BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 2.03

PRODUCTION PROCESS STANDARD

Installation of Hi-Shear Rivets

Issue 18 - This standard supersedes PPS 2.03, Issue 17.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- 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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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of Hi-Shear rivets and dowel pins.

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 (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 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 (de Havilland) Specifications

3.2.1 PPS 1.01 - Dimpling of Aluminum Alloys.

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

3.2.3 PPS 1.09 - Drilling and Reaming.

3.2.4 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.2.5 PPS 13.26 - General Subcontractor Provisions.

3.2.6 PPS 21.20 - Mixing and Handling Two Part Sealants.

3.2.7 PPS 27.05 - Manual Edge Finishing.

3.2.8 PPS 31.17 - Solvent Usage.

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

3.2.10 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 DHMS S3.06 Type I, Class C-80 sealant.

4.1.3 Hi-Shear rivets, dowel pins and collars as specified on the relevant engineering drawing. Refer to Figure 1 for a general description of Hi-Shear rivets, dowel pins and collars. Refer to Figure 2 for a breakdown of the Hi-Shear rivet and dowel pin part number. Refer to Figure 3 for a breakdown of the Hi-Shear collar part number. Protect Hi-Shear 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. Hi-Shear rivet collars are lubricated by the manufacturer; satisfactory installation is not possible if this lubricant has been removed or contaminated.

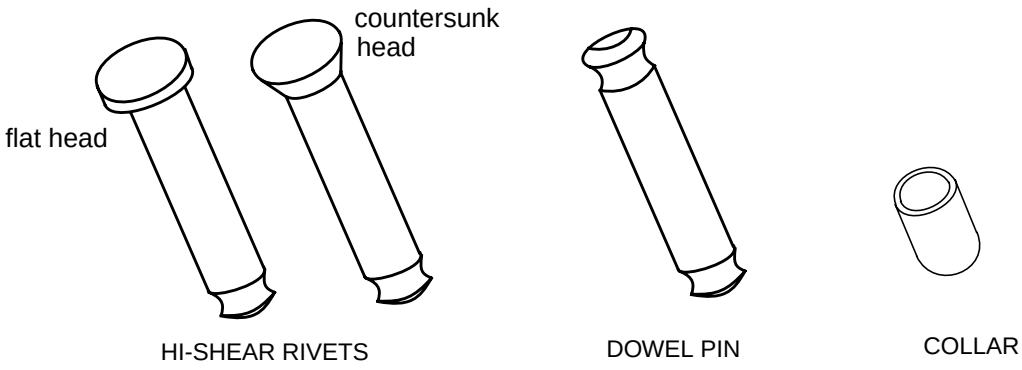


Figure 1 - General Description of Hi-Shear Rivets, Dowel Pins and Collars

RIVET TYPE
NAS 525 (HS 51P) - 100° countersunk head, steel
NAS 529 (HS 52P) - Flat head, steel
HS 30P - Dowel pin, steel
HS 39P - 100° countersunk head, steel, 1/64" oversize
HS 40P - Flat head, steel, 1/64" oversize
HS 41P - 100 countersunk head, steel, 1/32" oversize’
HS 42P - Flat Head, steel, 1/32" oversize

RIVET DIAMETER
In 1/32" increments (e.g., -4 = 4/32" = 1/8")

GRIP NUMBER	GRIP LENGTH
2	0.062" - 0.125"
3	0.126" - 0.188"
4	0.189" - 0.250"
5	0.251" - 0.312"
6	0.313" - 0.375"
7	0.376" - 0.438"
8	0.439" - 0.500"
9	0.501" - 0.562"
10	0.563" - 0.625"
11	0.626" - 0.688"
12	0.689" - 0.750"
13	0.751" - 0.812"
14	0.813" - 0.875"
15	0.876" - 0.938"
16	0.939" - 1.000"
17	1.001" - 1.0062"

GRIP NUMBER	GRIP LENGTH
18	1.063" - 1.125"
19	1.126" - 1.188"
20	1.189" - 1.250"
21	1.251" - 1.312"
22	1.313" - 1.375"
23	1.376" - 1.438"
24	1.439" - 1.500"
25	1.501" - 1.562"
26	1.563" - 1.625"
27	1.626" - 1.688"
28	1.689" - 1.750"
29	1.751" - 1.812"
30	1.813" - 1.875"
31	1.876" - 1.938"
32	1.939" - 2.000"

NAS 525 -4 -2

Note: Rivet Finish - Cadmium Plated Steel

Figure 2 - Hi-Shear Rivet and Dowel Pin Part Number Breakdown

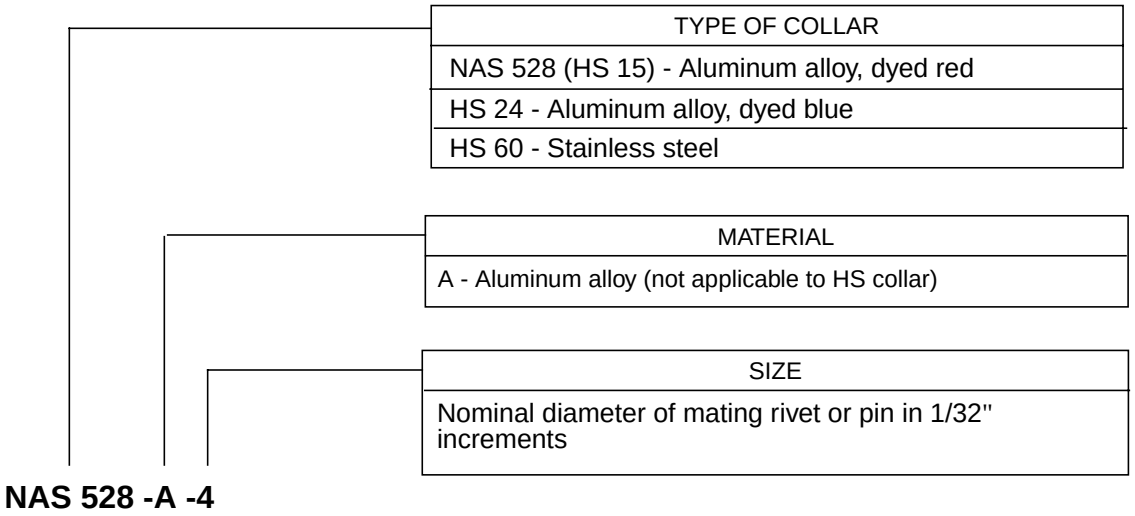


Figure 3 - Hi-Shear Collar Part Number Breakdown

4.2 Equipment

4.2.1 Flat ground bucking bars, rivet snaps or dollies as suitable for conventional solid rivets.

4.2.2 Hi-Shear grip scales.

4.2.3 Hi-Shear installation tools as listed in Table 6. Wrap the tips of all gun sets with insulation tape or plastic tape to avoid injuries in the case of cracking of the tools.

