BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 2.02

PRODUCTION PROCESS STANDARD

Installation of Cherry Rivets

Issue 17
- This standard supersedes PPS 2.02, Issue 16.
- 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)	June 27, 2013
	Production Process Standards (PPS)	
Approved By:	(L.K. John)	June 28, 2013
	Materials Technology	
	(Adam Gordon)	July 3, 2013
	Quality	

Table of Contents

Sections **Page**

Tables

Figures

1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of knob stem self-plugging and pull-through and serrated stem pull-through Cherry rivets.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this standard must be followed to ensure compliance with all applicable specifications. In general, if this standard conflicts with the engineering drawing, comply with the engineering drawing.

1.1.2 The requirements specified in this standard are necessary to fulfill the engineering design and reliability objectives.

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

1.1.4 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 1.01 - Dimpling Aluminum Alloys.

3.2 PPS 1.07 - Dimpling Ferrous, Nickel and Titanium Alloys.

3.3 PPS 1.09 - Drilling and Reaming.

3.4 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.5 PPS 2.66 - Installation of Cherrymax Rivets.

3.6 PPS 13.26 - General Subcontractor Provisions.

3.7 PPS 18.01 - Limitations on Shearing, Blanking and Piercing Aluminum and Magnesium Alloy Sheet.

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

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

4 Materials and Equipment

4.1 Materials

4.1.1 Cherry rivets as specified on the engineering drawing. Refer to Figure 1 for general descriptions of knob stem self-plugging and pull-through and serrated stem pull-through Cherry rivets. Refer to Figure 2 for a breakdown of the Cherry rivet part number. Cherry rivets are lubricated by the manufacturer; satisfactory installation is not possible if this lubricant has been removed or contaminated. Protect Cherry rivets at all times from dust, dirt, moisture and excessive heat. If possible, keep rivets in their original containers; if this is not possible keep rivets in non-absorbent containers.

4.1.1.1 Except as noted below, use only the type, diameter **and grip length** of fasteners specified on the engineering drawing.

- CR762 and CR763 rivets, which superseded CR162 and CR163 rivets, are superseded by CR3242 and CR3243 Cherrymax rivets. Refer to PPS 2.66 for the procedure and requirements for the installation of Cherrymax rivets.
- CR116 and CR117 rivets are superseded by CR9126 and CR9127 rivets. Use CR116 and CR117 rivets to depletion of existing stock.

