BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 1.01

PRODUCTION PROCESS STANDARD

Dimpling Aluminum Alloys

Issue 14
- This standard supersedes PPS 1.01, Issue 13.
- 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.

Prepared By:	(Michael Wright)	October 29, 2012
	Production Process Standards (PPS)	
Approved By:	(L.K. John)	October 30, 2012
	Materials Technology	
	(B. DeVreede)	October 30, 2012
	Quality	

Table of Contents

Sections **Page**

Figures

Tables

1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for dimpling aluminum 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 18.01 - Limitations on Shearing and Punching Aluminum Alloy Sheets.

3.6 PPS 27.02 - Edge Finishing Aluminum Alloy Parts.

3.7 PPS 31.17 - Solvent Usage.

4 Materials and Equipment

4.1 Material

4.1.1 Dimpling test coupon (see Figure 1).

4.2 Equipment

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

4.2.2 Cotton gloves (e.g., DSC 422-1).

5 Procedure

5.1 General

5.1.1 Dimple aluminum alloy using ram coin dimpling tools according to PPS 1.05. Alternatively, modified radius dimpling tools as specified in PPS 1.04 may be used to carry out dimpling for solid or blind rivets if it is not practical to use ram coin dimpling tools, provided that the modified radius dimples will be nested into other modified radius dimples or ram coin dimples will be nested into the modified radius dimples.

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

5.1.3 Except as noted below, carry out dimpling at room temperature:

- Hot dimple holes for bolts, screws, Dzus fasteners, Camloc fasteners, Jo-Bolts and lockbolts (except NAS1436 to NAS1442 shear type lockbolts).
- Hot dimple when simultaneous dimpling (i.e., dimpling two or more sheets together) is specified on the engineering drawing.
- Hot dimple the following alloys, gauges and tempers (including all variations of these basic tempers): 2014-T6 (all gauges), 2219-T6 (0.040" and thicker), 7075-T6 (all gauges) & 7075-T7 (all gauges). Hot dimple other alloys, tempers or fastener holes only if room temperature dimpling fails to meet the requirements of this standard.
- Anodized, alodined and primed parts may be hot or cold dimpled.

5.1.4 Dimple for decorative trim attachment screws having an included angle of 82° using standard 100° dimpling dies as follows:

Step 1. Select a dimple punch and die set from PPS 1.05 for a type and size fastener with a countersink diameter requirement equal to the dimple diameter specified on the Engineering Drawing for the particular attachment screw.

Step 2. Check that the punch pilot diameter is smaller than the final hole size specified for the attachment screw.

Step 3. Pre-drill parts to the punch pilot size, dimple and re-drill hole to final size as per the Engineering Drawing.

5.1.5 Dimpling of aluminum alloy extrusions is prohibited.

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

5.1.7 Dimpled holes may be re-dimpled (re-struck) once only, where required to obtain a better dimple configuration. If hot dimpling, allow the sheet to cool before re-dimpling. Dimples shall not be reversed, flattened or re-dimpled to another size.

5.2 Preparation of Work

5.2.1 Ensure parts are free of grease and foreign matter. Locally solvent clean according to PPS 31.17, if necessary.

5.2.2 Prepare holes for dimple tool pilots by drilling or punching to size. Perform drilling according to PPS 1.09. Punch according to PPS 18.01.