4.2.4 Rivet squeezers and pneumatic riveting guns (e.g., as listed in Table 8).

4.2.5 Hi-Shear fastener removal tools (e.g., as listed in Table 10).

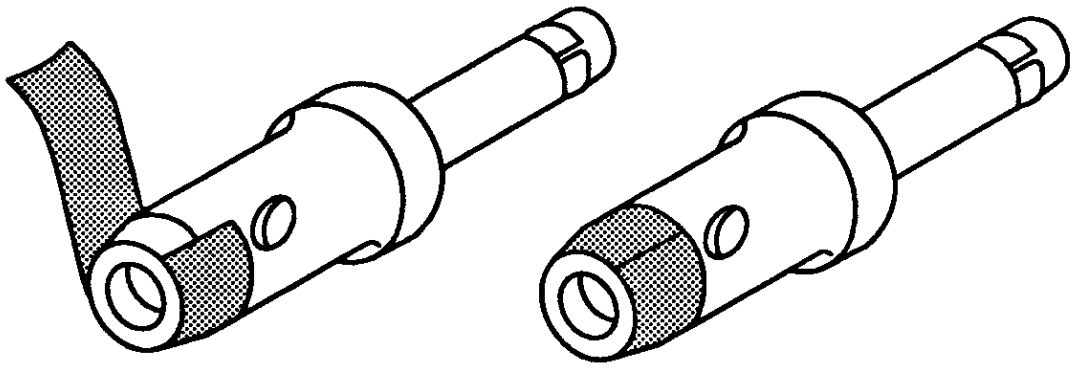


Figure 4 - Tape Wrapping of Gun Sets

5 Procedure

5.1 General

5.1.1 Hi-Shear rivets and dowel pins are permanent type fasteners designed for use in high strength structural joints.

5.1.2 The installation of Hi-Shear fasteners involves fitting the fastener in a close tolerance hole and cold swaging a locking collar onto the end of the rivet or dowel pin using the applicable Hi-Shear rivet set in a rivet gun or rivet squeezer.

5.1.3 As the effectiveness of the fastener is dependent upon correct installation, it is essential to strictly adhere to the procedure specified herein.

5.2 Preparation of Work

5.2.1 Perform all drilling and reaming of holes as specified herein according to PPS 1.09. It is recommended that final drilling be carried out using a piloted reamer.

5.2.2 Prepare holes for the installation of rivets (see Figure 6, Figure 7 & Figure 8) and dowel pins as follows:

Step 1. For holes to be dimpled, pre-drill for dimpling as specified inTable 1.

Table 1 - Pre-Drilling for Dimpling

FASTENER NOMINAL DIAMETER	PRE-DRILL FOR DIMPLING		FASTENER NOMINAL DIAMETER	PRE-DRILL FOR DIMPLING
-4 (1/8")	#33		-8 (1/4")	#1
-5 (5/32")	#27		-10 (5/16")	K
-6 (3/16")	#17		-12 (3/8")	---

Step 2. For flush head rivets to be installed in dimpled holes, ram coin dimple according to PPS 1.01 or PPS 1.07, as applicable.

Step 3. Pre-drill for final drilling as specified in the following table. For dowel pins, pre-drill at the angle specified by the engineering drawing.

Table 2 - Pre-Drilling for Final Drilling/Reaming

FASTENER NOMINAL DIAMETER	RECOMMENDED PRE-DRILL FOR FINAL DRILLING/REAMING
-4 (1/8")	#40
-5 (5/32")	#27
-6 (3/16")	#16

FASTENER NOMINAL DIAMETER	RECOMMENDED PRE-DRILL FOR FINAL DRILLING/REAMING
-8 (1/4")	#1
-10 (5/16")	L
-12 (3/8")	S

Step 4. For flush head rivets to be installed in countersunk holes, countersink according to PPS 1.33 to the countersink diameter specified in Table 3.

Table 3 - Countersink Requirements

FASTENER NOMINAL DIAMETER	COUNTERSINK PILOT DIAMETER	REFERENCE COUNTERSINK DIAMETER (100° ANGLE) (Note 1)
-4 (1/8")	0.098"	0.193" - 0.203"
-5 (5/32")	0.144"	0.238" - 0.248"
-6 (3/16")	0.177"	0.286" - 0.296"
-8 (1/4")	0.228"	0.379" - 0.389"
-10 (5/16")	0.290"	0.458" - 0.468"
-12 (3/8")	0.348"	0.545" - 0.555"

Note 1. The countersink diameters specified herein are for reference only; prepare countersinks so that the head protrusion of flush head pins will meet the requirements of Figure 22.

Step 5. Ream/drill the hole to the final size specified in Table 7.

Table 4 - Final Hole Size Requirements

FASTENER NOMINAL DIAMETER	RECOMMENDED CUTTER SIZE	FINAL HOLE LIMITS
-4 (1/8")	0.1235"	0.1230" - 0.1245"
-5 (5/32")	0.1550"	0.1545" - 0.1560"
-6 (3/16")	0.1890"	0.1885" - 0.1900"
-8 (1/4")	0.2485"	0.2480" - 0.2495"
-10 (5/16")	0.3110"	0.3105" - 0.3120"
-12 (3/8")	0.3735"	0.3730" - 0.3745"

Step 6. For flat head rivets, manually break the edge of the hole 0.010" - 0.020" on the side on which the fastener head will seat according to PPS 27.05.