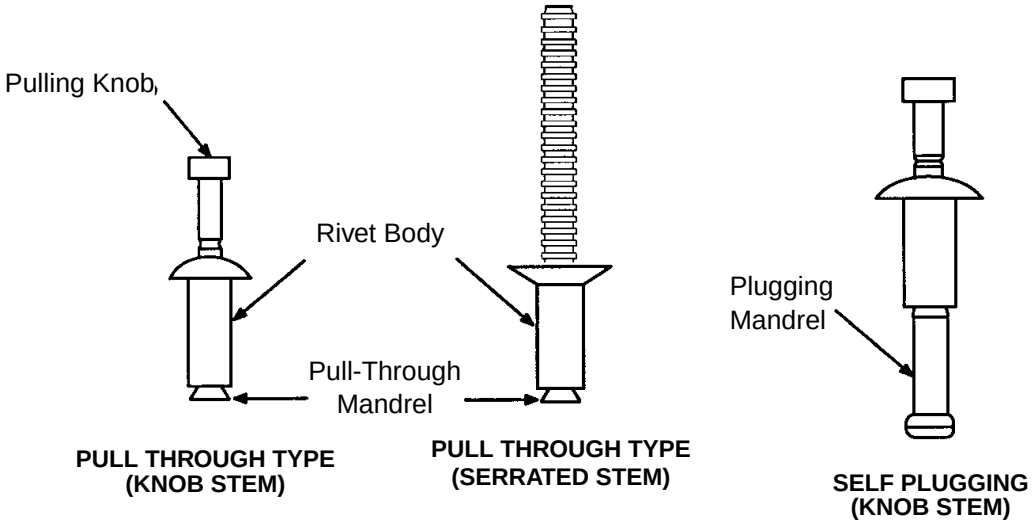


Figure 1 - General Description of Cherry Rivet

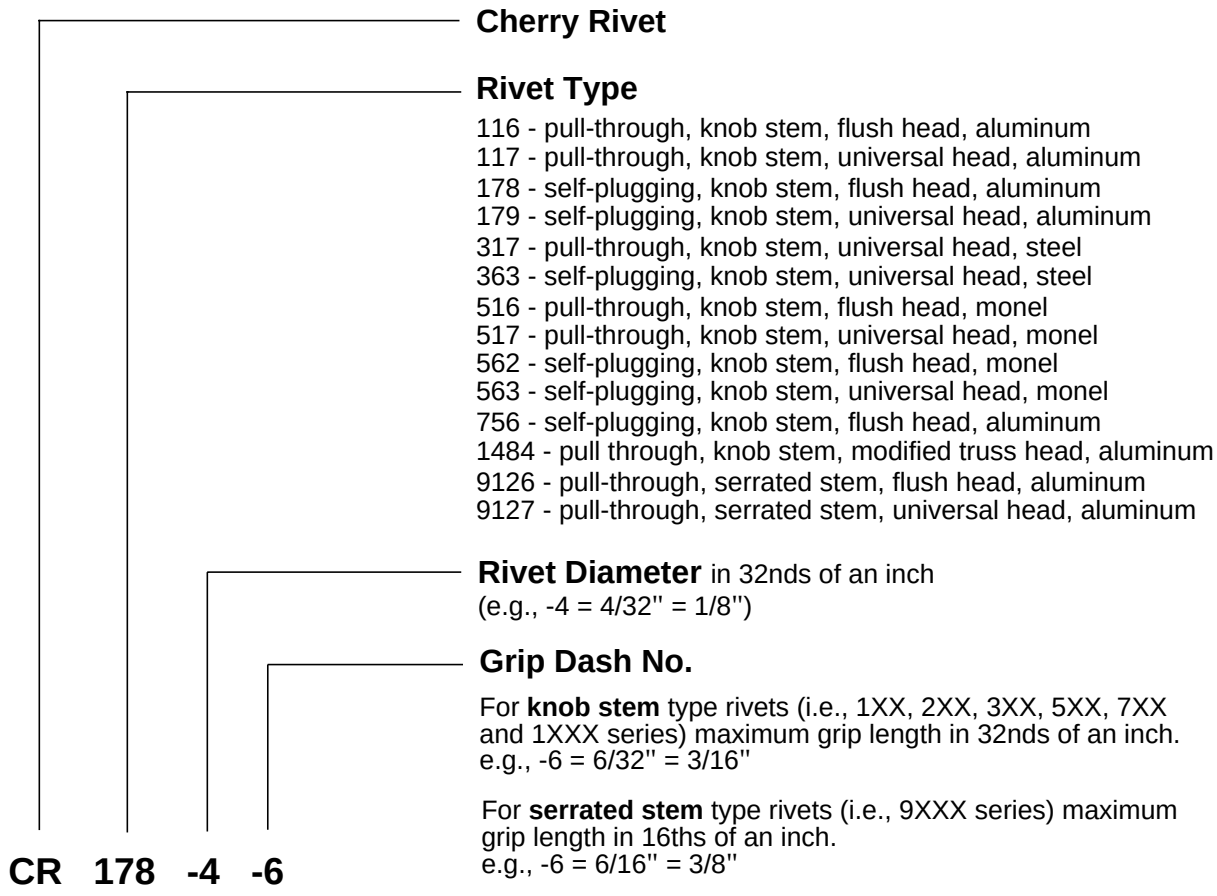


Figure 2 - Cherry Rivet Part Number

4.2 Equipment

4.2.1 Cherry rivet installation guns, as listed in Table 5 and Table 6.

4.2.2 Cherry rivet pulling heads, as listed in Table 7.

4.2.3 Cherry pulling head extension, G6HEA.

4.2.4 Cherry right angle pulling head adapter, G6AA.

4.2.5 Cherry adapter, #226.

4.2.6 Cherry rivet grip gauge, #269C3.

4.2.7 Stem trimming tools (e.g., hand trimmer Cherry #209, power trimmers Cherry #220B or #225B, power stem saw Cherry #301B and flat ground nippers).

5 Procedure

5.1 General

5.1.1 Cherry self-plugging rivets are high strength blind rivets which are expanded and set by means of a mandrel stem which is drawn partially through the rivet and finally trimmed flush with the head of the rivet. The retained portion of the mandrel stem acts as a plug to fill the rivet.

5.1.2 Cherry pull-through rivets are hollow blind rivets which are expanded and set by means of a mandrel stem which is drawn completely through the rivet.

5.2 Preparation of Work

5.2.1 For installation of flush head Cherry rivets, the fastener hole must be either countersunk or dimpled; refer to Table 3 for the minimum material gauge which may be countersunk.

