BOMBARDIER

Toronto Site

PROPRIETARY INFORMATION

PPS 2.66

PRODUCTION PROCESS STANDARD

INSTALLATION OF BLIND RIVETS

Issue 16
- This standard supersedes PPS 2.66, Issue 15.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- Direct PPS 2.66 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.

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	Production Process Standards		

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Tables

1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of blind rivets.

1.2 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.

1.2.1 Refer to PPS 13.26 for the subcontractor provisions applicable to this PPS.

1.2.2 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 1.01 - Dimpling Aluminum Alloys.

3.2.2 PPS 1.07 - Dimpling of Ferrous, Nickel and Titanium Alloys.

3.2.3 PPS 1.09 - Drilling and Reaming.

3.2.4 PPS 1.33 - Countersinking for Flush Head Rivets.

3.2.5 PPS 13.26 - General Subcontractor Provisions.

3.2.6 PPS 13.39 - Bombardier Toronto Engineering Process Manual.

3.2.7 PPS 21.03 - Priming, Sealing and Repair of Integral Fuel Tanks.

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, Equipment and Facilities

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 Blind rivets as specified on the engineering drawing or EO 7336. Refer to Figure 1, Figure 2 and Figure 3 for a breakdown of CherryMax, NAS and M7885 blind rivet part numbers. CherryMax blind rivets may be used as replacements for Cherry and Cherrylock blind rivets as specified in Table 1. Certain CherryMax blind rivets are qualified to MIL-R-7885 and may be used interchangeably with certain M7885 blind rivets: refer to Table 3 for a cross reference of CherryMax and M7885 blind rivets which may be used interchangeably. Refer to Figure 4 for a general description of blind rivets.

