BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 2.73

PRODUCTION PROCESS STANDARD

INSTALLATION OF BI-METALLIC RIVETS

Issue 6
- This standard supersedes PPS 2.73, Issue 5.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS 2.73 related questions to michael.wright@aero.bombardier.com.
- This PPS is effective as of the distribution date.

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	Quality		

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 the installation of bi-metallic rivets (B0205009, B0205010 and B0205011) in interference fit holes in metallic structure. For installation of bi-metallic rivets in composite structure, refer to Liaison Engineering.

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.

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 1.09 - Drilling and Reaming.

3.2.2 PPS 1.12 - Use of Rivet Squeezers (Portable and Stationary).

3.2.3 PPS 1.14 - Use of Pneumatic Rivet Guns.

3.2.4 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.2.5 PPS 13.26 - General Subcontractor Provisions.

3.2.6 PPS 27.05 - Manual Edge Finishing.

3.2.7 PPS 31.17 - Solvent Usage.

3.2.8 PPS 34.02 - Application of Alkyd Zinc Chromate Primer (F1).

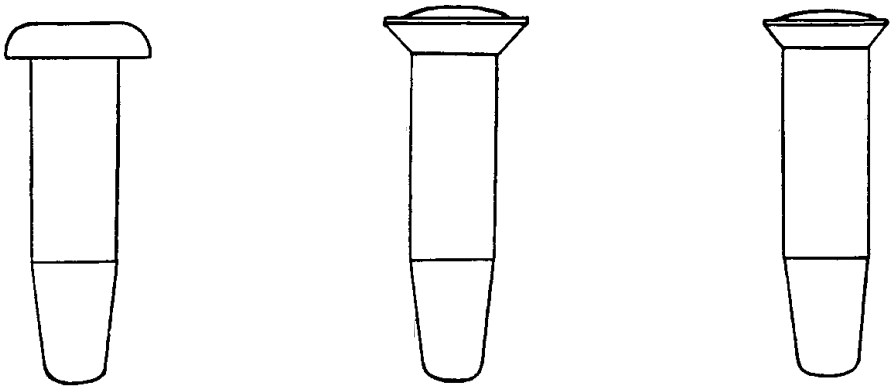
3.2.9 PPS 34.08 - Application of Epoxy-Polyamide Primer (F19 & F45).

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 Bi-metallic rivets (B0205009, B0205010 and B0205011) as specified by the engineering drawing. See Figure 1 for a part number breakdown.



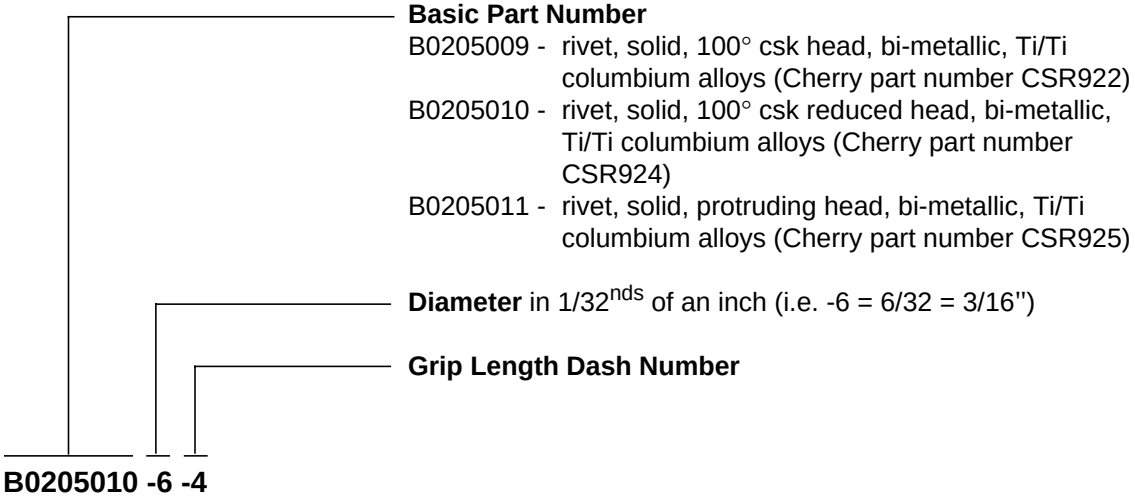


Figure 1 - Part Number Breakdown

4.2 Equipment

4.2.1 Deburring tool, (e.g., SD8066 Vixen file).

4.2.2 Grip gauges (e.g., Cherry #247A6).

4.2.3 Support block (e.g., SD8853).

5 Procedure

5.1 General

5.1.1 Perform all drilling according to PPS 1.09 (including pilot holes, pre-drilling and final drilling).

5.1.2 Bi-metallic rivets consist of a 6Al-4V titanium alloy head and shank welded to a tail of ductile titanium alloy to produce a solid one piece high strength rivet capable of being installed in interference fit holes in metallic structure using conventional riveting equipment.

