BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.07

PRODUCTION PROCESS STANDARD

Dimpling Ferrous, Nickel and Titanium Alloys

Issue 8
- This standard supersedes PPS 1.07, Issue 7.
- 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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	Production Process Standards (PPS)	
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	Quality	

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for dimpling ferrous, nickel and titanium alloy sheets.

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 1.04 - Modified Radius Dimpling Equipment.

3.2 PPS 1.05 - Ram Coin Dimpling Equipment.

3.3 PPS 1.09 - Drilling and Reaming.

3.4 PPS 13.26 - General Subcontractor Provisions.

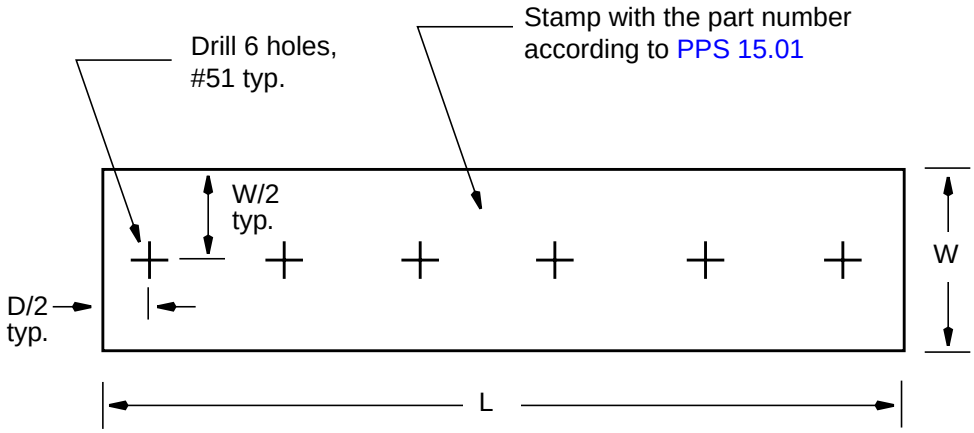
3.5 PPS 27.04 - Edge Finishing Titanium Alloy Parts.

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

4 Materials and Equipment

4.1 Materials

4.1.1 Test strips (e.g., Bombardier Toronto (de Havilland) CSP 440) as shown in Figure 1.



	L	W	D
Solid & Blind Rivets - up to 3/16" dia.	4 1/2"	1"	3/4"
Lockbolts & Jobolts - up to 3/16" dia.			
Hi-Shear Rivets & Rivnuts - up to 3/16" dia.			
Screws & Bolts - smaller than #10			
Solid & Blind Rivets - 1/4" dia. & larger	6"	1 1/2"	1"
Solid & Blind Rivets - 1/4" dia. & larger			
Lockbolts & Jobolts - 1/4" dia. & larger			
Hi-Shear Rivets & Rivnuts - 1/4" dia. & larger			
Screws & Bolts - #10 & larger			
Dzus & Camloc Fasteners - all sizes	9"	2"	1 1/2"

Figure 1 - Dimpling Test Strips

4.2 Equipment

4.2.1 Dimpling tools as listed in PPS 1.04 and PPS 1.05.

5 Procedure

5.1 Limitations

5.1.1 Except as noted, use only ram coin dimpling tools as specified in PPS 1.05 to dimple ferrous, nickel or titanium alloys according to the procedure specified herein. Modified radius dimpling tools as specified in PPS 1.04 may be used to carry out dimpling for solid or blind rivets only if it is not possible to use ram coin dimpling tools. Modified radius dimpling tools shall only be used in applications where modified radius dimples or where ram coin dimples will be nested into the modified radius dimple.

5.1.2 Both ram coin and modified radius dimpling methods are subject to the limitations and requirements of this standard.

5.1.3 Except when dimpling titanium alloys, perform dimpling at room temperature. Hot dimple titanium alloys according to PPS 1.05. Alloys other than titanium may only be hot dimpled if authorized in writing by Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB.

5.1.4 Simultaneous dimpling (i.e., dimpling two sheets together) is only permissible if specified on the engineering drawing or Product Specification.

5.1.5 Dimpling of tapered material is permissible provided that the degree of taper does not exceed 0.001 inch/inch.

5.1.6 If required to obtain a better dimple configuration, dimpled holes may be re-dimpled (i.e., re-struck) once, only. If hot dimpling, allow the sheet to cool before re-dimpling. Do not reverse, flatten or re-dimple dimples to another size.

5.1.7 Except as noted, carry out dimpling before the application of primer or plating. Thin gauge titanium sheet, less than 0.025" in thickness, may be hot dimpled after the application of F19 primer, provided that the temperature is reduced to 600°F ± 25°F.

5.2 Preparation of Work

5.2.1 Ensure parts are free of grease, paint and other foreign matter.

5.2.2 Drill holes for dimple tool pilots to the size specified in the applicable fastener PPS according to PPS 1.09. After drilling, deburr holes according to PPS 27.04 or PPS 27.10, as applicable, so as to leave a sharp edge corner at each hole. Chamfered or radiused hole edges are not acceptable.