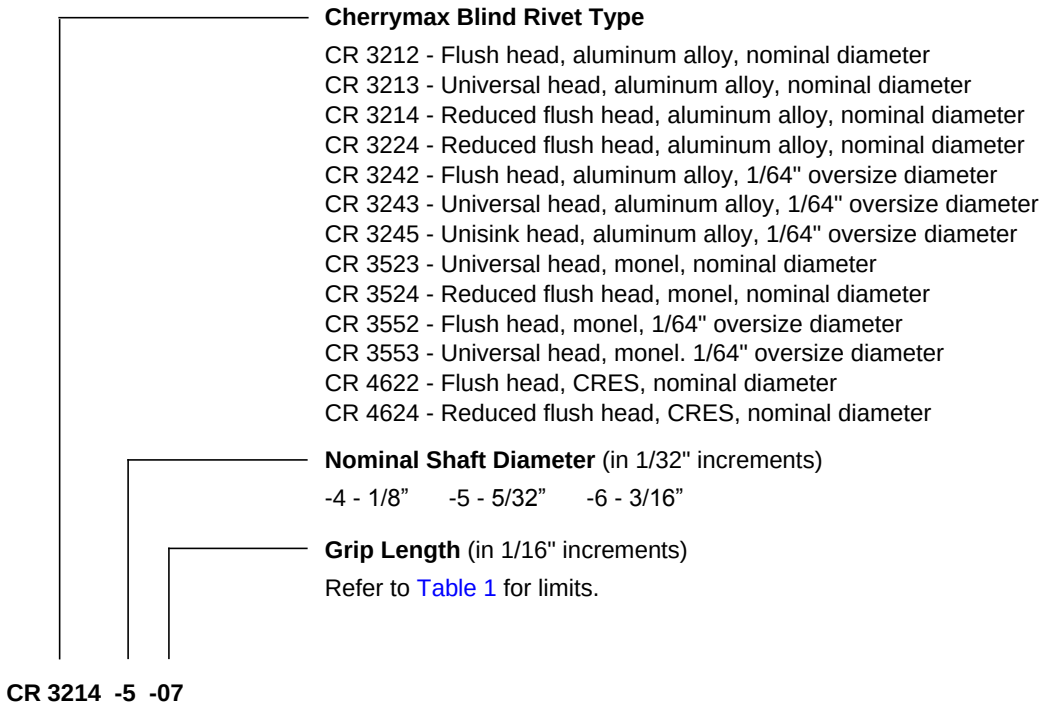


Figure 1. Breakdown of Cherrymax Blind Rivet Part Number

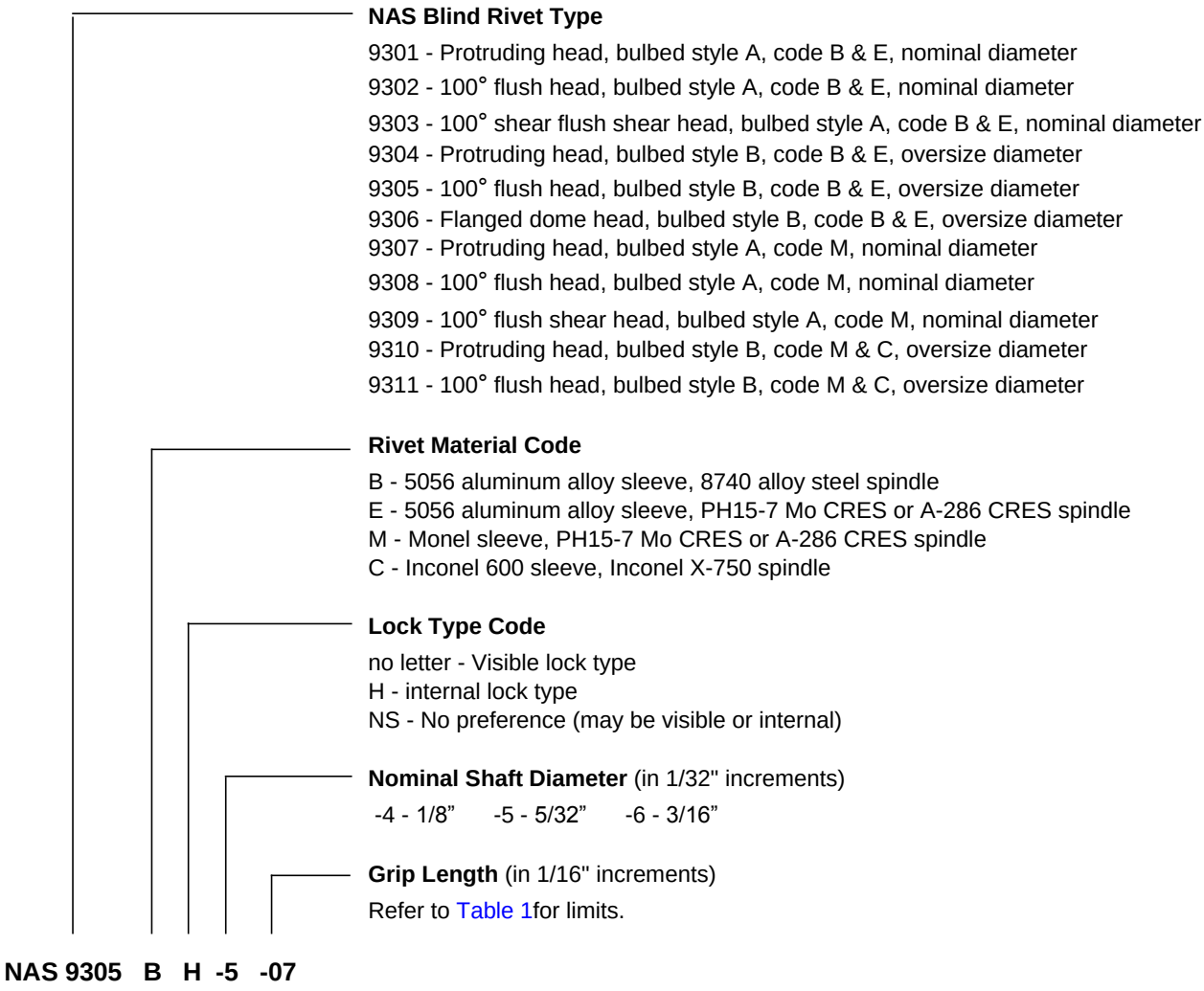


Figure 2. NAS Blind Rivet Part Number Breakdown

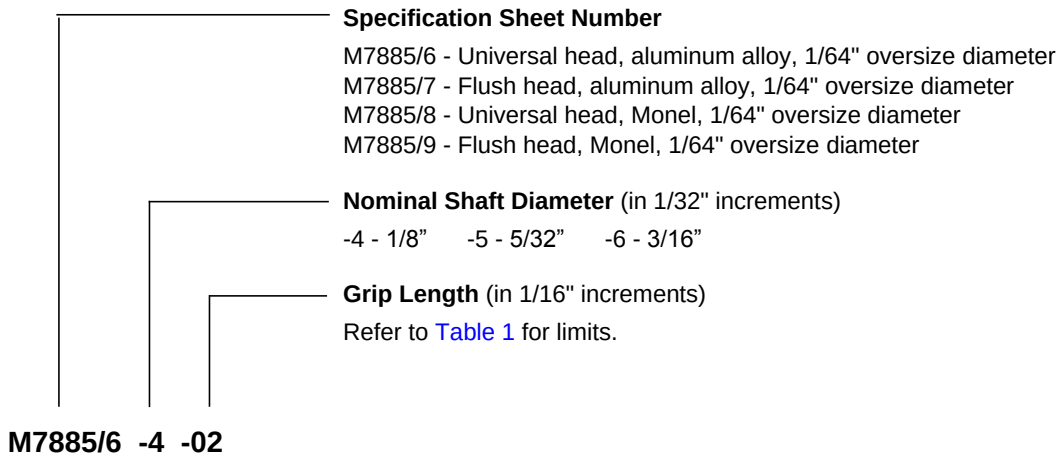


Figure 3. Breakdown of M7885 Blind Rivet Part Number

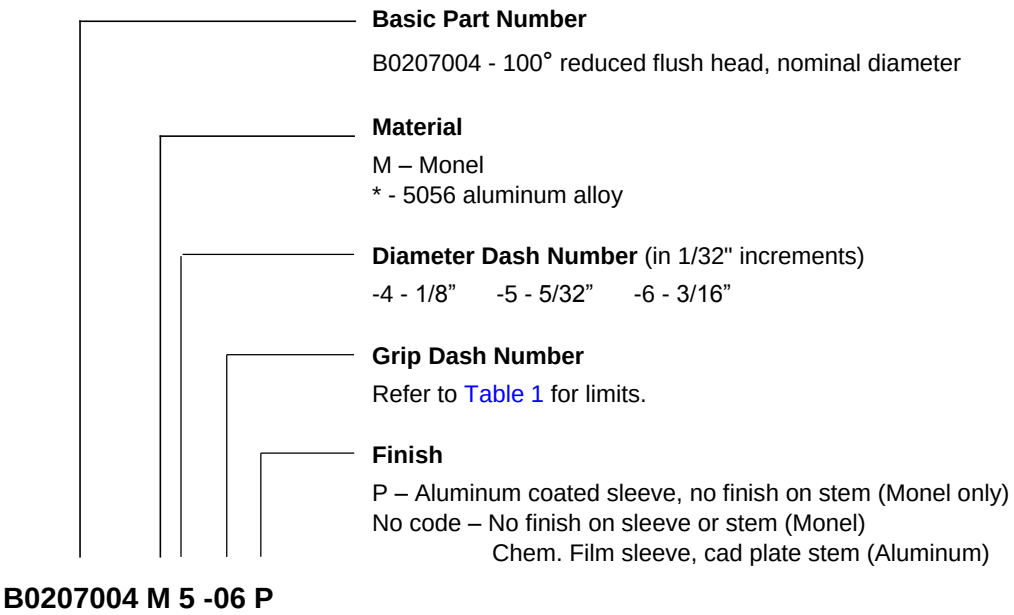


Figure 4. Breakdown of B0207004 Blind Rivet Part Number

Table 1. Grip Length Limits

Grip Number	Material Thickness	
	Minimum	Maximum
-01	Note 1	0.062”
-02	Note 2	0.125”
-03	0.126”	0.187”
-04	0.188”	0.250”