5.2 Preparation of Fastener Holes

5.2.1 Prepare fastener holes as follows:

Step 1. Assemble the parts in the orientation specified on the engineering drawing.

Step 2. Pre-drill the fastener holes according to PPS 1.09 using the appropriate size pre-drill and drill guide bushing for the size of reamer to be used. Refer to Table 1 for the required final hole size and recommended pre-drills.

Table 1 - Hole Preparation Data

NOMINAL FASTENER DIAMETER	RECOMMENDED PRE-DRILL SIZE	RECOMMENDED REAMER		FINAL HOLE SIZE
		SIZE	TS.561.11.13	
5/32" (-5)	0.1440"	0.1615"	MK 20 or MK 130	0.1610" - 0.1625"
3/16" (-6)	0.1600"	0.1865"	MK 49	0.1860" - 0.1880"
	0.1770"	0.1865"	MK 21 or MK 131	
1/4" (-8)	0.2280"	0.2465"	MK 22, MK 121, MK 123, MK 124 or MK 132	0.2460" - 0.2480"

Step 3. Ream the pre-drilled fastener hole to final size. Refer to Table 1 for the required final hole size and recommended reamers.

Step 4. For flush head bi-metallic rivets, prepare countersinks according to PPS 1.33. The countersink diameter specified in Table 2 is for reference only, prepare the countersink so that the manufactured head will protrude 0.002" - 0.005".

Table 2 - Countersink Data (for reference only)

FASTENER	NOMINAL FASTENER DIAMETER	REFERENCE COUNTERSINK DIAMETER
B0205009 (100° csk head)	5/32" (-5)	0.274" - 0.279"
	3/16" (-6)	0.341" - 0.346"
	1/4" (-8)	0.464" - 0.469"
B0205010 (100° csk reduced head)	5/32" (-5)	0.232" - 0.237"
	3/16" (-6)	0.287" - 0.292"
	1/4" (-8)	0.380" - 0.385"

Step 5. Radius hole edges under the rivet head 0.030" - 0.035" as shown in Figure 2. Alternatively, if radiusing equipment is not available, it is acceptable to chamfer the hole edges according to PPS 27.05, as shown in Figure 3.