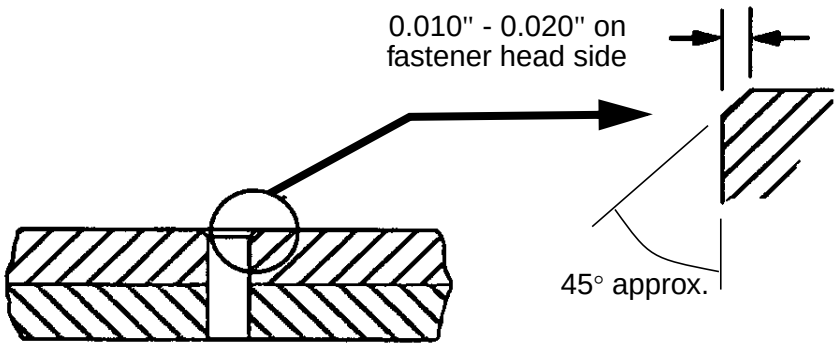


Figure 5 - Chamfer for Proper Seating of Flat Head Rivets

Step 7. If possible, after completion of all final reaming/drilling, disassemble mating parts and remove any chips or metal cuttings from faying surfaces.

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.

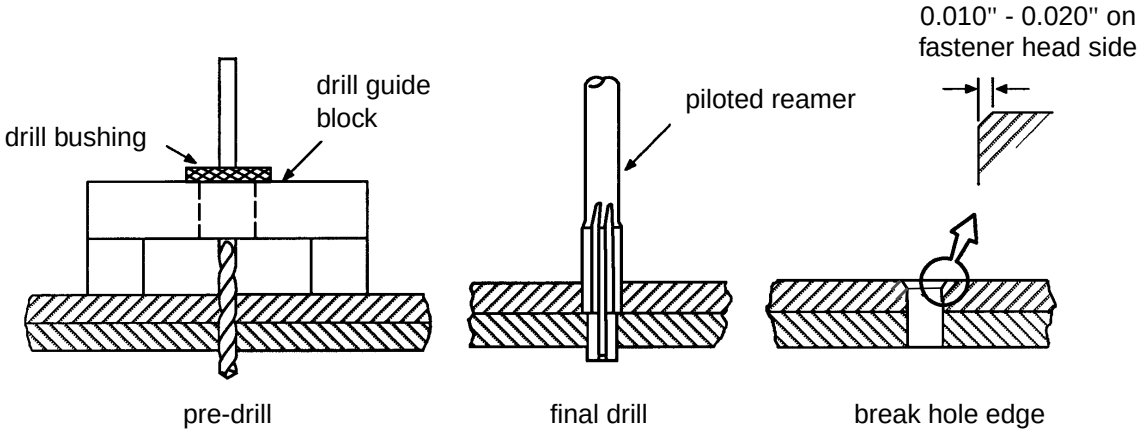


Figure 6 - Hole Preparation for Flat Head Rivets

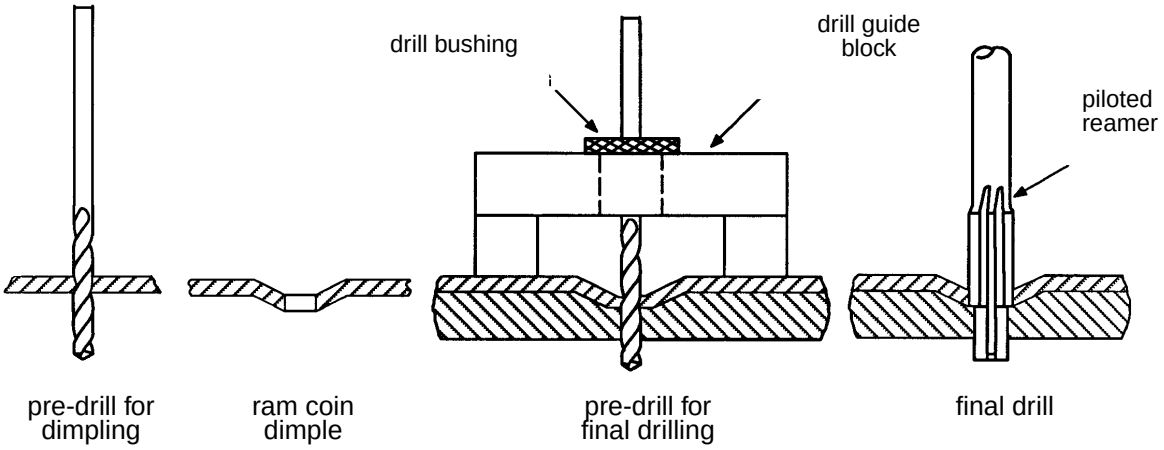


Figure 7 - Hole Preparation for Flush Head Rivets (Dimpled Installation)

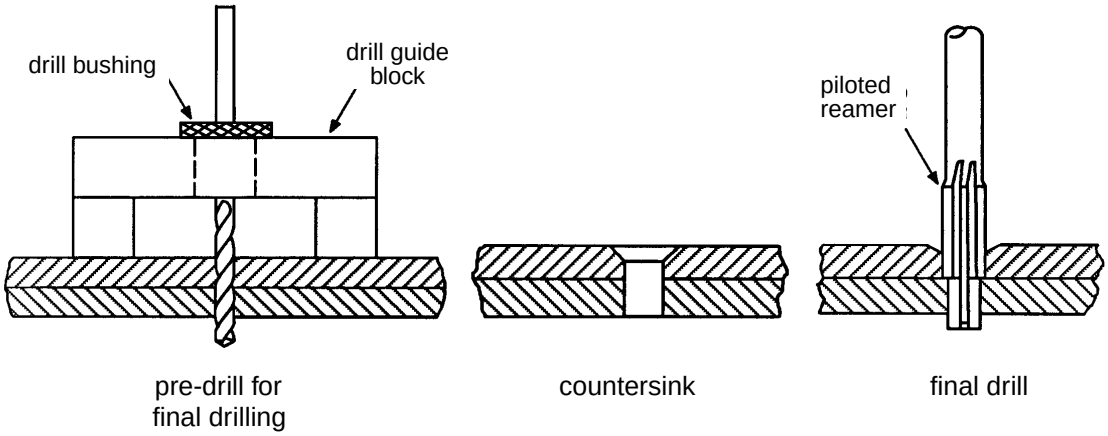


Figure 8 - Hole Preparation for Flush Head Rivets (Countersink Installation)