5.2.2 Prepare holes for installation of Cherry rivets as follows:

Step 1. Pre-drill holes which are to be dimpled to the size specified in Table 1 according to PPS 1.09. Alternatively, holes in aluminum alloy may be punched according to PPS 18.01.

Table 1 - Pre-Drill for Dimpling

NOMINAL RIVET DIAMETER	PRE-DRILL FOR DIMPLING
-4 (1/8")	#40
-5 (5/32")	#30

NOMINAL RIVET DIAMETER	PRE-DRILL FOR DIMPLING
-6 (3/16")	#20
-8 (1/4")	#6

Step 2. For holes to be dimpled, dimple according to PPS 1.01 or PPS 1.07, as applicable.

Step 3. Drill the hole to the final size specified in Table 2 according to PPS 1.09. Alternatively, holes in aluminum alloy, which have not been dimpled, may be punched according to PPS 18.01.

Table 2 - Final Hole Data

NOMINAL RIVET DIAMETER	RECOMMENDED DRILL SIZE	MAXIMUM HOLE SIZE
-3 (3/32")	#40	0.101"
-4 (1/8")	#30	0.132"
-5 (5/32")	#20	0.164"

NOMINAL RIVET DIAMETER	RECOMMENDED DRILL SIZE	MAXIMUM HOLE SIZE
-6 (3/16")	#10	0.196"
-8 (1/4")	F	0.261"

Step 4. Countersink applicable holes according to PPS 1.33. Refer to Table 3 for the recommended countersink diameter. The countersink diameters specified are for reference only; install flush head Cherry rivets so that the head protrusion limits specified in paragraph 6.4 are met.

Table 3 - Countersinking Data

NOMINAL RIVET DIAMETER	MINIMUM MATERIAL GAUGE	RECOMMENDED COUNTERSINK DIAMETER
-3 (3/32")	0.046"	0.165" - 0.175"
-4 (1/8")	0.052"	0.211" - 0.221"
-5 (5/32")	0.065"	0.272" - 0.282"

NOMINAL RIVET DIAMETER	MINIMUM MATERIAL GAUGE	RECOMMENDED COUNTERSINK DIAMETER
-6 (3/16")	0.080"	0.339" - 0.349"
-8 (1/4")	0.105"	0.462" - 0.472"

Step 5. Except for aluminum Cherry rivets installed in aluminum structure, prime countersinks in metal surfaces 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.

5.2.3 On a sample basis, check at random (across the entire pattern) the number of holes specified in Table 4 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 Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

5.2.3.1 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 (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

Table 4 - Hole Size Verification Sample Requirement

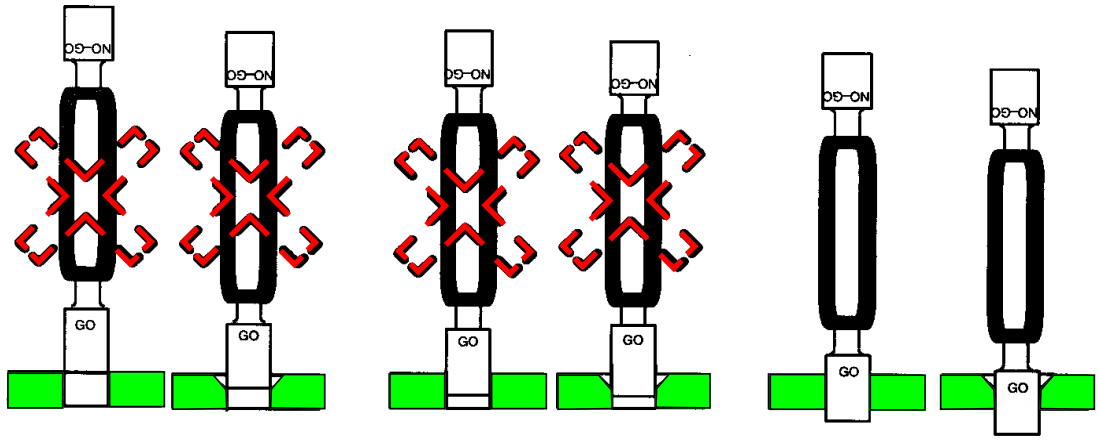
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11

NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
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 2 using the applicable go/no-go gauge as follows (see Figure 3):

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 2.