Grip Number	Material Thickness	
	Minimum	Maximum
-05	0.251”	0.312”
-06	0.313”	0.375”
-07	0.376”	0.437”
-08	0.438”	0.500”

Grip Number	Material Thickness	
	Minimum	Maximum
-09	0.501”	0.562”
-10	0.563”	0.625”
-11	0.626”	0.687”
-12	0.688”	0.750”

		Rivet Diameter		
		-4	-5	-6
Note 1.	Minimum grip for universal head blind rivets.	0.025”	0.031”	0.037”
Note 2.	Minimum grip for flush head blind rivets.	0.045”	0.063”	0.073”
	Minimum grip for universal/protruding head blind rivets.	0.063”	0.063”	0.063”

Table 2. Chery/Cherrylock Rivet Replacement

Cherry Rivet	Cherrylock Rivet	Replacement CherryMax Rivet	Authorization
CR 756	CR 2248	CR3242	SREO
CR 762			
CR 757	CR 2249	CR 3243	SREO
CR 763			
N/A	CR 2538	CR 3552	SREO
	CR 2539	CR 3553	SREO

Table 3. CherryMax/MIL-R-7885 Interchangeability

Cherrymax Blind Rivet	MIL-R-7885 Blind Rivet
CR 3242	M7885/7
CR3243	M7885/6
CR 3553	M7885/8

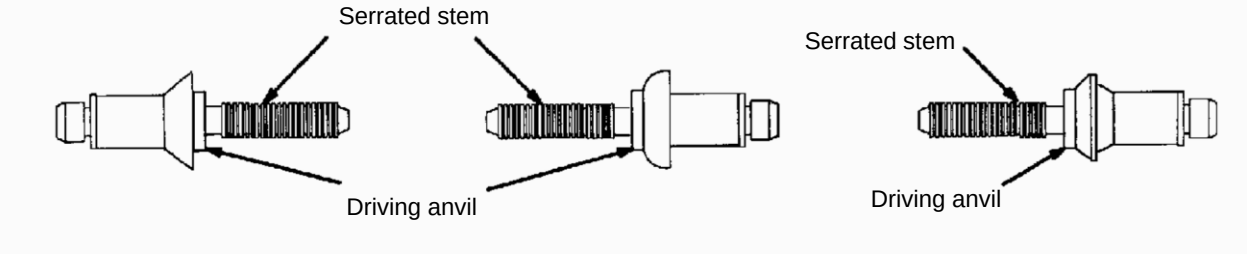


Figure 5. Blind Rivets

4.2 **Equipment**

4.2.1 CherryMax rivet installation guns and pulling heads as listed in Table 9. Refer to Figure 7 for a general reference of tool dimensions.

4.2.2 Pneumatic-hydraulic power riveter, MIL-R-85188.

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

4.2.4 Rivet grip gauge (e.g., Cherry #269C3).

4.2.5 Drilling aid fixtures, (e.g., TS.519.10.14 MK1, MK2 and MK3).

4.2.6 CherryMax G-27 hand riveter.

5 Procedure

5.1 General

5.1.1 Blind rivets are high strength fasteners which are set and locked by means of a single action pulling tool which pulls the mandrel stem to form the blind head, form the spindle retaining lock ring in place and simultaneously break off the mandrel stem.

5.1.2 Each rivet is supplied fully assembled with a driving anvil which is discarded after installing the rivet.

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

5.1.4 Store blind rivets in their original packages until used. Protect blind rivets from contamination such as dust, dirt, moisture or excessive heat which could damage or destroy the lubricant coating applied by the manufacturer.

5.2 Preparation of Holes

5.2.1 If countersinking of the fastener hole is specified on the engineering drawing, prepare holes as follows:

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

Step 2. Drill pilot holes as specified in Table 4.

Step 3. Countersink the fastener holes to the diameter specified in Table 4 according to PPS 1.33.

Step 4. Unless previously drilled to final size using a micro-stop countersink, drill the fastener holes to final size according to Table 5.

Step 5. If possible, disassemble the parts to remove chips and metal cuttings from the faying surfaces.

Step 6. Remove the standing burr from the exit hole side of the part using a Vixen file (ref. para. 4.2.3).

Step 7. Prime the countersunk surfaces in metal parts 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.

Table 4. Countersink Data

Rivet			Pre-Drill	Countersink Diameter
Head Style	**Blind Rivet**	**Shaft Diameter**		
Reduced Flush Head	B0207004, CR 3214, CR 3224, CR 3524, CR 4624, NAS 9303 & NAS 9309	-4	3/32”	0.191” – 0.196”
		-5	1/8”	0.242” – 0.247”
		-6	5/32”	0.297” – 0.302”
Flush Head	CR 3212, CR 3242, CR 3552, CR 4622, M7885/7, M7885/9, NAS 9302, NAS 9305, NAS 9308 & NAS 9311	-4	3/32”	0.211” – 0.221”
		-5	1/8”	0.272” – 0.282”
		-6	5/32”	0.339” – 0.349”
Flanged Dome Head or Unisink Head	CR 3245 & NAS 9306	-4	3/32”	0.165” – 0.175”
		-5	1/8	0.208” – 0.218”
		-6	5/32”	0.250” – 0.260”
Note 1. If micro-stop countersink cutters with full size pilots are available it is acceptable to countersink and drill the hole to final size as specified in Table 5 simultaneously.				