5.2.3 Deburr all holes before dimpling according to PPS 27.02. Do not chamfer or radius hole edges.

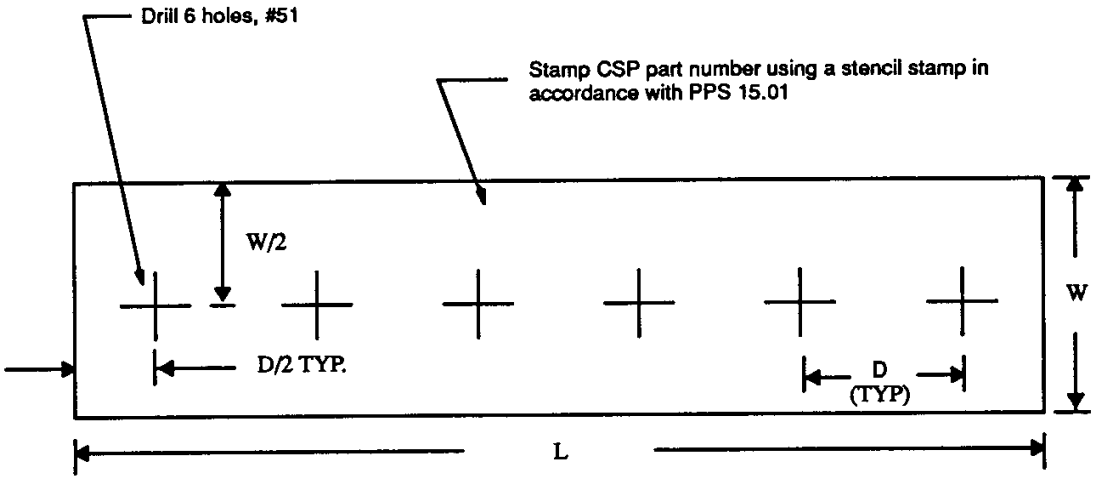
5.3 Preparation and Set-Up of Equipment

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

5.4 Preparation and Dimpling of Test Coupons

5.4.1 For each production run, prepare a CSP 440 test coupon as shown in Figure 1. A production 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 breakdown or shift changeover. For the test coupon, use the same material, temper and gauge as the production parts. For production parts that are tapered, prepare a test coupon similarly tapered or 2 test coupons, one to represent the minimum thickness, the other to represent the maximum thickness. When production parts are to be simultaneous dimpled, spot weld, rivet, or cleco together the test coupon to simulate the production parts during dimpling. Hot or cold dimple the test coupon using the same tools and settings as to be used for the production run.

5.4.2 Dimpled test coupons must meet the requirements specified in section 6.



FASTENER TYPE AND SIZE	DIMENSIONS (Inches)			BASIC DASH NUMBER
	L	W	D	
Solid and Blind Rivets up to 3/16″ diameter	4 1/2"	1"	3/4"	–1 or –2 (no holes)
Lockbolts, Hi–Loks and Visu Loks up to 3/16″ diameter				
Hi–Shear rivets and Rivnuts up to 3/16″ in diameter				
Screws and bolts smaller than # 10				
Solid and Blind Rivets – 1/4″ dia. and larger	6"	1 1/2"	1"	– 3
Lockbolts and Jobolts – 1/4″ dia. and larger				
Hi–Shear Rivets and Rivnuts – 1/4″ dia. and larger				
Screws and Bolts – #10 and larger				
Dzus and Camloc Fasteners – all sizes	9"	2"	1 1/2"	– 4

Test Coupon Part Number Breakdown:

CSP440 - 4 - 025 - 9046/1A - An

- CSP440 — Basic Dimpling Test Coupon Part Number
- 4 — Basic Dash Number
- 025 — Material Thickness (thousands)
- 9046/1A — Alloy
- An — Temper

Figure 1 - CSP 440 Dimpling Test Coupon

5.5 Production Dimpling

5.5.1 Commence production dimpling only after an acceptable test coupon has been produced. Use the same tools and settings for production dimpling as used for test strip dimpling, except that the dimpling pressure may be adjusted slightly to offset waviness in the part.

5.6 Final Drilling After Dimpling

5.6.1 Carry out drilling of dimpled holes to the final size specified by the engineering drawing or applicable fastener PPS, at the assembly stage by simultaneous drilling of mating parts to ensure alignment of holes.

5.6.2 After drilling, deburr holes according to PPS 27.02. Remove folded in burrs, if any, by running the applicable final size drill through the hole.

6 Requirements

6.1 Improperly prepared holes (e.g., undersize, oversize, out of round, excessive burrs, etc.) are not acceptable.

6.2 Visually check test coupons using a 10X (minimum) magnifying glass to verify conformance of the test coupons to the requirements shown in Table 1 or Table 2, as applicable. When requested by Bombardier Toronto (de Havilland), submit randomly selected test strips for metallographic examination by a Bombardier Toronto (de Havilland) approved laboratory.

6.3 Visually check all dimples in production parts using a 10X magnifying glass to verify conformance to the requirements of Table 1 or Table 2, as applicable. 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 coupon meeting the requirements of Table 1 or Table 2, has been produced. Parts containing unacceptable dimples are not acceptable.

7 Safety Precautions

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

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 hot dies.

