring	Ferrous and Non-Ferrous	PPS 27.11
Decorative Surface Finishes	Ferrous and Non-Ferrous	PPS 27.06
Edge Finishing Aluminum Alloy Parts	Aluminum Alloy	PPS 27.02

Note 1. For machining other than that specified in this table (e.g., conventional milling, NC routing, etc.) refer to the procedure specified in section 5.2

Table 3 - Machining Processes (Note 1)

MACHINING PROCESSES	APPLICABLE METALS	PPS
Edge Finishing Magnesium Alloy Parts	Magnesium Alloy	PPS 27.08
Edge Finishing Steel, Nickel and Copper Alloy Parts	Steel, Nickel and Copper Alloys	PPS 27.10
Edge Finishing of Titanium Alloy Parts	Titanium Alloy	PPS 27.04
Manual Edge Finishing	Ferrous and Non-Ferrous	PPS 27.05
Repair of Surface Defects in Aluminum Alloy Sheet	Aluminum Alloy Sheet	PPS 27.01
Surface Finishing of Machined Parts	Ferrous and Non-Ferrous	PPS 27.03
Vibratory Tumble Deburring	Ferrous and Non-Ferrous	PPS 27.07
Note 1. For machining other than that specified in this table (e.g., conventional milling, NC routing, etc.) refer to the procedure specified in section 5.2		

5.2 Other Machining Processes

5.2.1 For machining processes other than those specified in Table 3, general recommendations for feeds, speeds and other machining parameters shall be in accordance with the machine manufacturer's recommended settings or can be found in handbooks such as the Machining Data Handbook. Feeds, speeds, tool geometry and coolant shall be selected to prevent overheating or damaging the part. Operate machining equipment according to the manufacturer's instructions.

5.3 Stress Relief after Machining

5.3.1 When specified on the engineering drawing, stress relieve parts after machining according to the engineering drawing instructions or referenced PPS.

6 Requirements

6.1 Machined parts must meet all the requirements of the engineering drawing, including surface finish and dimensional tolerances. In addition, machined parts must be free of visual defects such as overheated areas, pits, scratches, gouges, etc. For the machining processes listed in Table 3, the requirements of the referenced PPS's must also be met.

7 Safety Precautions

7.1 The safety precautions specified herein are specific to Bombardier (Toronto Site) 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.

7.3 For machining processes listed in Table 3, refer to the applicable PPS for the safety precautions. For machining processes other than those specified in Table 3, observe general shop safety precautions and the safety precautions recommended by the equipment manufacturer when performing the procedure specified herein.

8 Personnel Requirements

8.1 For the machining processes listed in Table 3, refer to the applicable PPS for personnel requirements. Personnel responsible for machining processes other than those specified in Table 3 must have a good working knowledge of the applicable procedure and requirements as specified herein and must have exhibited their competency to their supervisor.