Table 5. Final Hole Data

Fastener			Final Drill	
Type	**Blind Rivet**	**Shaft Diameter**	**Drill Size**	**Hole Size**
Nominal	B0207004, CR 3212, CR 3213, CR 3214, CR 3224, CR 3523, CR 3524, CR 4622, CR 4624, NAS 9301, NAS 9302, NAS 9303, NAS 9307, NAS9308 & NAS 9309	-4	#30	0.129” – 0.132”
		-5	#20	0.160” – 0.164”
		-6	#10	0.192” – 0.196”
1/64” Oversize	CR 3242, CR 3243, CR3245, CR3552, CR3553, M7885/6, M7885/8, M7885/9. NAS 9304, NAS 9305, NAS9306, NAS 9310 & NAS9311	-4	#27	0.143” – 0.146”
		-5	#16	0.176” – 0.180”
		-6	#5	0.205” – 0.209”

5.2.2 If dimpling is specified on the engineering drawing, prepare holes for the installation of fasteners as follows:

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

Step 2. Pre-drill for dimpling as specified in Table 6.

Step 3. Dimple the pre-drilled holes according to PPS 1.01 or PPS 1.07, as applicable.

Step 4. Drill the fastener holes to final size according to Table 5.

Step 5. If possible disassemble the parts to remove chips and metal cuttings from the faying surfaces.

Step 6. Remove the standing burr from the exit hole side of the part using a Vixen file (ref. para. 4.2.3).

Table 6. Pilot Holes for Dimpling

Rivet Shaft Diameter	Pre-Drill
-4	#40
-5	#30
-6	#21

5.2.3 If neither countersinking nor dimpling is specified on the engineering drawing, prepare holes for the installation of fasteners as follows:

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

Step 2. Pre-drill as specified in Table 7.

Step 3. Drill the fastener holes to final size according to Table 5.

Step 4. If possible, disassemble the parts to remove chips and metal cuttings from the faying surfaces.

Step 5. Remove the standing burr from the exit hole side of the part using a Vixen file (ref. para. 4.2.3).

Table 7. Pilot Holes for Protruding Head Blind Rivets

Rivet Shaft Diameter	Pre-Drill
-4	#40
-5	#30
-6	#21

5.2.4 On a sample basis, check at random (across the entire pattern) the number of holes specified in Table 8 for conformance to the hole limit requirements, 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 MRB or Bombardier delegated MRB for disposition.

5.2.4.1 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 8. Hole Size Verification Sample Requirement

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 5 using the applicable go/no-go gauge as follows (see Figure 5):

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 5.

Step 2. Lightly insert the no-go end of the plug 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 (Toronto Site) MRB or Bombardier (Toronto Site) delegated MRB for disposition.

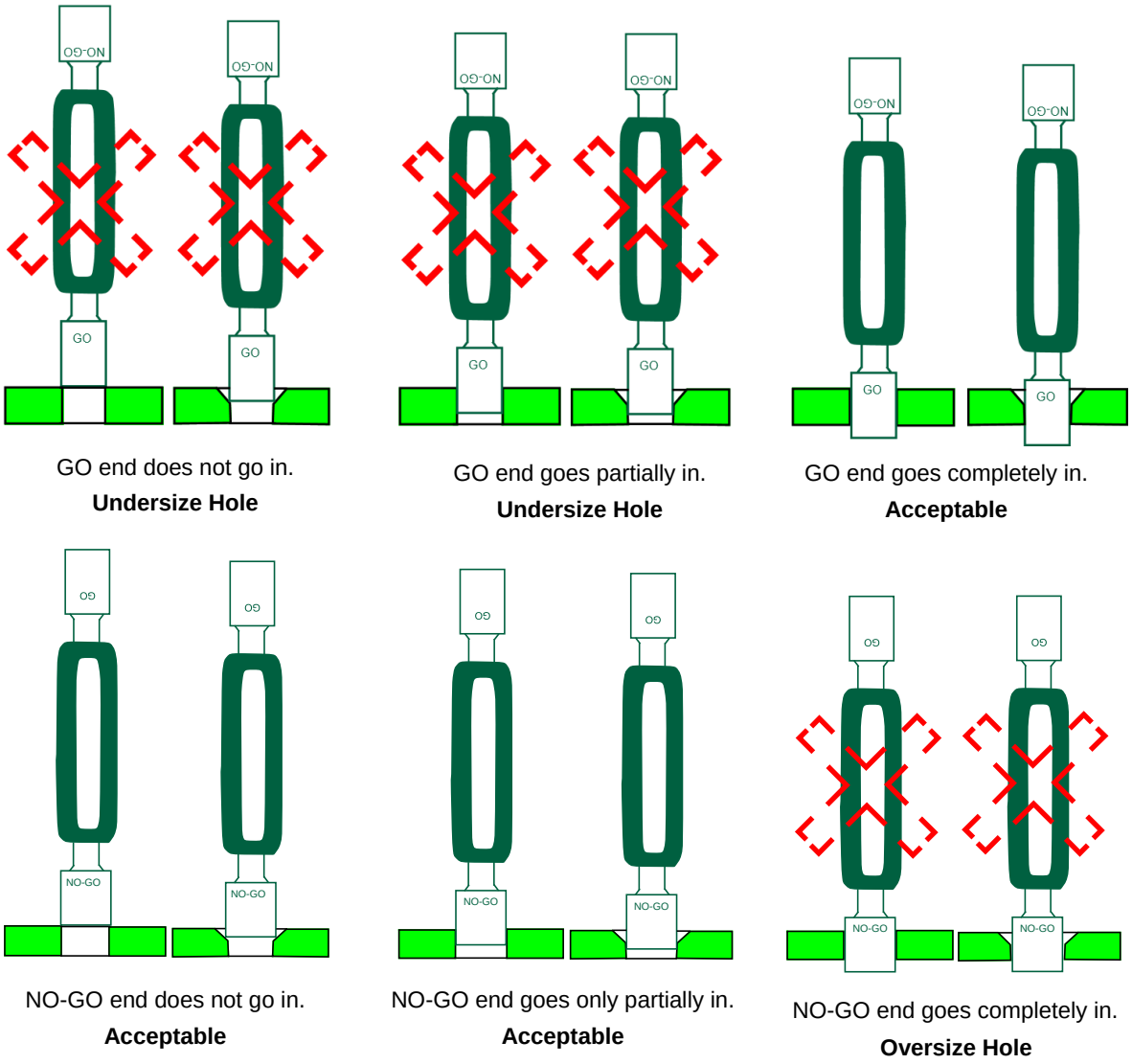


Figure 6. Use of GO/No-GO Gauges

5.4 Fastener Selection

5.4.1 Except as noted in para. 4.1.1 or EO 7336, install only the type and diameter of fastener specified on the engineering drawing, product specification or shop order.