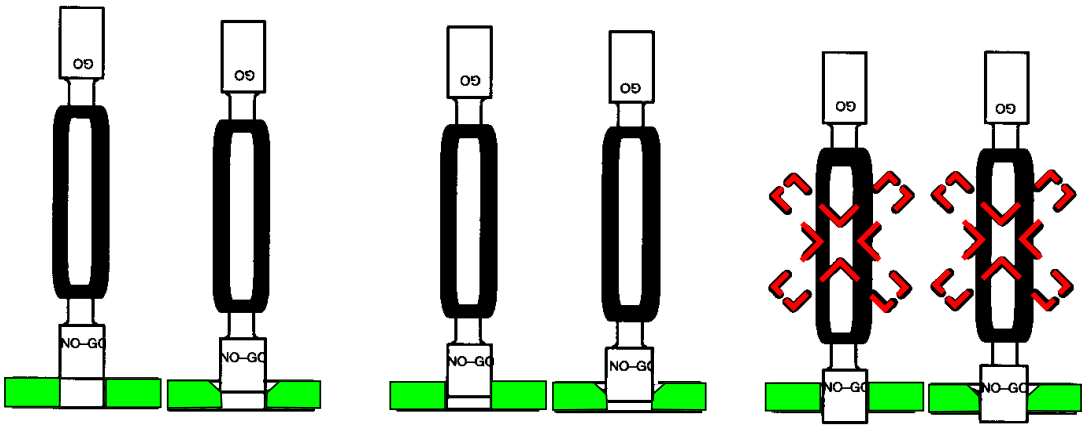


Does not go in.
UNDERSIZE HOLE

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

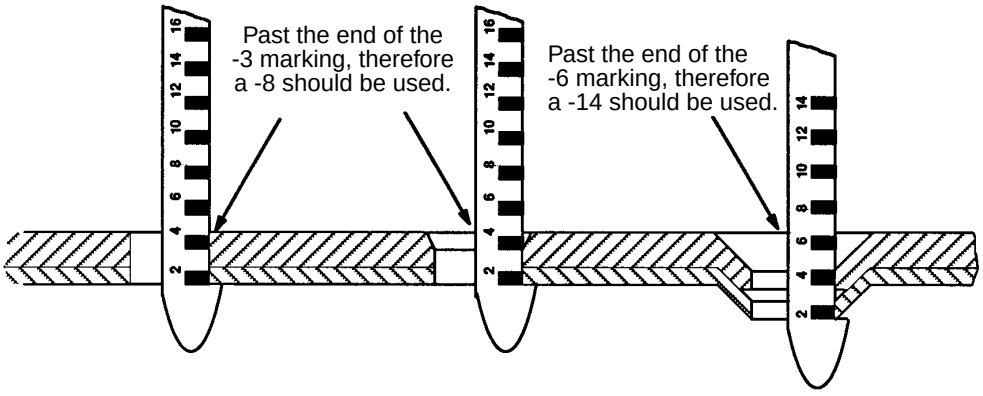
USE OF NO-GO END

Figure 3 - use of Go/No-Go gauges

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 (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

5.4 Fastener Selection

5.4.1 In order to verify that the specified grip length is correct after final hole preparation, measure the combined material thickness by inserting a Cherry rivet grip gauge (#269C3) and reading the number on the scale (see Figure 4). Multiply the number by 2 to determine the required rivet grip length dash number (if the gauge reads -3, a -6 rivet is required). If the grip length determined by measurement does not agree with the specified grip length, contact Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition. It is **NOT** acceptable to substitute a longer or shorter grip length than specified without MRB authorization.



Note: Multiply number on grip gauge by 2 to determine rivet grip length dash number.

Note: When using a grip gauge, always read to the next higher number as shown. For example, if the reading is past the end of the -3 marking then a -8 (-4 multiplied by two) should be used.