8 Personnel Requirements

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

Table 1 - Visual Requirements for Ram Coin Dimpling

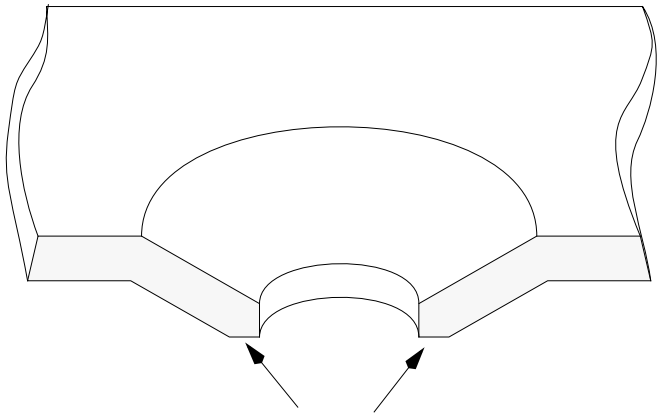
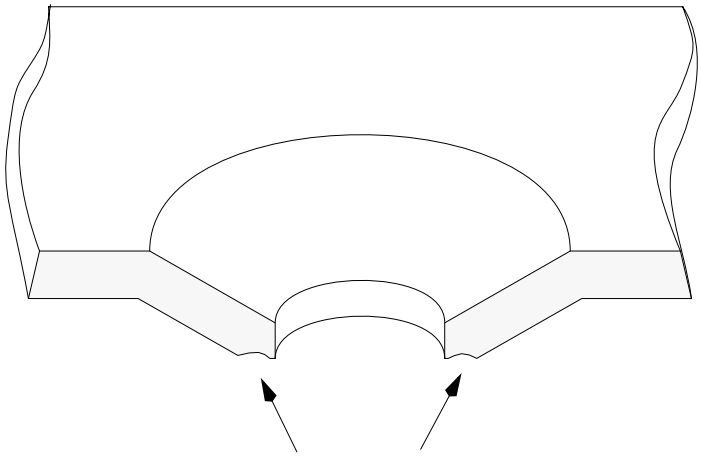
VISUAL APPEARANCE	DESCRIPTION
	Ideal Ram Coin Dimple • Good definition • No scratches or marks on dimple surface • No cracks • Suitable ram flat
	Ringed Ram Flat - Acceptable • Caused by worn ram face or excessive ram pressure. • Prevent by replacing worn ram or by decreasing ram pressure, as applicable.

Table 1 - Visual Requirements for Ram Coin Dimpling

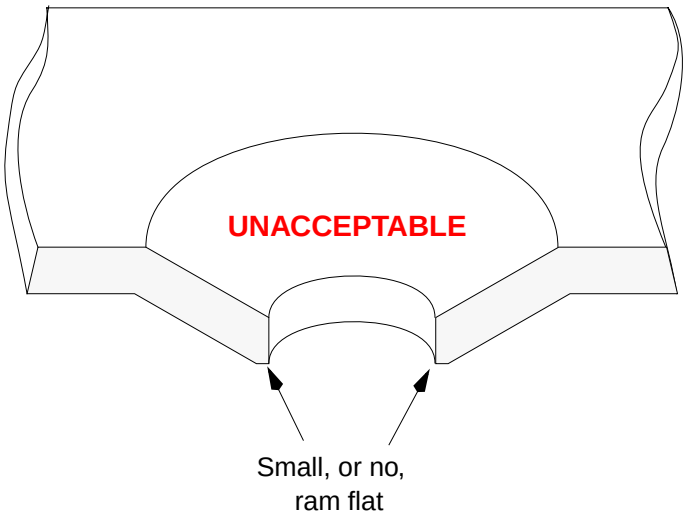
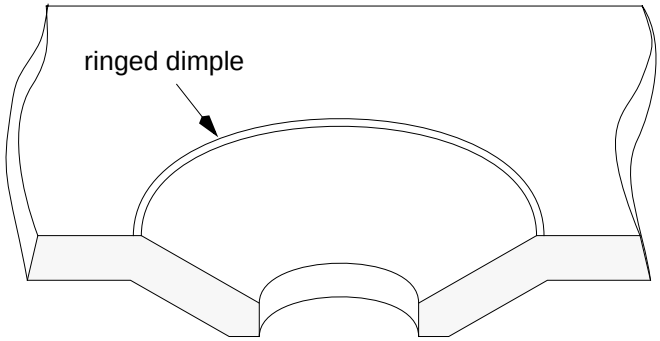
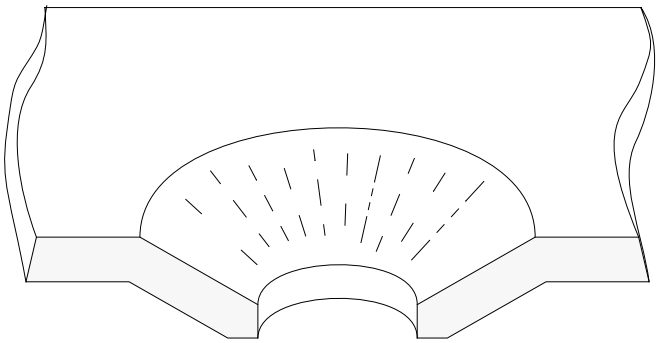
VISUAL APPEARANCE	DESCRIPTION
	Small or no ram flat - **Unacceptable** except for the top sheet of simultaneous dimpling • Caused by insufficient ram pressure. • Prevent by increasing ram pressure.
	Ringed dimple - **Acceptable** only if the rivet head will extend above flush with the skin surface. • Caused by excessive dimpling pressure. • Prevent by reducing dimpling pressure.
	Marks on Dimple - **Acceptable** • Caused by foreign matter on tools. • Prevent by cleaning or replacing tools.