5.4.2 In order to verify that the grip length specified is correct, measure the combined material thickness, after final drilling, using a grip gauge as shown in Figure 6. Always read to the next higher number (i.e., if the reading is past the **end** of the -3 marking then use a -4 fastener). The fastener grip length specified on the Product Specification, Shop Order or Assembly Manual is only a reference length, and if the grip length determined by measurement does not agree with the specified grip length, use the measured grip length.

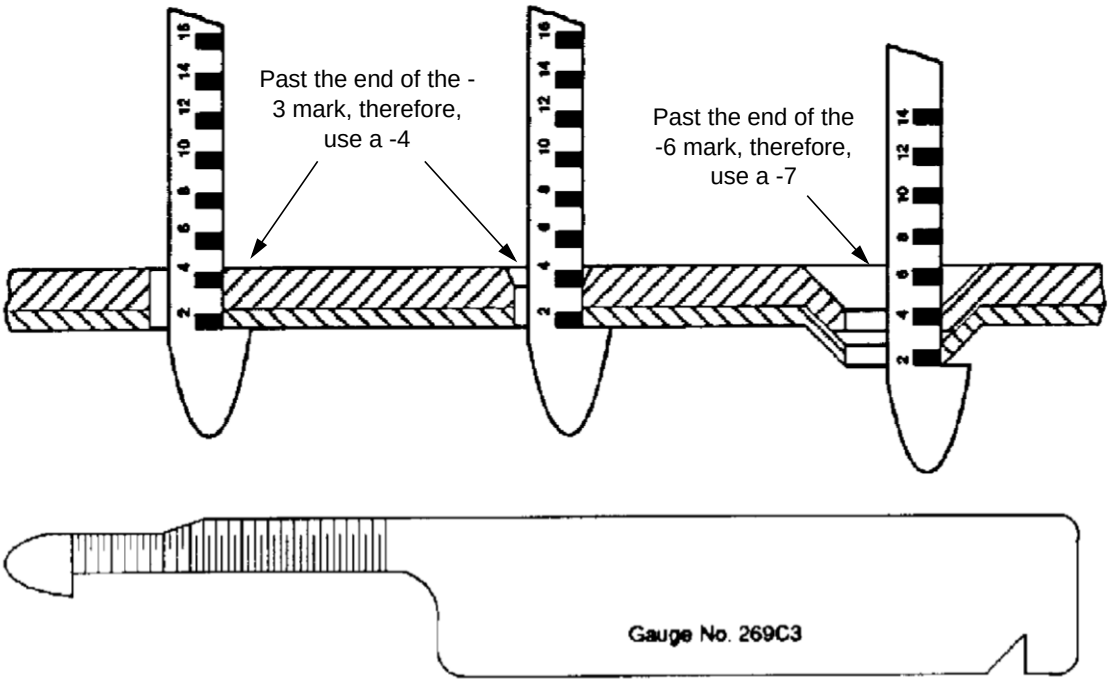


Figure 7. Use of Grip Gauge

5.5 Selecting Installation Tools

5.5.1 Install M7885 blind rivets using pneumatic-hydraulic power riveters meeting the requirements of MIL-R-85188.

5.5.2 Guns fitted with offset and right angle pulling heads are intended for use in limited access areas.

5.5.3 Except for CherryMax G-701 series guns, any of the installation gun/pulling head combinations listed in Table 9 may be used to install -4, -5 and -6 diameter CherryMax, B0207004 or NAS93XX blind rivets. All these guns will pull Universal, Unisink and Flush Head blind rivets in all of the available grip lengths. Do not use CherryMax G-701 series guns to install -6 diameter blind rivets.

5.5.4 At Bombardier (Toronto Site), installation guns are available as complete units including the pulling head. Do not interchange pulling heads from one gun to another.