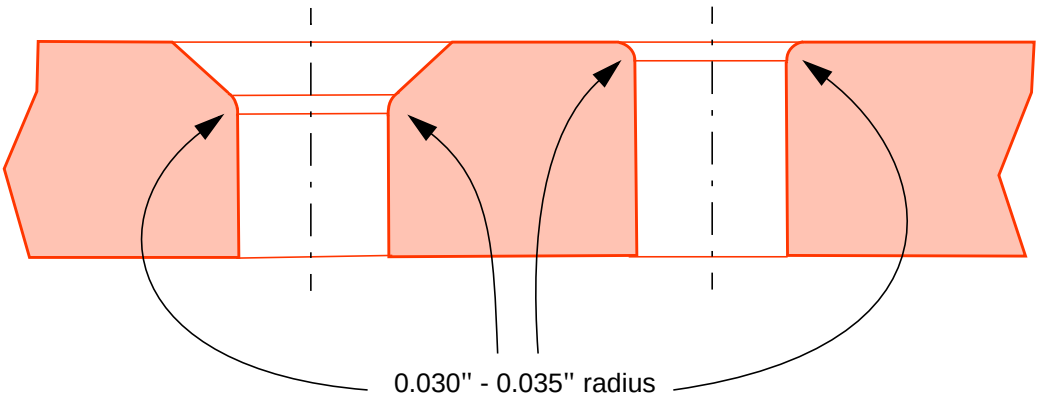


Figure 2 - Radiusing of Hole Edges for Fastener Seating

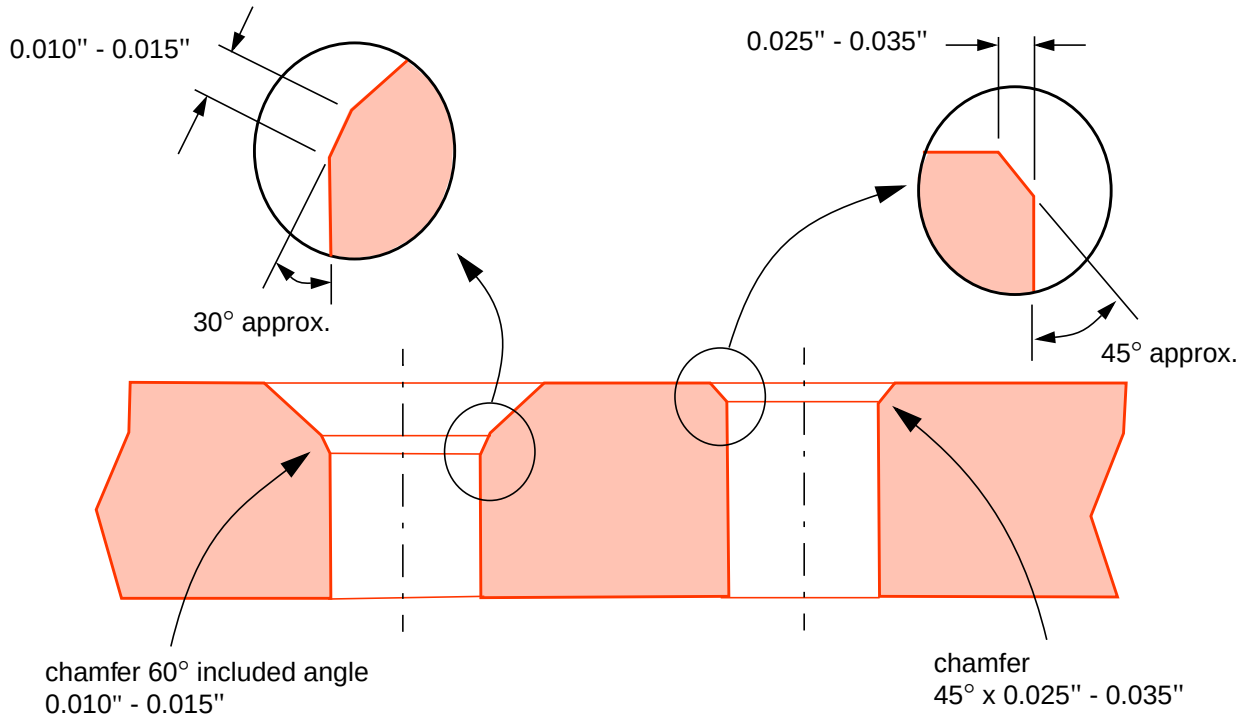


Figure 3 - Breaking of Hole Edges for Fastener Seating

Step 6. If possible, disassemble the parts to remove chips and metal cuttings from the faying surfaces.

Step 7. Remove the standing burr from the hole on the exit side of the part using a Vixen file.

Step 8. Prime countersinks with a coat of F1 zinc chromate primer according to PPS 34.02 or F19 Type 2 epoxy-polyamide primer according to PPS 34.08.

5.2.2 On a sample basis, check at random (across the entire pattern) the number of holes specified in Table 3 for conformance to the hole limit requirements of Table 1 using a go/no-go gauge or other hole measuring gauge. If any oversize holes are found in the sample, check every hole in the pattern. Refer all oversize holes to Bombardier Aerospace Toronto MRB or Bombardier Aerospace Toronto delegated MRB for disposition.

5.2.2.1 While checking holes using a GO/NO-GO gauge or other hole measuring gauge, also check visually for hole ovality. For holes with a visually evident oval or out of round shape, check the hole diameter at several positions using suitable hole measurement equipment (e.g., vernier calliper, hole micrometer, etc.) to determine the minor and major diameters of the hole. The minor and major diameters of the hole must be within the minimum and maximum hole diameter tolerances, respectively. If the minor or major diameters of any oval hole in the sample are not within the minimum and maximum hole diameter tolerance, check every hole in the pattern for conformance to the hole limit requirements and visually for ovality as specified herein. Refer all non-conforming holes to Bombardier (Toronto Site) MRB or Bombardier (Toronto Site) delegated MRB for disposition.