5.2.3 On a sample basis, check at random (across the entire pattern) the number of holes specified in Table 5 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 5 - Hole Size Verification Sample Requirement

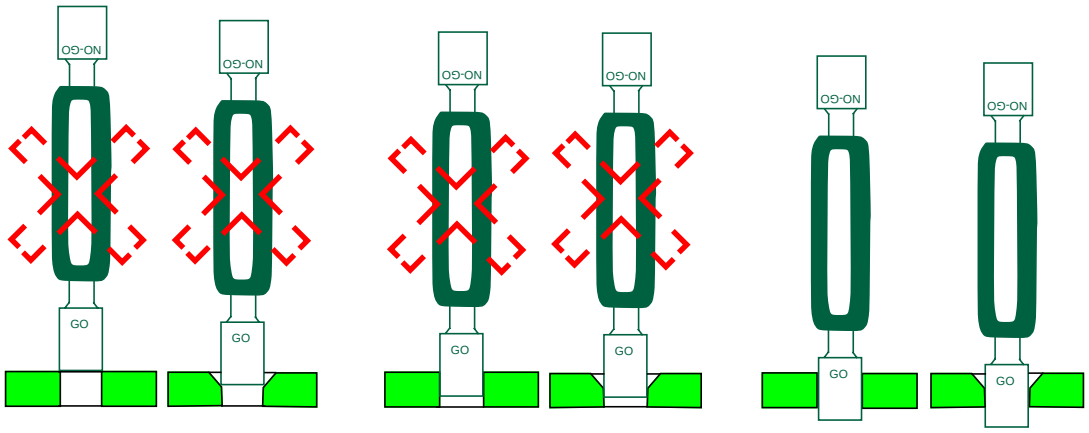
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of Go/No-Go Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of Table 4 using the applicable go/no-go gauge as follows (see Figure 9):

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 4.

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.

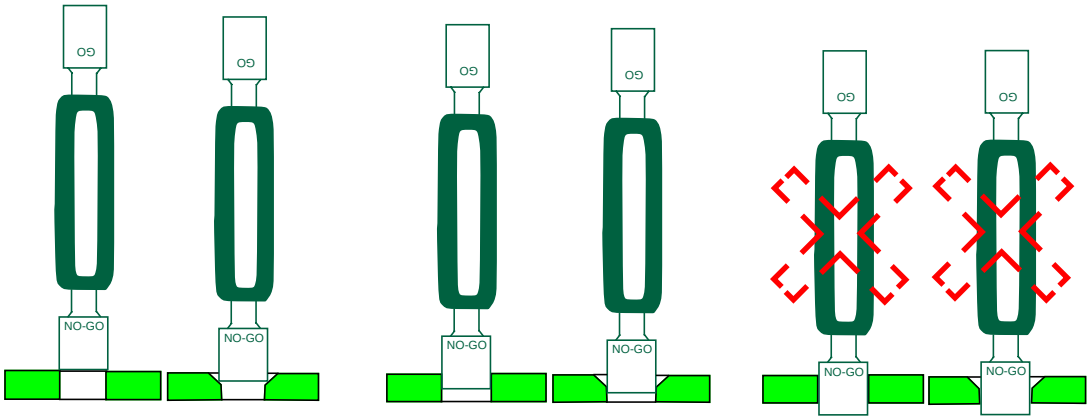


Does not go in.
UNDERSIZE HOLE

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 9 - Use of Go/No-Go Gauges

5.4 Fastener Selection

5.4.1 The fastener **grip length** specified on the assembly manual is only a reference length. If the grip length determined by measurement is different than the reference length, install a fastener of the measured length. However, the **type** and **diameter** of fastener installed must be as specified on the engineering drawing.

5.4.2 Where a dimpled sheet nests into another dimple or into a countersink, as shown in Figure 10, ensure that a small gap or sheet separation, from 0.001" - 0.010", exists between sheets.

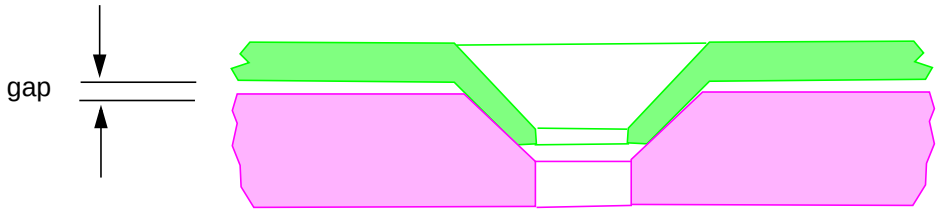


Figure 10 - Dimpled Sheet Separation

5.4.3 Measure the material thickness, after final drilling, using a Hi-Shear grip scale. Insert the grip scale into the prepared hole and read the numbers on the scale (see Figure 11). If the hole depth is even slightly beyond the end of a particular indication on the scale, use the next larger size. The number shown on the scale corresponds to the Hi-Shear rivet dash number. If a tapered condition exists, use the grip length indicated for the thickest section.