5.3 Preparation and Set-Up of Equipment

5.3.1 Select dimpling tools from PPS 1.04 or PPS 1.05, as applicable.

5.3.2 Set-up and operate dimpling tools according to PPS 1.04 or PPS 1.05, as applicable.

5.4 Preparation and Dimpling of Test Strips

5.4.1 Before each production run, prepare a test strip as shown in Figure 1. A production run is defined as a run is defined as a run of dimples for the same size and type of fastener, in the same material and gauge, with no change of tooling or machine setting, and no breaks due to machine break down or shift change over. The test strip must be of the same material, temper and gauge as the production parts. If production parts are tapered, the test strip must be similarly tapered or, use two strips, one to represent the minimum thickness, the other to represent the maximum thickness. For simultaneous dimpling, spot weld, rivet, or Cleco the test strips simulating the production parts together.

5.4.2 Hot or cold dimple the test strip, as applicable, using the appropriate tools and settings.

5.4.3 Check the dimpled test strip according to section 6.1.

5.5 Production Dimpling

5.5.1 Commence production dimpling only after an acceptable test strip has been produced and checked.

5.5.2 Use the same tools and settings for production dimpling as used for test strip dimpling. However, it is acceptable to adjust the dimpling pressure slightly to offset waviness in the part.

5.6 Final Drilling after Dimpling

5.6.1 Drill dimpled holes to final size, if necessary, at the assembly stage by simultaneous drilling of mating parts to ensure alignment in the parts. Refer to the Engineering drawing or applicable fastener PPS for the final hole size required. Deburr holes drilled in titanium according to PPS 27.04.

6 Requirements

6.1 Test Strips

6.1.1 Visually check test strips to verify conformance to the requirements specified in Figure 2 using a 10X magnifying glass. If in doubt, submit test strips for metallographic examination.

6.2 Production Parts

6.2.1 Visually check randomly selected dimples in production parts to verify conformance to the requirements of Figure 2 using a 10X magnifying glass. If unacceptable dimples are found, suspend production dimpling until the cause of failure has been established, corrective action has been taken and a new test strip meeting the requirements of section 6.1 has been produced. Also, if unacceptable dimples are found, check **all** dimples produced in the same production run before the suspension of dimpling. Parts with **any** unacceptable dimples are unacceptable.

7 Safety Precautions

7.1 Disconnect the air line from drillmotors when installing or changing drill bits.

7.2 Allow hot dimpling dies to cool for a minimum of 10 minutes before removal from the dimpling machine. Wear cotton gloves when removing dies.

8 Personnel Requirements

8.1 Refer to PPS 1.04 or PPS 1.05 for the personnel requirements for dimpling using modified radius dimpling equipment or ram coin dimpling equipment, respectively.

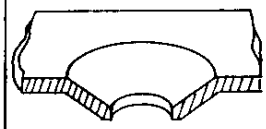
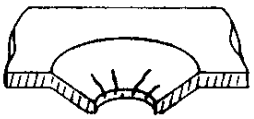
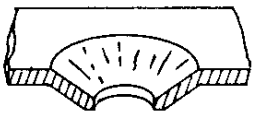
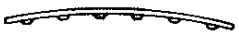
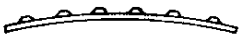
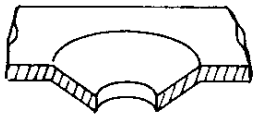
ACCEPTABLE		NOT ACCEPTABLE	
	GOOD DEFINITION - Correct dimpling and ram pressure. - No scratches or marks on dimple surface. - No cracks. REMARKS For single sheet dimpling, the ram flat dia. should be equal to the ram dia. For simultaneous dimpling, the ram flat of the top sheet would be smaller.		CRACKED DIMPLE FLARE - Dies not properly heated. - Cracked inner ram. - Insufficient ram pressure. - Pilot holes too small. CORRECTIONS - Check for proper temperature settings. - Replace cracked ram. - Increase ram pressure. - Enlarge pilot holes.
	RINGED RAM FLAT - Ram face worn. - Excessive ram pressure. CORRECTIONS - Replace worn ram, or adjust to lower ram pressure, as applicable.		CIRCUMFERENTIAL CRACK - Insufficient heat in the sheet. - Sheet redimpled in reverse direction to original. CORRECTIONS - If caused by cold dimpling, Liaison Engineering shall be consulted. Use hot tools when authorized.
	MARKS ON DIMPLE - Foreign matter on tools. - Scored punch or die. CORRECTIONS - Clean or replace tools as applicable.		CONVEX STRIP (Test strips shall be checked along their lengths with a straight edge). - Excessive dimpling pressure. CORRECTIONS - Reduce dimpling pressure.
	RINGED DIMPLE - Acceptable provided that the installed rivet head will be above the skin surface. - Excessive dimpling pressure. CORRECTIONS - Lower dimpling pressure.		CONCAVE STRIP (Test strips shall be checked along their lengths with a straight edge). - Insufficient dimpling pressure. CORRECTIONS - Increase dimpling pressure and redimple.
	SMALL OR NO RAM FLAT - Acceptable provided that it is the top sheet of a simultaneous dimple. - Insufficient ram pressure. CORRECTIONS - Increase ram pressure and redimple.	NOTES: 1. Cracked dimples are not acceptable. 2. Holes improperly prepared (under size, over size, out-of-round, excessive burrs, etc.) are not acceptable.	

Figure 2 - visual Acceptance Limits for Dimples and Probable Defect Causes