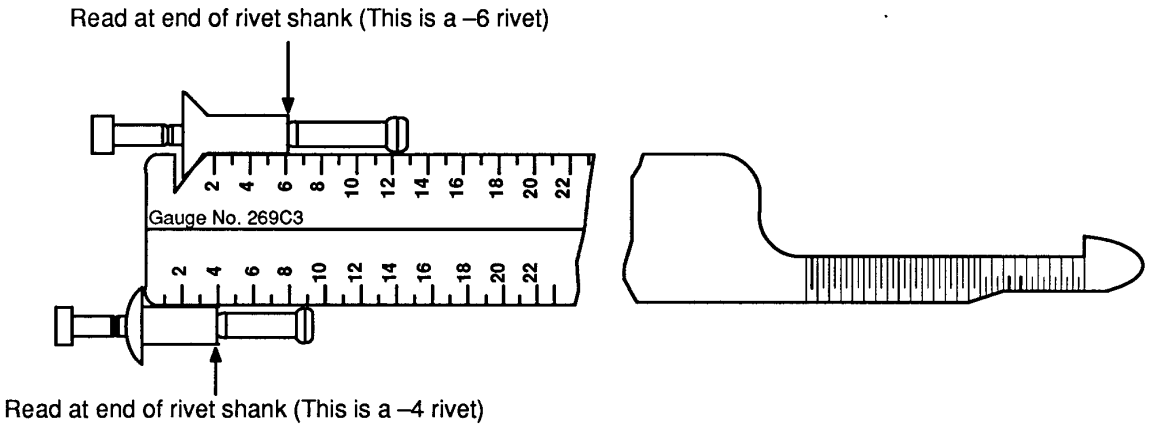


Figure 4 - Use of Cherry Rivet Selector Gauge

5.5 Preparation of Installation Tools

5.5.1 Refer to Table 5 **and** Table 6 to select a rivet gun of sufficient capacity for the type and size of rivet to be installed.

Table 5 - Cherry Gun Selection

GUN NUMBER AND TYPE		MAXIMUM RIVET DIAMETER							
		SELF PLUGGING RIVETS				PULL-THROUGH RIVETS			
		SERIES 100, 300 AND 500			SERIES 700	SERIES 100, 300, 500, 700			SERIES 9000
		ALUM.	STEEL	MONEL	ALUM.	ALUM.	STEEL	MONEL	ALUM.
G15RB (Note 1)	Air	3/16"	3/16"	5/32"	3/16"	3/16"	3/16"	3/16"	- - -
G15RC (Note 1)	Air	3/16"	5/32"	1/8"	3/16"	3/16"	5/32"	5/32"	- - -
G40C (Note 1)	Air	9/32"	9/32"	9/32"	9/32"	9/32"	9/32"	9/32"	- - -
G715 (Note 1)	Air	- - -	- - -	- - -	- - -	- - -	- - -	- - -	3/16"
G11	Hand	3/16"	5/32"	1/8"	3/16"	3/16"	3/16"	3/16"	- - -
G25B (Note 2)	Hand	- - -	- - -	- - -	- - -	5/32"	1/8"	1/8"	5/32"
G25B (Note 3)	Hand	1/8"	- - -	- - -	- - -	1/8"	- - -	- - -	5/32"
G36	Hand	3/16"	5/32"	1/8"	3/16"	3/16"	3/16"	3/16"	3/16"

Notes
1. Based on 90 psi air pressure at gun.
2. Pivot pin located in front pivot hole.
3. Pivot pin located in rear pivot hole.

Table 6 - Cherry Guns and Corresponding Maximum Grip Number

GUN NUMBER AND TYPE		MAXIMUM GRIP NUMBER							
		SELF PLUGGING				PULL-THROUGH			
		SERIES 100, 300 AND 500		SERIES 700		SERIES 100, 300, 500, 700		SERIES 9000	
		UNIV. HEAD	FLUSH HEAD	UNIV. HEAD	FLUSH HEAD.	UNIV. HEAD	FLUSH HEAD.	UNIV. HEAD	FLUSH HEAD.
G15RB (Note 1)	Air	8	10	8	10		16	- - -	- - -
G15RC (Note 1)	Air	16	18	16	18	24	26	- - -	- - -
G40C (Note 1)	Air	16	20	16	18	28 Note 5	9/32 Note 6	- - -	- - -
G715 (Note 1)	Air	- - -	- - -	- - -	- - -	- - -	- - -	5	6
G11	Hand	18	20	24	26	26	28	- - -	- - -
G25B (Note 2)	Hand	- - -	- - -	- - -	- - -			8	8
G25B (Note 3)	Hand	6 Note 4	8 Note 4	- - -	- - -			8	8
G36)	Hand	20	22	24	26	30	32	5	6

Notes
1. Based on 90 psi air pressure at gun.
2. Pivot pin located in front pivot hole.
3. Pivot pin located in rear pivot hole.
4. Applicable to series 100 rivets only.
5. 22 for 1/4" diameter.
6. 26 for 1/4" diameter.

5.5.2 Select a suitable pulling head from Table 7 for the size and type of rivet and the type of gun to be used. In the case of H80 and H90 series pulling heads, also select a suitable spacer from Table 8 for the particular rivet length.