Table 3 - Hole Size Verification Sample Requirements

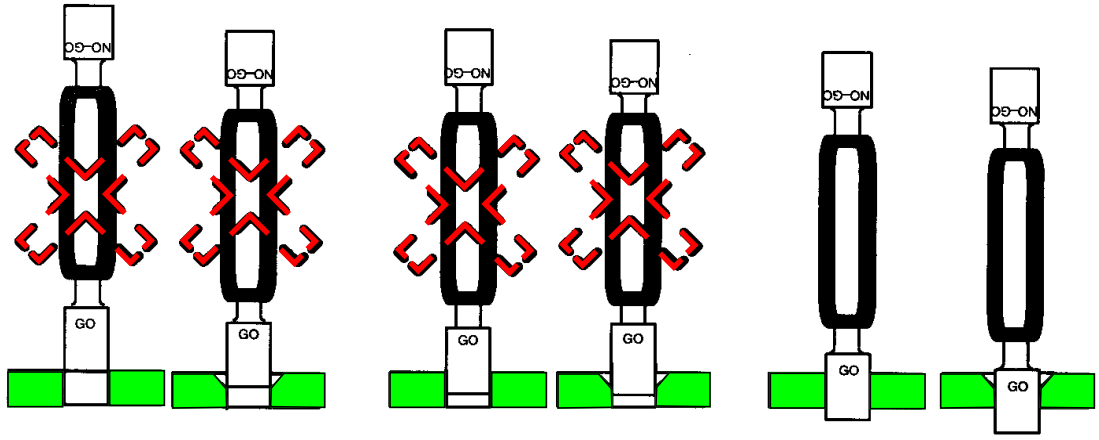
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of Go/No-Go Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of Table 1 using the applicable go/no-go gauge as follows (see Figure 4):

Step 1. Taking care not to force or rotate the go/no-go gauge, lightly insert the go end of the gauge into the fastener hole. If the go end of the gauge goes in only partially or does not go into the hole at all, the hole is **undersize**. Open undersize holes to the final diameter specified in Table 1.

Step 2. Lightly insert the no-go end of the gauge in the fastener hole. If the gauge goes completely into the hole, the hole is **oversize**; oversize holes are not acceptable and must be referred to Bombardier Aerospace Toronto MRB or Bombardier Aerospace Toronto delegated MRB for disposition.

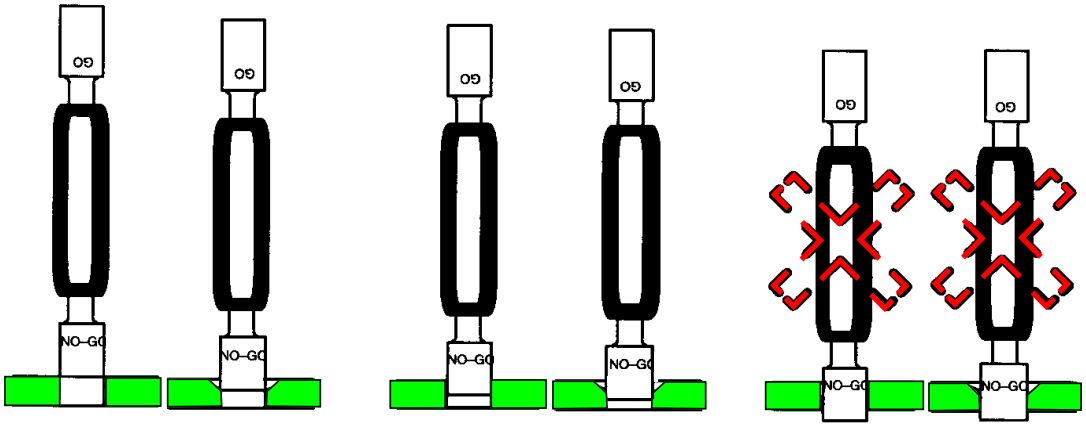


Does not go in.
UNDERSIZE HOLE

Goes only partially in.
UNDERSIZE HOLE

Goes in completely.
ACCEPTABLE

USE OF GO END



Does not go in.
ACCEPTABLE

Goes only partially in.
ACCEPTABLE

Goes in completely.
OVERSIZE HOLE

USE OF NO-GO END

Figure 4 - Use of Go/No-Go Gauges

5.3.2 Fastener Selection

5.3.3 Install only the type and diameter of fastener specified on the engineering drawing, product specification or shop order.

5.3.4 The fastener grip length specified on the product specification, shop order or assembly manual is only a reference length. After final drilling, for at least one hole in the pattern verify that the grip length specified is correct as follows:

Step 1. Ensure that the members are properly fitted up and tightly clamped together.

Step 2. Measure the combined material thickness using a grip gauge (see Equipment Section, paragraph 4.2.2) as shown in Figure 5. For holes in tapered structures, measure the grip length at the minimum side of the hole.