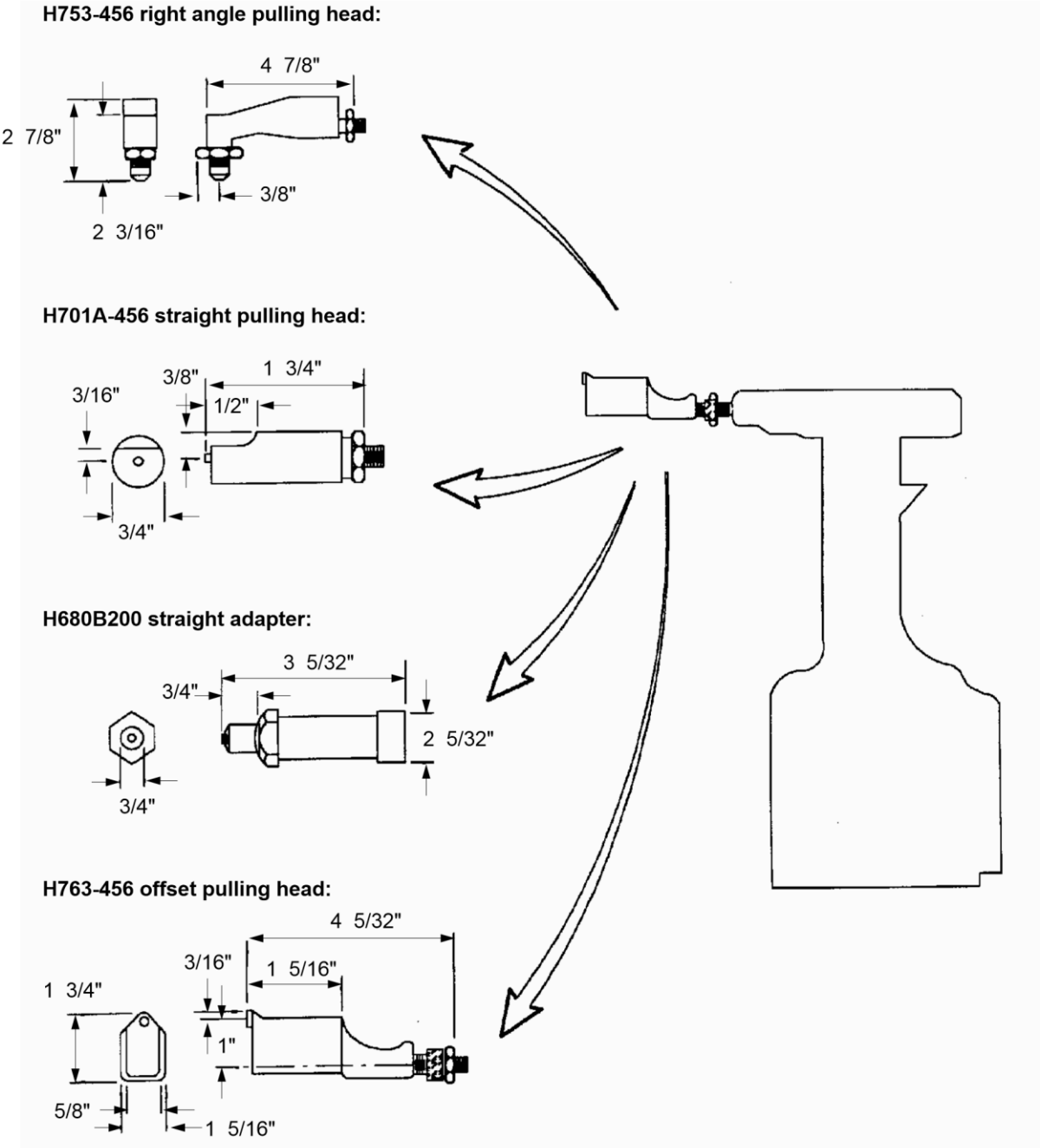


Figure 8. Installation Gun Pulling Heads

Table 9. Cherrymax Rivet Installation Guns and Pulling Heads

Cherrymax Rivet Pneumatic Installation Guns (Note 1)	**Cherrymax Rivet Pulling Heads** (See Figure 7)		
	Straight	**Offset**	**Right Angle**
G-684	H680B200 (Note 2)	n/a	n/a
G-700			
G-701	H701A-456 (Note 3)	H763-456 (Note 3)	H753-456 (Note 2)
G-704			
G-784	H680B200 (Note 2)	n/a	n/a

Note 1. 90 psi minimum air pressure required.
Note 2. Front ejection of rivet stems.
Note 3. Rear ejection of rivet stems.

5.6 Riveting Operation

5.6.1 Install blind rivets as follows (see Figure 9):

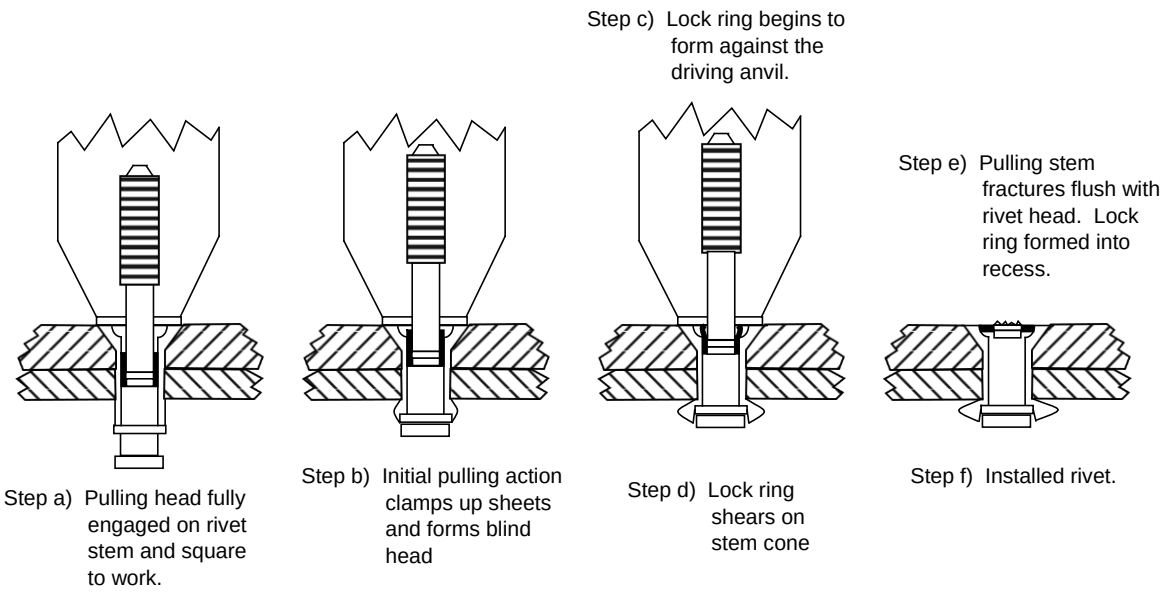


Figure 9. Typical Riveting Operation

Step 1. Clamp parts to be riveted tightly using Cleco type temporary fasteners in every 4th to 6th rivet hole. Ensure all holes are in alignment with dimples nesting properly and no excessive gaps existing between sheets.

Step 2. Insert the first rivet into the prepared hole.