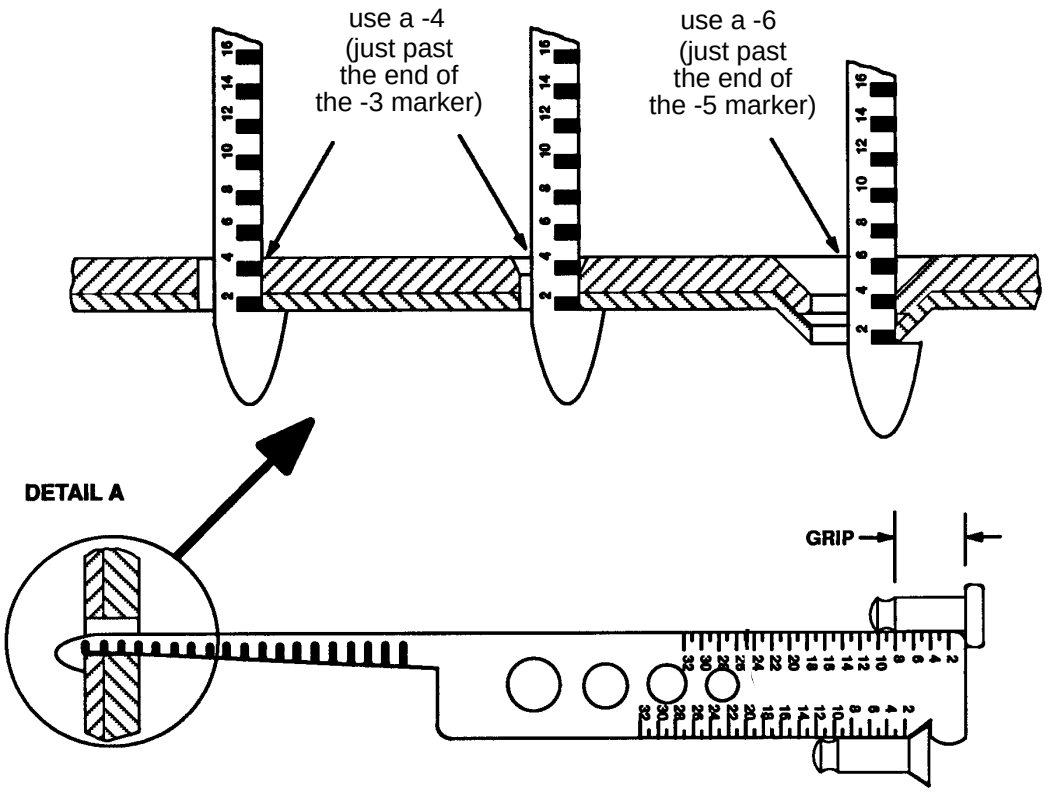
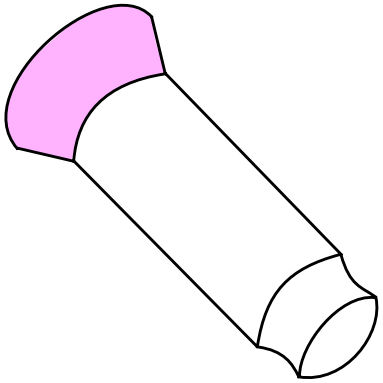


Figure 11 - Hi-Shear Grip Scale

5.4.4 If Hi-Shear rivets or dowel pins of the required length are not available, the next longer grip length may be used together with one AN960-( ) L steel washer under the collar, provided that the requirements of Figure 12 are met with the washer in place. Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB written approval is required to use more than one washer or a thicker washer.

5.5 Insertion of Fastener in Hole

5.5.1 For flush head fasteners, immediately before inserting into the prepared holes, apply a thin brush coat of DHMS S3.06 Type I sealant to the underside of the head as shown. DHMS S3.06 Type I sealant supersedes PR1431G sealant; if the engineering drawing specifies use of PR 1431G Type II or III, use PR 1431G Type II or III until depletion and then use DHMS S3.06 Type I, Class C-80 sealant (see EO 7336). Mix and handle sealant according to PPS 21.20.



5.5.2 Hi-Shear rivets and dowel pins can normally be inserted into the hole using normal thumb pressure. However, if necessary, light tapping with a 3/4 lb. (maximum) hammer, or light driving with a rivet gun fitted with a flat snap, may be used to seat the rivet or dowel pin.

5.5.3 Insert dowel pins into the prepared hole so that an equal amount of the pin protrudes from each side of the work. When using a hammer to fit dowel pins, use a hard fibre block to protect the end of the pin. When using a rivet gun to fit dowel pins, use a dowel pin set to prevent damaging the end of the pin.

5.5.4 After insertion, ensure that the protrusion of the fastener pin groove through the work meets the requirements of Figure 12. If the rivet or dowel pin protrusion is incorrect, re-check the required grip length.