Table 7 - Cherry Pulling Heads

RIVET TYPE	PULLING HEAD SERIES	RIVET HEAD	PULLING HEAD RIVET DIAMETER					INSTALL GUN
			3/32"	1/8"	5/32"	3/16"	1/4"	
Series 100, 300 and 500	G6H	Universal	G6H3B	G6H4B	G6H5B	G6H6B	- - -	G11, G15, G25B, G36 Note 1
		Flush	G6H3C	G6H4C	G6H5C	G6H6C	- - -	
	H40	Universal	- - -	- - -	H405B	H406B	H408B	G40
		Flush	- - -	- - -	H405C	H406C	H408C	
	H60 Right Angle	Universal	- - -	H604B	H605B	H606B	- - -	G111, G15, G36 Note 1
		Flush	- - -	H604C	H605C	H606C	- - -	
Series 700	H70	Universal	- - -	H704B	H705B	H706B	H708B	G111, G15, G36 Note 1
		Flush	- - -	H704C	H705C	H706C	H708C	
	H80 Note 2	Universal	H803U	H804J	H805U	H806U	- - -	G111, G15, G36 Note 1
		Flush	H803C	H804C	H805C	H806C	- - -	
	H90 Note 2	Universal	- - -	H904J	H905U	H906U	H908U	G40
		Flush	- - -	H904C	H905C	H906C	H908C	
Series 9000	H9015	Universal	H90153U	H90154U	H90155U	H90156U	- - -	G715
		Flush	H90153C	H90154C	H90155C	H90156C	- - -	

Notes: 1. May be fitted to a G40 gun by means of a #226 adapter.
2. Refer to Table 8 for the applicable spacer sleeve required for the rivet length to be installed.

Table 8 - Spacer Sleeves for H80 and H90 Pulling Heads (Note 1)

RIVET HEAD	GRIP RANGE	SPACER SLEEVE
Countersink	2 - 10	A
	12 - 18	B
	20 - 26	C
	28 - 32	D
Universal	2 - 8	A
	10 - 16	B
	18 - 24	C
	26 - 28	D

Note 1. H80 spacers are a straight (bush) type and H90 spacers are flanged on one end.

5.5.3 Ensure that air line connectors are free from foreign particles before connecting pneumatic installation guns.

5.5.4 G6H, H60, H70 and H80 pulling heads are designed to fit directly onto the G11, G15, G25 and G36 type installation guns. If necessary, it is possible to attach these pulling heads to the model G40 gun by means of a #226 adapter. Install pulling heads as follows:

Step 1. Engage the threads of the draw bolt with the head piston threads of the gun and rotate the pulling head clockwise, simultaneously engaging the pulling head sleeve threads.

Step 2. Thread the pulling head into the gun by hand as far as it will go. Locate the pulling head slot in the most convenient position and tighten the lock nut.

Step 3. Keep the handles of the G11 and G25 guns open while attaching the pulling head. Hold the rod of the G11 gun with a screwdriver to prevent it from rotating.

Step 4. Screw the adapter fitting completely into the H80 pulling head sleeve after inserting the spacer. Ensure that, with the draw bolt fully retracted, the white dot on the draw bolt is visible through the hole for the grip length of rivet to be installed.

5.5.5 H40 pulling heads are designed to fit directly onto the G40 type installation gun. Install H40 pulling heads as follows:

Step 1. Thread the draw bolt onto the piston head of the gun until it is snug.

Step 2. Place the snap-on sleeve over the draw bolt and push it into the sleeve adapter.

Step 3. Rotate the pulling head counter clockwise, up to one full turn, to locate the slot in the most convenient position. Ensure that the spring retaining assembly snaps into one of the depressions in the sleeve.

5.5.6 H90 pulling heads are designed to fit directly onto the G40 type installation gun. Install H90 pulling heads as follows:

Step 1. Insert the applicable spacer over the gun head piston threads, flanged end first.

Step 2. Screw the draw bolt onto the gun head piston threads until snug. The draw bolt may be backed off slightly to locate the slot in a convenient position.

Step 3. Place the sleeve over the draw bolt, push it into the sleeve adapter and tighten the locking screws.

5.5.7 H9015 pulling heads are designed to fit directly onto the model G715 installing gun. Install H9015 pulling heads as follows:

Step 1. Insert the threaded end of the pulling head into the threaded socket of the gun and tighten until snug.

Step 2. The pulling head may be backed off slightly to ensure that the rivet stem ejection slot is in the most convenient position.

Step 3. Tighten the lock nut.

5.5.8 When necessary to clear an adjacent structure or reach a difficult location, a G6AA right angle adapter may be fitted directly onto the G11, G15, G25, G36 installation guns.