5.3.4.1 If the grip length determined by measurement does not agree with the specified grip length but is within 2 grip lengths, use the measured grip length. In the case of a discrepancy greater than 2 grip lengths, refer to Liaison Engineering.

5.3.4.2 If the required grip length is not available it is **not** acceptable to use of rivets of a longer grip length. Also, under no circumstances should a rivet be cut to a shorter grip length.

In this example, the grip length gauge indicates that a -8 grip length rivet is needed. Unless the arrow points directly to a particular grip length (as in this case), use the next longer grip length (i.e., if the arrow had pointed to just beyond the -8 mark then a -8R grip length rivet would have been required.

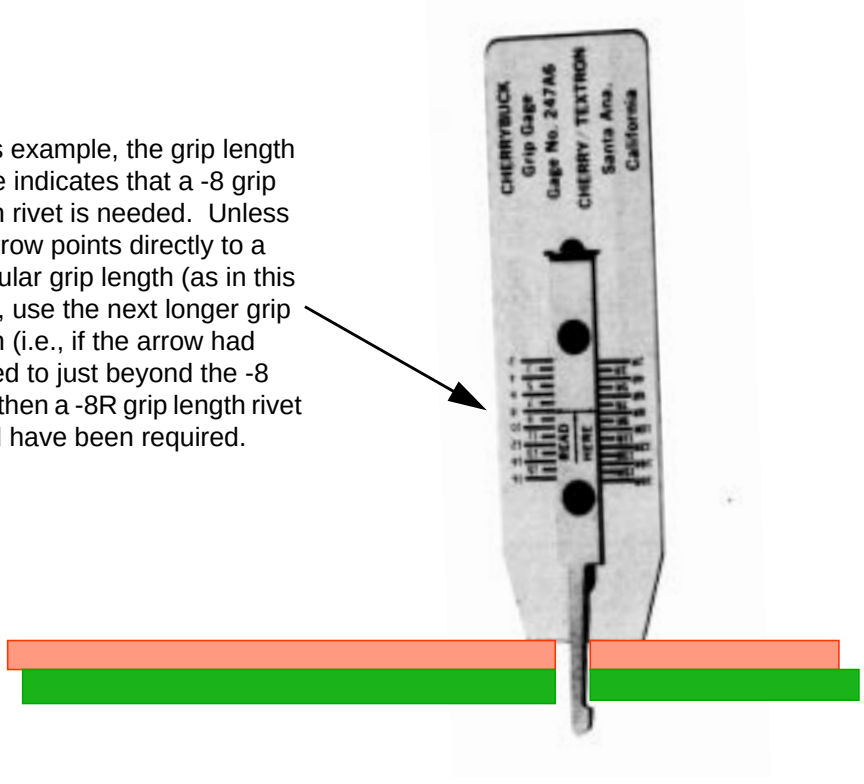


Figure 5 - Use of Grip Gauge

5.4 Preparation of Rivets

5.4.1 Do not clean rivets in any manner that would result in removal of the lubricant applied by the manufacturer.

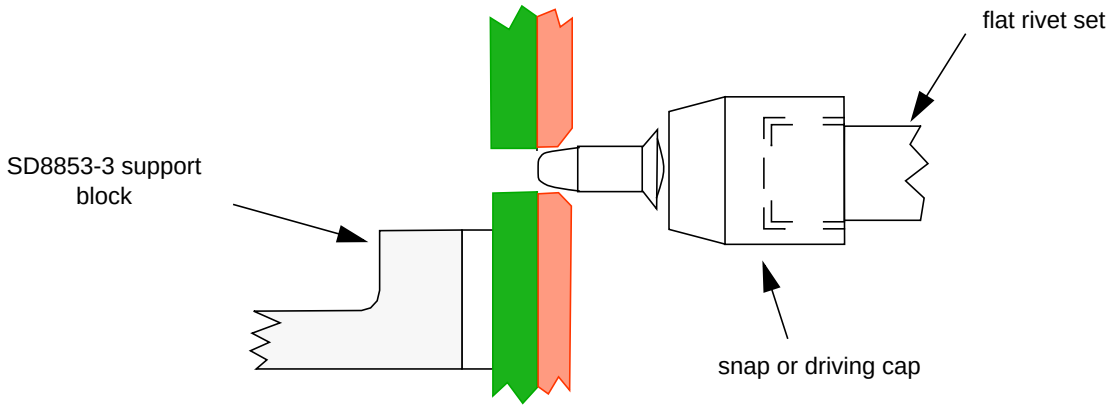
5.4.2 Bi-metallic rivets as specified herein are received lubricated by the manufacturer. Do not apply additional lubricant to the rivet or the hole.