Table 1 - Visual Requirements for Ram Coin Dimpling

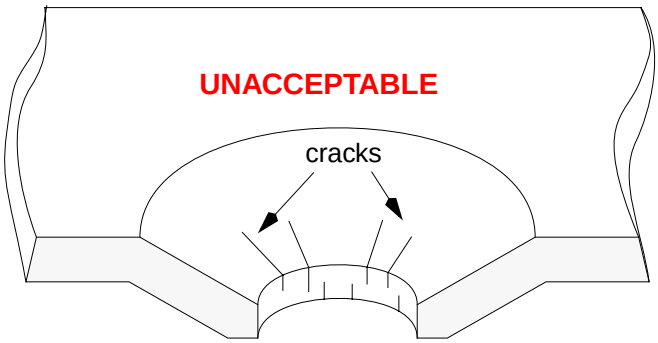
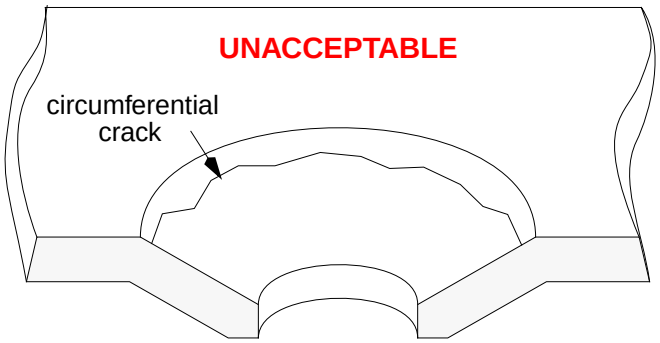
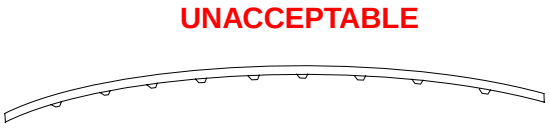
VISUAL APPEARANCE	DESCRIPTION
	Cracked Dimple Flare - **Unacceptable** • Caused by improperly heated dies, cracked inner ram, insufficient ram pressure or pilot hole too small. • Prevent by checking for proper die temperature settings, replacement of cracked inner ram, increasing ram pressure or by enlarging pilot holes, as applicable.
	Circumferential Crack - **Unacceptable** • Caused by improperly heated dies, cracked inner ram, insufficient ram pressure or pilot hole too small. • Prevent by checking for proper die temperature settings, replacement of cracked inner ram, increasing ram pressure or by enlarging pilot holes, as applicable.
	Convex Test Strip - **Unacceptable** • Caused by excessive dimpling pressure. • Prevent by reducing dimpling pressure.
	Concave Test Strip - **Unacceptable** • Caused by insufficient dimpling pressure. • Prevent by increasing dimpling pressure.