Step 3. Place the pulling head of the riveter fully onto the rivet stem so that the pulling head rests against the driving anvil of the rivet. If installing 1/8" diameter fasteners, a hand riveter (ref. para. 4.2.6) may be used.

Step 4. Holding the riveter square to the surface of the work, push the pulling head firmly against the work and squeeze the trigger to set the rivet and break off the rivet stem. Release the trigger to eject the rivet stem.

Step 5. Install the remaining blind rivets according to Step 2 through Step 4.

5.7 Post Installation Procedure

5.7.1 Except in fuel tanks, brush touch-up exposed metal of the pulling stem fracture with F19 Type 2 epoxy-polyamide primer according to PPS 34.08. In fuel tank areas, brush touch up exposed metal of the pull stem fracture with F21 Type II epoxy primer according to PPS 21.03.

5.8 Removal of Installed Blind Rivets

5.8.1 If necessary, remove installed blind rivets as follows (see Figure 10):

Step 1. Drill out the rivet stem to the depth of the rivet head using a drilling aid and drill as specified in Table 10. Use the universal side of the drilling aid on universal head blind rivets and the flush side on flush head blind rivets. Ensure that the drill is centred on the stem.

On rigid structures it is acceptable to attempt to drive out the rivet **stem** before drilling as specified in Step 2 provided that care is taken to ensure the surrounding structure is not damaged in the process.

Step 2. Drive out the remaining rivet **stem** using a punch. Use only light blows on the rivet stem. In order to prevent damage to thin gauge structures, support the structure from the reverse side using a support block while driving out the rivet.

Step 3. Drill completely through the rivet head using a drill corresponding to the nominal shank diameter of the rivet, so as to break off the rivet head.

Step 4. Drive out the rivet **shank** using a punch. In order to prevent damage to thin gauge structures, support the structure from the reverse side using a support block while driving out the rivet

Table 10. Drilling Aid and Drill for Removal of Installed Blind Rivets

Rivet		Drill Aid TS.519.10.14	Drill
Nominal Diameter	Dash Number		
1/8”	-4	MK 1	#40
5/32”	-5	MK 2	#30
3/16”	-6	MK 3	#20

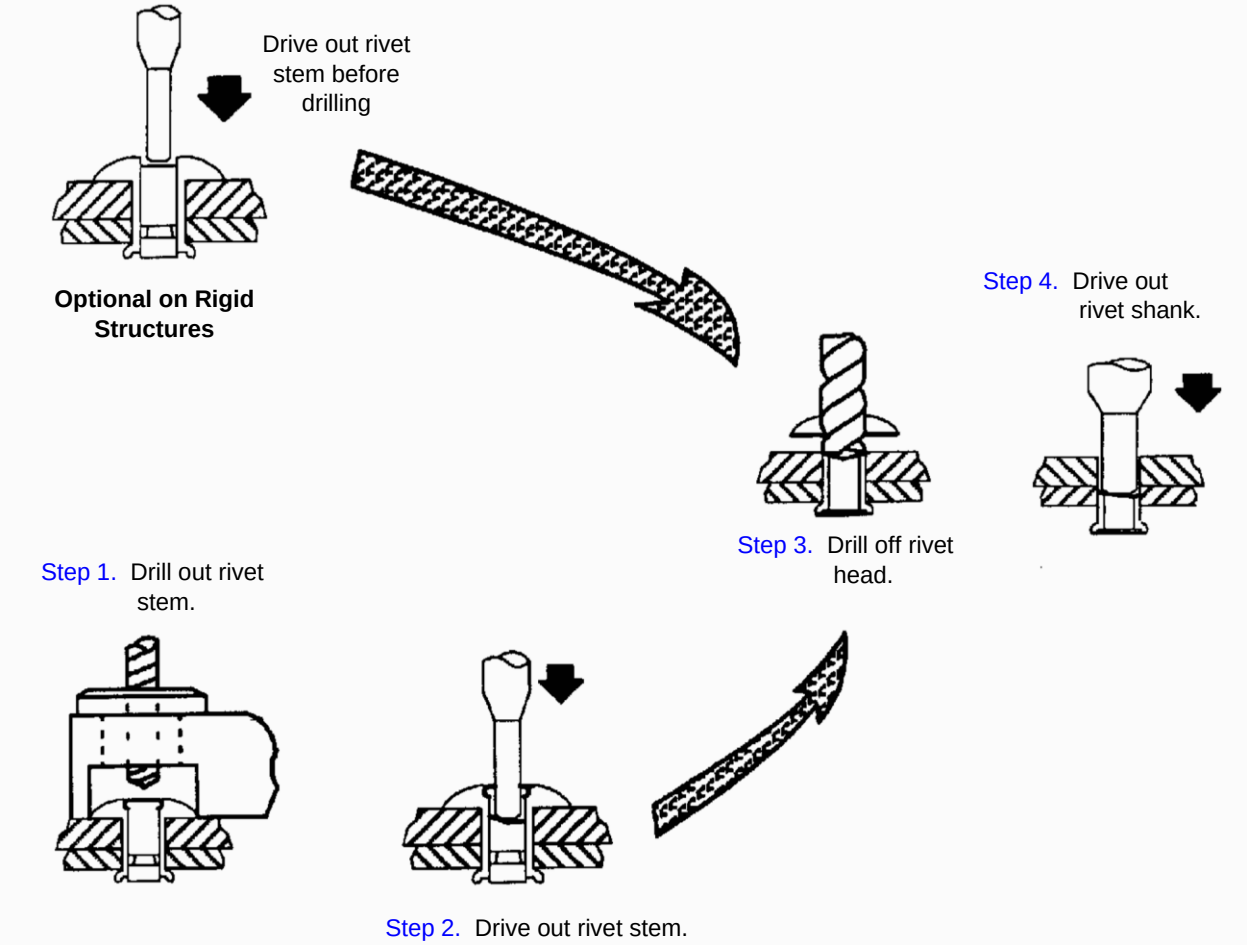


Figure 10. Removal of Installed Blind Rivets

6 Requirements

6.1 Ensure that installed blind rivets meet all the requirements specified in Table 11.

6.2 Exposed metal of pulling stem fractures must have been touched-up with F19 Type 2 epoxy-polyamide primer (outside fuel tanks) or F21 Type II epoxy primer (inside fuel tanks), as specified in section 5.7.