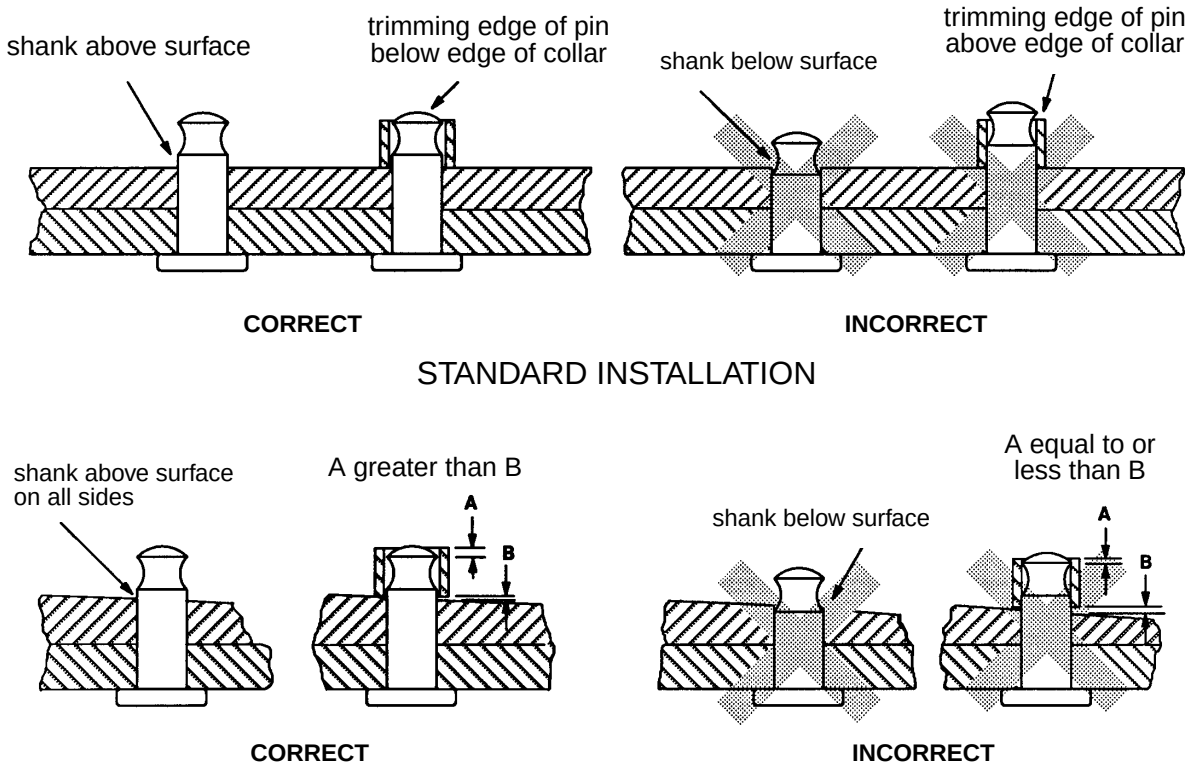


Figure 12 - Visual Check for Correct Grip Length

5.6 Collar Installation on Hi-Shear Rivets and Dowel Pins

5.6.1 Swage Hi-Shear rivet collars onto rivets and dowel pins by squeeze riveting, percussion riveting or reaction riveting. Select the correct Hi-Shear gun set, adapters and bucking bars, for the installation method to be employed, according to Table 7 or Table 6. Install stainless steel collars (HS60) using HS15401 tools marked with a yellow circumferential band. Use the squeeze riveting method wherever accessibility and the location of the structure permit. Use reaction riveting only if the structure prevents percussion or squeeze riveting. Select a suitable rivet gun or squeezer from Table 8 for the applicable Hi-Shear rivet size and gun/squeezer set shank diameter. Ensure that there is no wet paint or sealant on the shank end of the rivet or on the collar before swaging.

Table 6 - Hi-Shear Rivet Installation Tools

INSTALLATION METHOD	RIVETING TOOLS REQUIRED	APPLICABILITY	COLLAR SWAGING TOOLS		
			DESCRIPTION	SHANK DIA.	HI-SHEAR TOOL NUMBER
General Squeeze Riveting (paragraph 5.6.2)	Pneumatic Rivet Squeezer Standard Flush Squeezer Rivet Snap Set or Hi-Shear Squeezer Set	Portable rivet Squeezer	Squeezer Set	0.187"	HS61187
				0.250"	HS61250
		Stationary rivet squeezer		0.250"	HS63250
				0.375"	HS63375
General Percussion Riveting (paragraph 5.6.3)	Pneumatic Rivet Gun Flat Ground Bucking Bar Approximately 1.5X Weight of Rivet Gun Applicable Hi-Shear Gun Rivet Snap Set	Open areas	Straight Gun Set (Note 1)	0.401"	HS11401
				0.498"	HS11498
				0.401"	HS12401
				0.498"	HS12498
				0.498"	HS13498
				0.401"	HS15401
		Corner areas	Offset Gun Set	0.401"	HS21401
				0.498"	HS23498
		Frame return areas	Notched Gun Set	0.401"	HS31401
				0.498"	HS31498
		Restricted areas and channels	Goose neck insert adapter	0.401"	HS410401-48
				0.498"	HS41498-1012
			Insert Set	---	HS51406
				---	HS51531

Note 1: Available in various lengths, from 2.75” to 7.50”, as required for installation.
Note 2: For the installation of stainless steel collars (HS60), use only HS15401 Hi-Shear tools (shaded above).

Table 6 - Hi-Shear Rivet Installation Tools

INSTALLATION METHOD	RIVETING TOOLS REQUIRED	APPLICABILITY	COLLAR SWAGING TOOLS		
			DESCRIPTION	SHANK DIA.	HI-SHEAR TOOL NUMBER
Restricted Reaction Riveting (paragraph 5.6.4)	Pneumatic Rivet Gun (Note 2) Hi-Shear Rivet Dolly Fitted with Applicable Collar Set Flat Rivet Snap	Open areas	Rivet Dolly	0.401"	HS81401
				0.498"	HS81498
			Collar Set Tools	Straight Gun Set	
				Offset Gun Set	
				Notched Gun Set	
		Restricted areas	Universal Dolly	---	HS82406-3
				---	HS82531-4
			Collar Set Tools	---	Goose neck insert adapter
				---	Insert set

Note 1: Available in various lengths, from 2.75” to 7.50”, as required for installation.
Note 2: For the installation of stainless steel collars (HS60), use only HS15401 Hi-Shear tools (shaded above).

Table 7 - Hi-Shear Dowel Pin Installation Tools

INSTALLATION METHOD	RIVETING TOOLS REQUIRED	COLLAR SWAGING TOOLS		
		DESCRIPTION	SHANK DIA.	HI-SHEAR TOOL NUMBER
General Squeeze Riveting (paragraph 5.6.5)	Pneumatic Rivet Squeezer Set Hi-Shear Squeeze Set	Portable Rivet Squeezer Sets (Note 1)	0.187"	HS61187
			0.250"	HS61250
		Stationary Rivet Squeezer Sets (Note 1)	0.250"	HS63250
			0.375"	HS63375
General Percussion Riveting (paragraph 5.6.6)	Pneumatic Rivet Gun Hi-Shear Rivet Dolly Fitted with Applicable Collar Set Hi-Shear Dowel Pin Set	Rivet Dolly	0.401"	HS81401
			0.498"	HS81498
		Collar Set Tools	Straight, Offset or Notched Gun Sets	
		Dowel Pin Set Tools	0.401"	HS71401-48
			0.498"	HS71498

Note 1: Two collar or squeezer sets are required for installation of dowel pins.