Table 2 - Visual Requirements for Modified Radius Dimpling

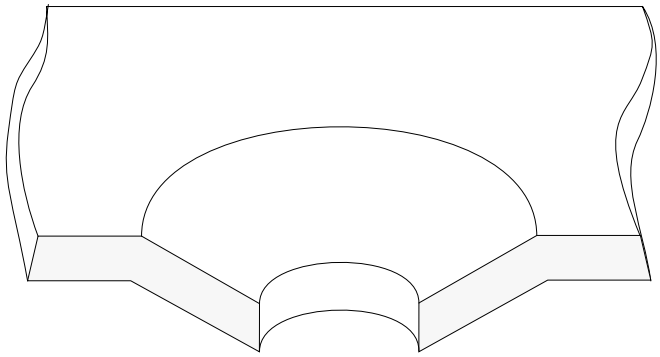
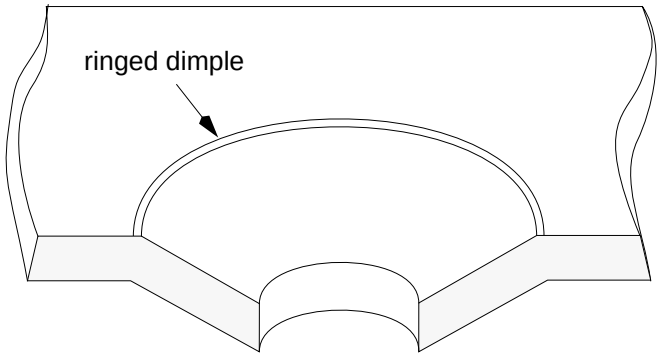
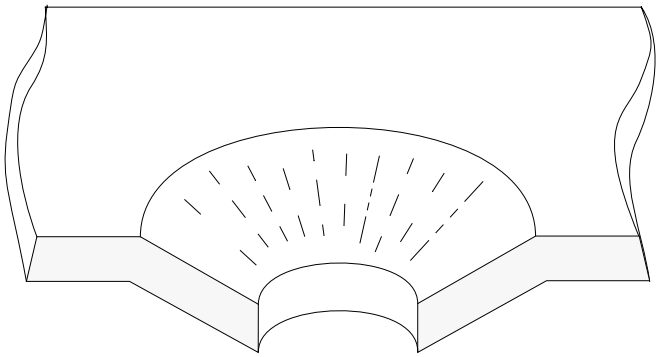
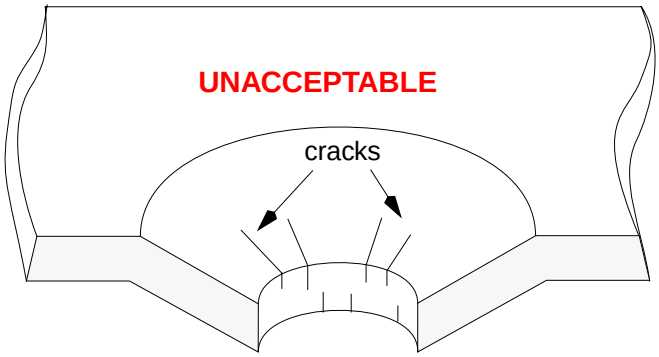
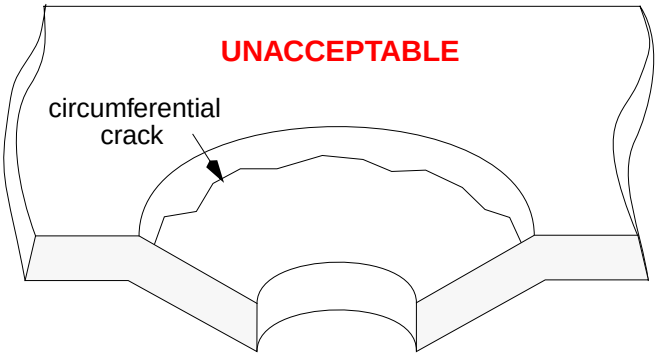
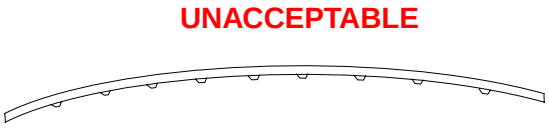
VISUAL APPEARANCE	DESCRIPTION
	**Ideal** Ram Coin Dimple • Good definition • No scratches or marks on dimple surface • No cracks
	Ringed dimple - **Acceptable** only if the rivet head will extend above flush with the skin surface. • Caused by excessive dimpling pressure. • Prevent by reducing dimpling pressure.
	Marks on Dimple - **Acceptable** • Caused by foreign matter on tools. • Prevent by cleaning or replacing tools.

Table 2 - Visual Requirements for Modified Radius Dimpling

VISUAL APPEARANCE	DESCRIPTION
	Cracked Dimple Flare - **Unacceptable** • Caused by improperly heated dies, cracked inner ram, insufficient ram pressure or pilot hole too small. • Prevent by checking for proper die temperature settings, replacement of cracked inner ram, increasing ram pressure or by enlarging pilot holes, as applicable.
	Circumferential Crack - **Unacceptable** • Caused by improperly heated dies, cracked inner ram, insufficient ram pressure or pilot hole too small. • Prevent by checking for proper die temperature settings, replacement of cracked inner ram, increasing ram pressure or by enlarging pilot holes, as applicable.
	Convex Test Strip - **Unacceptable** • Caused by excessive dimpling pressure. • Prevent by reducing dimpling pressure.
	Concave Test Strip - **Unacceptable** • Caused by insufficient dimpling pressure. • Prevent by increasing dimpling pressure.