6.3 If a dimpled sheet nests into another dimple or countersink, ensure that a small gap or sheet separation of 0.001" - 0.010" exists between sheets (see Figure 11).

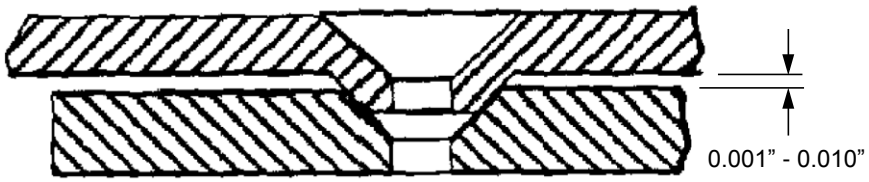
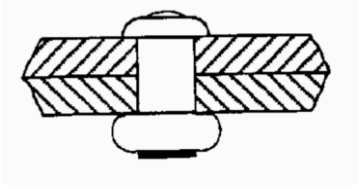
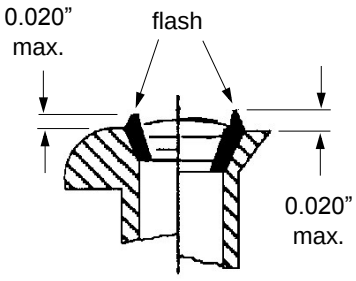
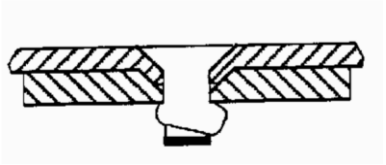
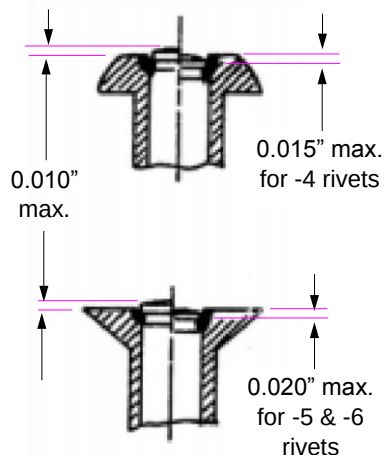
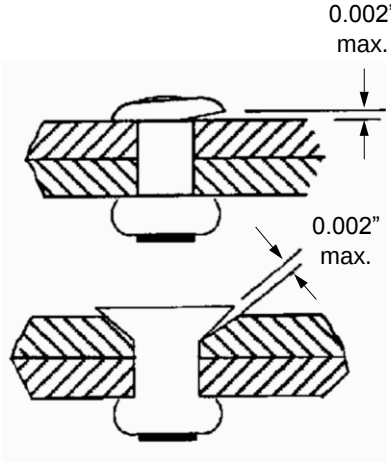
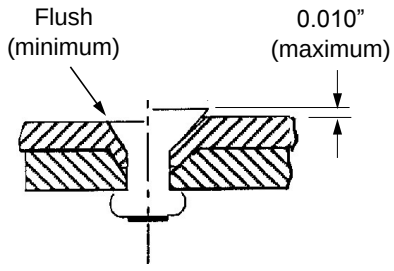


Figure 11. Sheet Separation

Table 11. Visual Examination of Installed Blind Rivets

Visual Appearance	Description	Corrective Action
	Acceptable: - good installation - sheets drawn up tight - stem trimmed flush - no cracks in shop head	None Required
	Unacceptable: - if there is a gap between the sheets - if there are cracks in the shop head	Replace Fastener
	Acceptable: - if lock ring flash is no more than 0.020" above the fastener head	If required for safety or aerodynamic reasons, the flash may be shaved or filed flush with the fastener head. However, any evidence that the fastener head has been marked in the process is unacceptable.
	Unacceptable: if lock ring flash is more than 0.020" above the fastener head	Replace Fastener

Visual Appearance	Description	Corrective Action
	Acceptable: - irregular bulb formation	None Required
	Acceptable: - if the rivet stem fracture is no more than 0.010" above flush - for a -4 rivet, if the rivet stemfracture is no more than 0.015" below flush - for a -5 or -6 rivet, if the rivet stem fracture is no more than 0.020" below flush	If required for safety or aerodynamic reasons, the stem may be shaved or filed flush with the fastener head. However, any evidence that the fastener head has been marked in the process is unacceptable.
	Unacceptable: - if the rivet stem fracture is more than 0.010" above flush - if the rivet stem fracture is more than 0.015" below flush for a -4 rivet - if the rivet stem fracture is more than 0.020" below flush for a -5 or -6 rivet	Replace Fastener Take care when installing blind rivets to hold the riveter square to the surface of the work. If the riveter is not square to the work it is much more likely for the stem protrusion to be outside the acceptable limits.
	Unacceptable: - if the gap under one side of the head exceeds 0.002" (i.e. feeler gauge touches the fastener shank)	Protruding Head Bolt: Replace rivet Flush Head Bolt: Check countersink diameter
	Unacceptable: - if the head of a flush type rivet is below flush or more than 0.010" above flush. In dimpled installations measure flushness 1/4" away from the edge of the head)	Remove fastener and check countersink diameter

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.**

8 Personnel Requirements

8.1 Personnel must have a good working knowledge of the applicable procedure and requirements as specified herein and must have exhibited their competency to their supervisor.

9 Maintenance of Equipment

9.1 It is recommended that a few drops of light machine oil be injected into the air inlet of air tools daily. Do not rework or alter tooling without proper authorization. Repair damaged or worn tools, as required.