5.5.9 If an extended reach is required, use the 6HEA-2 (2" in length) or G6HEA-4 (4" in length) pulling head extension fitted directly to the G11, G25 or G36 installation guns.

5.5.10 The pulling head accessories may be attached to the G40 installation gun by means of a #226 adapter.

5.6 Riveting Operations

5.6.1 Rivet as follows:

Step 1. Position the parts to be riveted. Ensure curved parts mate without excessive gaps.

Step 2. Clamp the assemblies in every 4^{th} to 6^{th} rivet hole using Cleco type fasteners.

Step 3. Insert the rivet shank into the hole and fit the slots of the draw bolt and pulling head sleeve over the rivet stem. Ensure that the knob of stem rivets is fully seated inside the pulling head or that the pulling head jaws fully engage the stem grooves of serrated stem rivets.

Step 4. Holding the installation gun square to the surface of the work, push the pulling head firmly against the rivet head.

Step 5. Pull the trigger or squeeze the handles of the installation gun to pull the stem of the riveter.

- Pull the stems of pull-through rivets completely through the rivet shank during installation (see Figure 5).
- The stems of self-plugging rivets are drawn a controlled amount through the rivet to form a blind head and retain the stem in the rivet shank.
- The stem knob of series 100, 300 and 500 self-plugging rivets is broken off during installation, indicating that sufficient stem drawing has been accomplished (see Figure 6-A).
- The stem shoulder of series 700 self-plugging rivets should extend 1/16" - 5/32" above the head following pulling (see Figure 6-B).

Step 6. Trim the stems of self-plugging rivets as close to the manufactured head as possible, using stem trimming tools (see paragraph 4.2.7) and then shave or file to within 0.010" above flush. Use light pressure when shaving or filing stems to avoid pushing the stem out of the rivet.

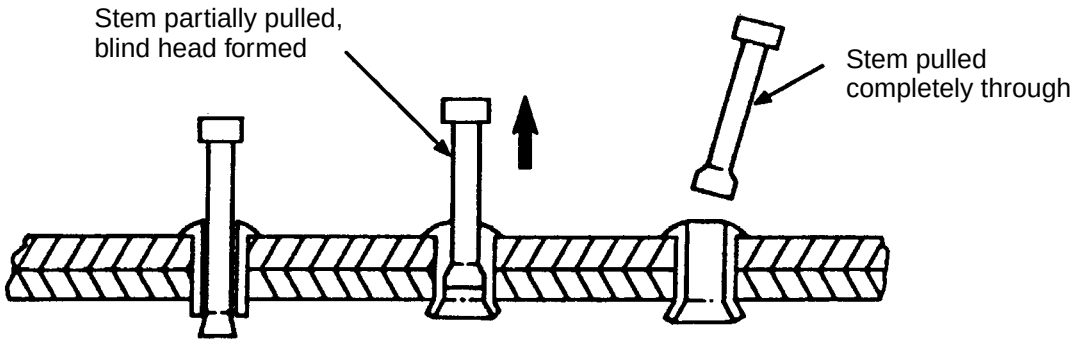


Figure 5 - Installation of Pull-Through Rivets

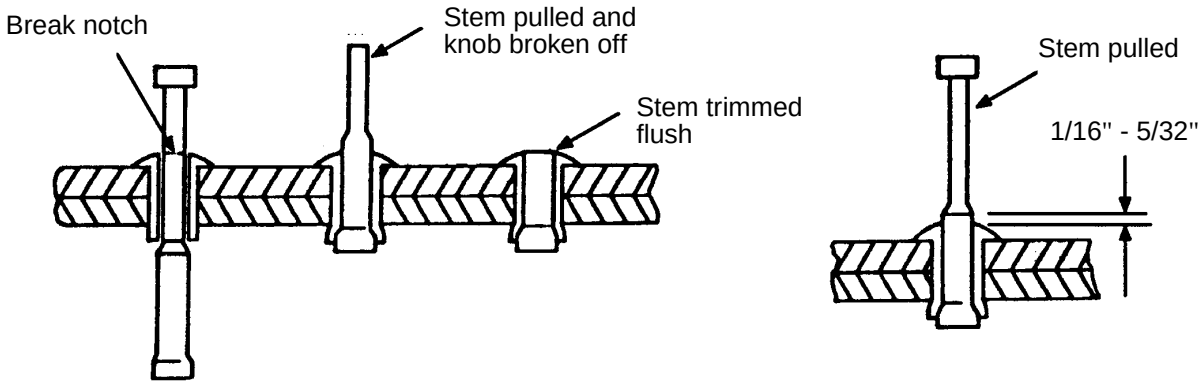


Fig. A - Series 100, 300 & 500 Rivets

Fig. B - Series 700 Rivets

Figure 6 - Installation of Self-Plugging Rivets

5.7 Removal of Installed Rivets

5.7.1 If necessary, remove installed rivets as follows:

Step 1. Drive out the stems of self-plugging rivets using a small punch and hammer. If this is not possible, make a punch mark in the centre of the stem and drill completely through the head of the installed rivet, using a drill of the same size as the nominal rivet diameter, so as to break off the rivet head.