5.5 Installation of Rivets

5.5.1 Install rivets as follows:

Step 1. Clamp the parts firmly together using Clecos in every 4th to 6th hole. Ensure that there is intimate contact between the mating surfaces.

Step 2. Carefully seat the rivets into the interference fit holes by light driving with a rivet gun while supporting the opposite side of the panel with a SD8853-3 or -5 support block as shown below. Take care to avoid damage to the structure surface or fastener head.



Step 3. Ensure that the rivets are fully seated.

Step 4. Check that the heads of flush head rivets protrude 0.002" - 0.005".

Step 5. If possible, upset the rivets using a rivet squeezer according to PPS 1.12. Alternatively, if necessary, it is acceptable (although not preferred) to upset the rivets using a rivet gun according to PPS 1.14. If fay sealant was used, ensure that all the rivets are upset within the sealant application life.

5.6 Removal and Replacement of Rivets

5.6.1 If necessary, remove rivets as follows:

Step 1. Use a drill of the same diameter as the rivet shank to drill through the head a distance equal to the rivet head height. If possible drill out the rivet from the manufactured head side since it is centred with more accuracy than the shop head.

Step 2. Carefully pry off the rivet head using a straight punch.

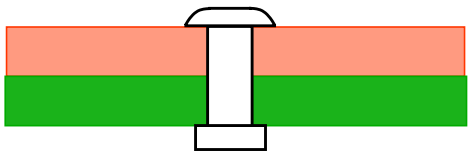
Step 3. While supporting the sheet on the opposite side to prevent dimpling around the rivet hole, drive out the rivet shank using a small punch. Take care to avoid damage to the surrounding structure.

Step 4. Dimensionally check that the hole conforms to the requirements of Table 1 using a go/no-go gauge (see Figure 4), a plug gauge or other hole measuring gauge. Also check the hole ovality; the minor and major diameters of the hole must be within the minimum and maximum hole diameter tolerances, respectively. If the hole is oversize, it must be referred to Bombardier Aerospace Toronto MRB or Bombardier Aerospace Toronto delegated MRB for written authorization to repair and for the applicable oversize fastener.

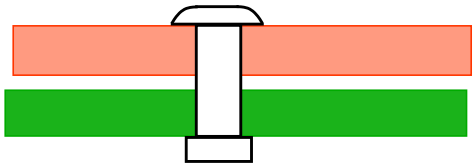
6 Requirements

6.1 Visually check installed bi-metallic rivets as follows.

6.1.1 The sheets must be drawn up tightly as shown:



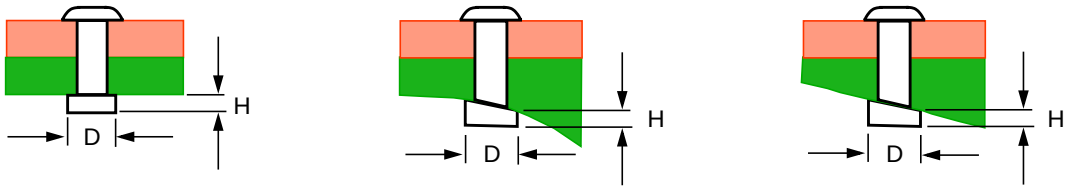
Proper Installation



Gap Between Sheets Unacceptable

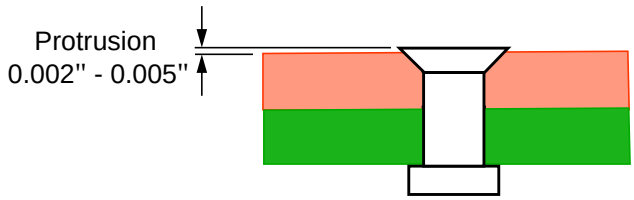
6.1.2 Shop formed heads must meet the requirements specified in Table 4.