Table 8 - Capacity of Squeezers and Riveting Guns

PNEUMATIC RIVET GUNS			RIVET SQUEEZERS		
HI-SHEAR RIVET SIZE	**SHANK DIAMETER**	**RIVETING GUN**	**SUITABLE FOR HI-SHEAR RIVET SIZE (INCHES)**	**SHANK DIAMETER**	**RIVET SQUEEZER**
-6 (3/16") and smaller	0.401"	CP-3X	-6 (3/16") and smaller	0.187"	CP-351-C
		Cleco E4			CP-355
-6 (3/16") (Note 1)	0.401"	CP-4X			Cleco A13B
		Cleco E5		0.250"	Cleco 24B
	0.498"	CP-5X		0.357"	CP-450-EA
		Cleco G4	-8 (1/4")	0.187"	CP-355
-8 (1/4")	0.401"	CP-4X		0.250"	Cleco 24B
		Cleco E5		0.375"	CP-450-EA
-8 (1/4") (Note 1)	0.498"	CP-5X	-10 (5/16")	0.375"	CP-450-EA
		CP-9X	-12 (3/8")		
		Cleco G4			
-10 (5/16")	0.498"	CP-9X			
		Cleco G4			
-12 (3/8")	0.498"	CP-9X			

Note 1. Recommended for rivet sizes where reaction riveting, goose neck adapter or long gun set are to be used.
Note 2. It is acceptable to alternative rivet guns or squeezers provided all requirements specified herein are met.

5.6.2 Swage collars onto Hi-Shear rivets using the squeeze riveting method as follows (see Figure 13):

Step 1. Adjust the rivet squeezer to 0.010" overdrive in order to compensate for variations in material thickness, pin length and countersink depth.

Step 2. Hold the flush rivet set squarely against the rivet head and the squeezer set over the collar.

Step 3. Operate the rivet squeezer and swage the collar into the groove in the pin. Continue until the trimming edge of the rivet trims the surplus collar material.

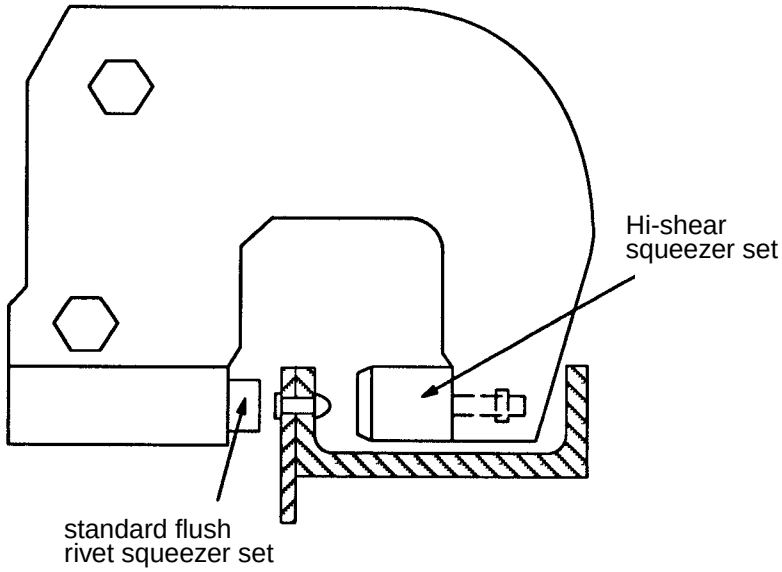


Figure 13 - Squeeze Riveting Method for Hi-Shear Rivets

5.6.3 Swage collars onto Hi-Shear rivets using the percussion riveting method as follows (see Figure 14):

Step 1. Mount the appropriate Hi-Shear tool in the pneumatic riveting gun.

Step 2. Place the tool squarely over the collar.

Step 3. Position a flat bucking bar squarely and securely against the head of the rivet.

Step 4. Operate the pneumatic riveting gun and swage the collar into the groove of the pin until the trimming edge of the pin trims the surplus collar material. Swage the collar quickly, using short, high-pressure bursts. The tightness of the installed rivet depends upon the time taken to swage the collar. Long, weak bursts work-harden the collar, making it more difficult to swage.