Step 2. Drive out the rivet shank using a suitable drift punch. In order to prevent damage to thin gauge material, support the structure from the reverse side using a support block while driving out the shank.

6 Requirements

6.1 The stem shoulder on 700 series self-plugging rivets must extend 1/16" - 5/32" above the rivet head after being pulled (see Figure 6-B).

6.2 The stem of self-plugging rivets must be no more than 0.010" above flush with the manufactured head.

6.3 Replace loose, cracked or damaged rivets.

6.4 Flush head protrusion up to a maximum of 0.010" above the surface of the skin (see Figure 7) is acceptable. Flush head rivets which have countersink heads protruding more than 0.010" are not acceptable and must be replaced after verifying that the countersink or dimple size is correct. Take the measurement of the head height in dimpled installations from the normal skin surface and not from the depressed area immediately surrounding the dimple (i.e., at least 1/4" from the edge of the rivet head as shown in Figure 7).

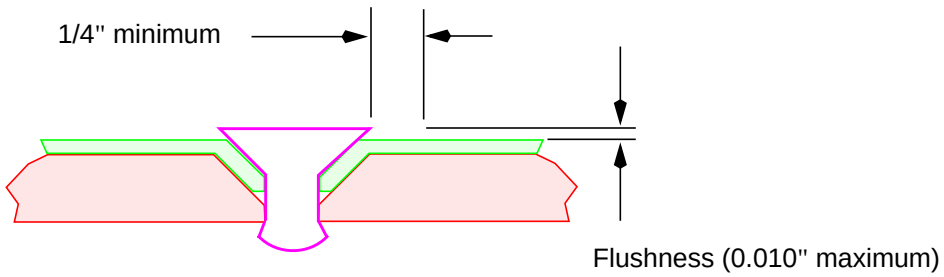
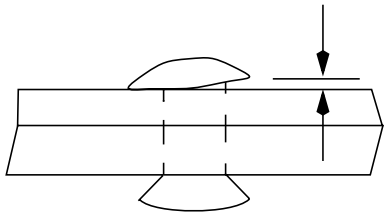


Figure 7 - Measuring Flushness

6.5 The maximum acceptable gap under the rivet head shall be as shown in Figure 8.



A gap under one side of the head is acceptable if the applicable feeler gauge does not touch the rivet shank

RIVET DIAMETER	MAXIMUM GAP (Feeler Gauge)
1/8" - 5/32"	0.002"
7/32" - 3/16"	0.003"
1/4"	0.004"

Figure 8 - Maximum Gap Under Rivet Head

6.6 A small gap or sheet separation of 0.001" to 0.010" must exit between sheets where a dimpled sheet nests into another dimple or countersink (see Figure 9).

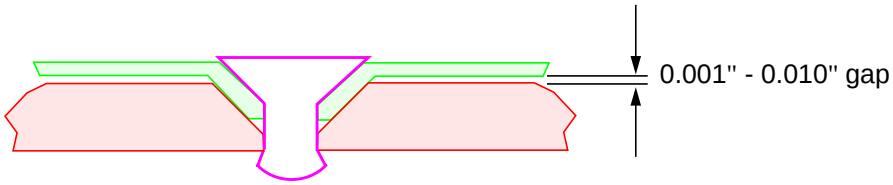


Figure 9 - Sheet Separation

7 Safety Precautions

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

8 Personnel Requirements

8.1 Personnel responsible for the installation of Cherry rivets must have a good working knowledge of the procedure and requirements as specified herein and shall have exhibited their competency to their supervisor.

9 Recommended Maintenance of Equipment

9.1 Keep riveting tools clean. Oil or grease moving parts regularly. Inject a few drops of light machine oil into the air inlet of air tools daily.

9.2 Check riveting tools and accessories according to a regular schedule.

9.3 Replace damaged or badly worn parts as necessary.

9.4 Do not rework or alter riveting tools unless appropriately authorized.