Table 4 - Requirements for Shop Formed Heads

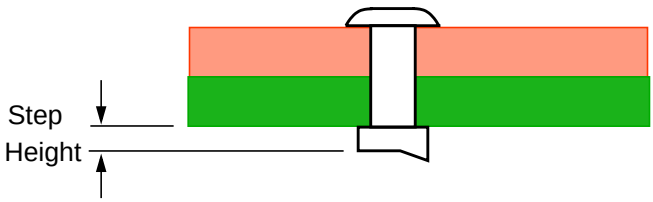


NOMINAL RIVET DIAMETER	HEAD DIAMETER "D"	HEAD THICKNESS "H"
-5 (5/32")	0.213" - 0.253"	0.056" - 0.108"
-6 (3/16")	0.246" - 0.312"	0.065" - 0.128"
-8 (1/4")	0.325" - 0.417"	0.085" - 0.168"

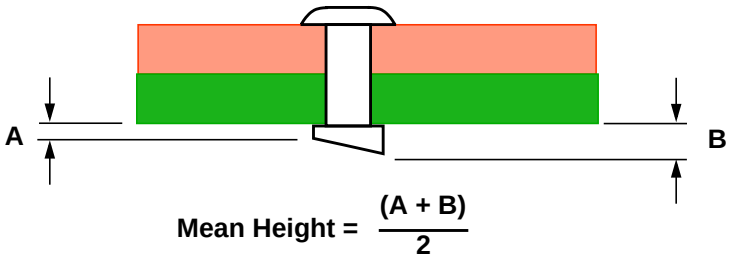
6.1.3 For flush head installations, the flush head must protrude 0.002" - 0.005". Do **not** shave the heads of bi-metallic rivets under any circumstances. If the protrusion requirements have not been met the rivet must be removed according to section 5.6 and replaced.



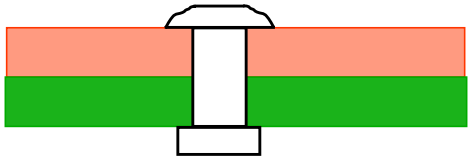
6.1.4 If the height of a stepped portion, if any, of a shop head (as shown below) is less than the minimum height specified in Table 4, the rivet must be replaced.



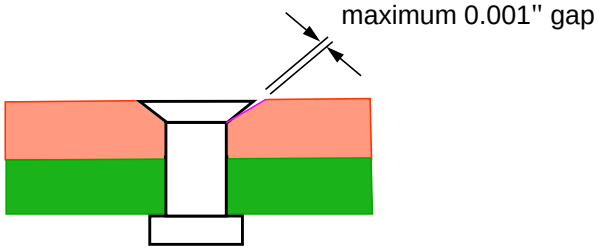
6.1.5 If the mean (average) height of a sloped shop head (see the following figure) is less than the minimum specified in Table 4, the rivet must be replaced.



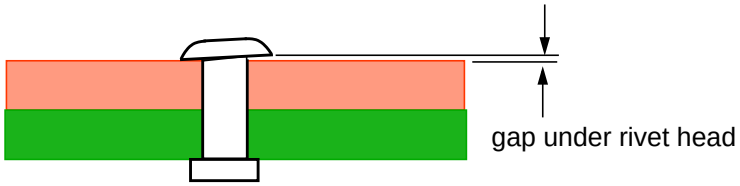
6.1.6 If the manufactured head of the rivet has been damaged by the installation tooling (e.g., wrong snap), as shown below, the rivet must be replaced.



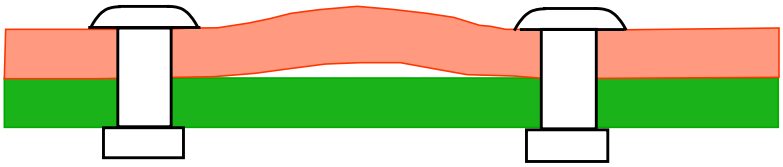
6.1.7 A gap under a manufactured flush head is only acceptable on one side of the head if the maximum size of that gap does not exceed 0.001" (as shown below). If a gap under a flush head exceeds 0.001" or extends all the way around the head, the rivet must be replaced and the countersink diameter checked.



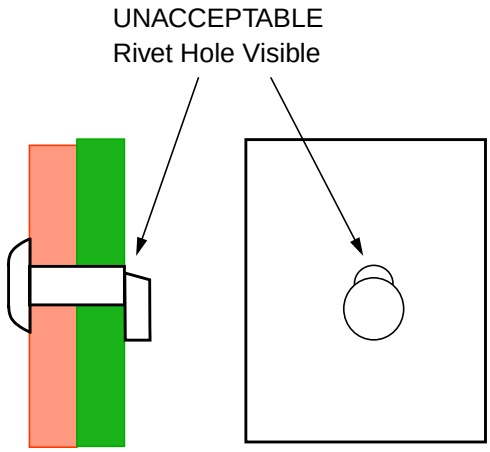
6.1.8 A gap under a manufactured protruding head is only acceptable on one side of the head and it must not be possible for a 0.002" feeler gauge to contact the rivet shank or move freely when slipped back and forth in a straight line perpendicular to the axis of the rivet shank. If the gap extends all around the head or it is possible for a 0.002" feeler gauge to contact the rivet shank or move freely when slipped back and forth in a straight line perpendicular to the axis of the rivet shank, the rivet must be replaced.



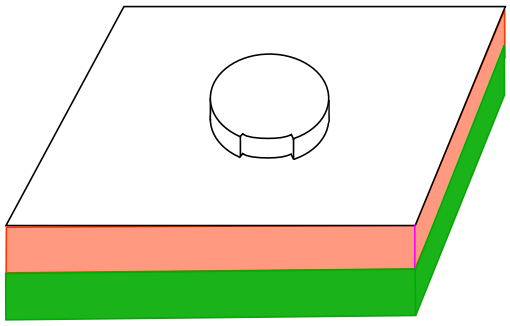
6.1.9 It is unacceptable for the sheets to bulge between the rivets as shown below:



6.1.10 If the rivet hole is visible beyond the periphery of an eccentric shop head (as shown below), the rivet must be replaced. Shop heads that are visibly eccentric (without the rivet hole visible beyond the periphery of the shop head) are acceptable only if the number of such rivets does not exceed 10% of the pattern and are not adjacent to one another.

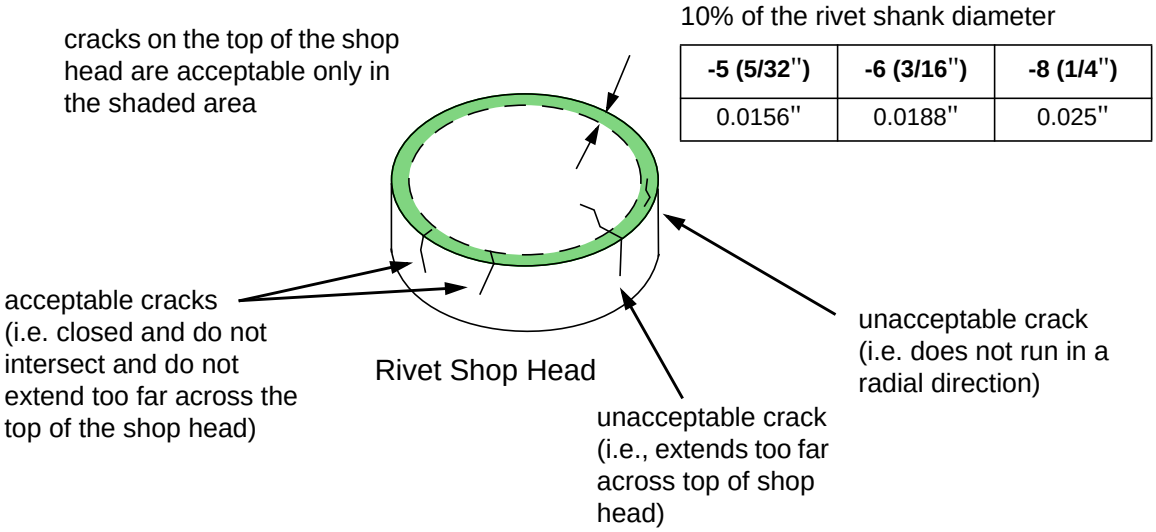


6.1.11 If the circumference or face of a rivet head shows evidence of a segment being sheared out (as shown below), the rivet must be replaced.



6.1.12 Except as noted below, if there are any cracks in the shop head, the rivet must be replaced. Cracks which meet all of the following characteristics are acceptable:

- To be acceptable the crack must be closed.
- To be acceptable the crack must run in a radial direction (i.e., from the edge of the rivet head towards the centre).
- To be acceptable the crack must not intersect with any other cracks or run in a direction such that it may intersect with another crack.
- To be acceptable the visible part of the crack must not extend more than 1/10th of the rivet shank diameter toward the centre of the rivet head (see below).



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 Observe the safety precautions specified in the referenced rivet installation equipment PPS's.

8 Personnel Requirements

8.1 Personnel responsible for installation of bi-metallic rivets (B0205009, B0205010 and B0205011) must have a good working knowledge of the procedure and requirements as specified herein and shall have exhibited their familiarity to their supervisor.