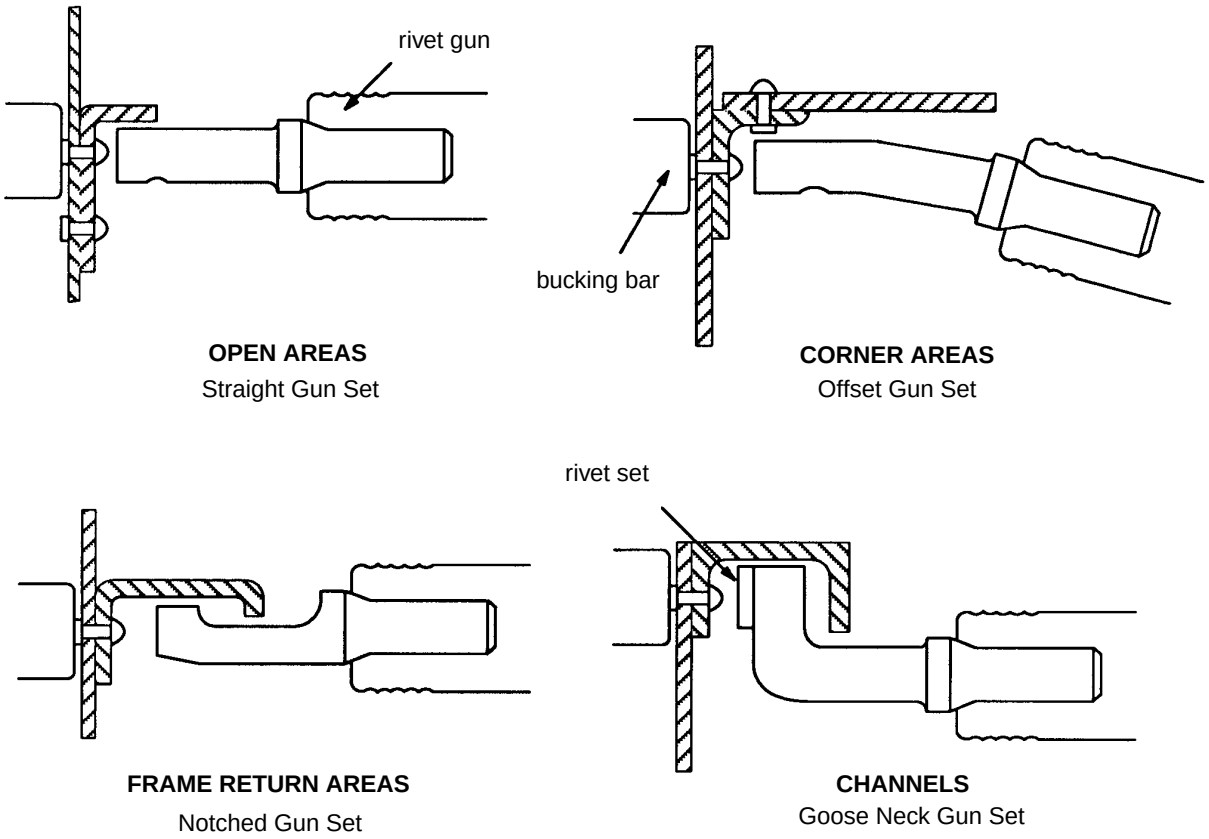


Figure 14 - Percussion Riveting Method for Hi-Shear Rivets

5.6.4 Swage collars onto Hi-Shear rivets using the reaction riveting method as follows (see Figure 15)

Step 1. Mount the flat snap in the pneumatic riveting gun and place the correct Hi-Shear tool, supported by the appropriate bucking bar, squarely over the collar.

Step 2. Hold the flat snap tightly against the rivet head and square to the surface.

Step 3. Operate the pneumatic gun and swage the collar into the groove of the pin. Continue until the trimming edge of the rivet trims the surplus collar material. Swage the collar quickly, using short, high-pressure bursts. The tightness of the installed rivet depends upon the time taken to swage the collar. Long, weak bursts work-harden the collar, making it more difficult to swage.

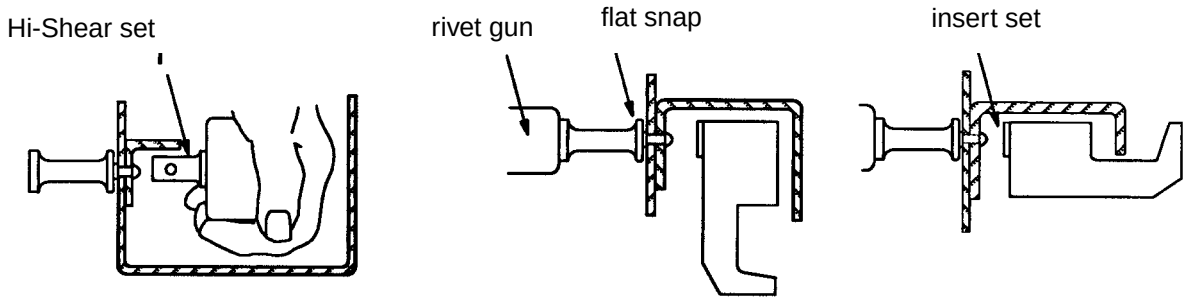


Figure 15 - Reaction Riveting Method for Hi-Shear Rivets

5.6.5 Swage collars onto dowel pins using the squeeze riveting method for dowel pins as follows (see Figure 16):

Step 1. Install a collar on both protruding portions.

Step 2. Mount a squeezer set in each jaw of the squeezer and position the squeezer squarely over the dowel pin. Swage both collars simultaneously until the trimming edges of the pins trim the surplus collar material.

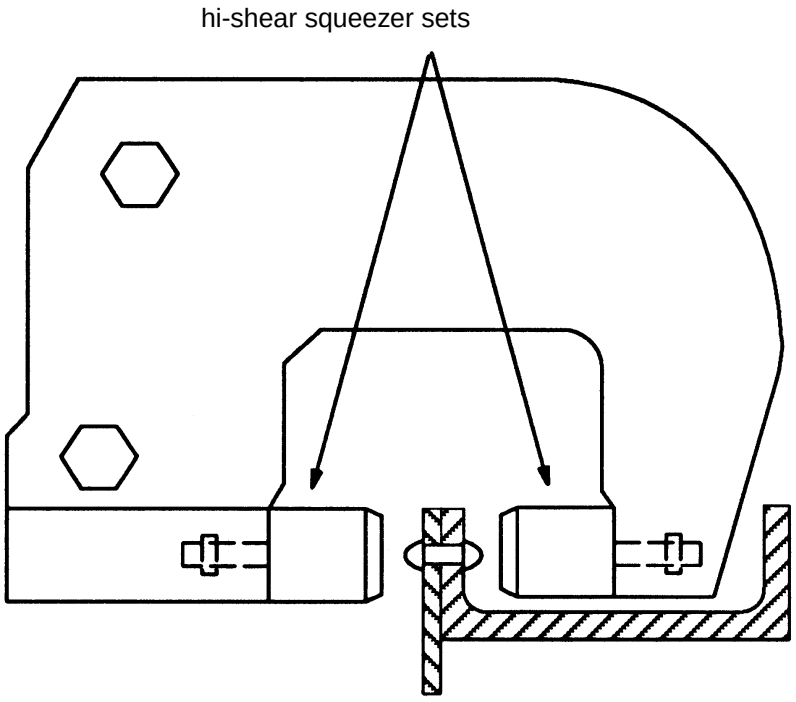


Figure 16 - Squeeze Riveting Method for Dowel Pins

5.6.6 Swage collars onto dowel pins using the percussion riveting method for dowel pins as follows (see Figure 17):

Step 1. Mount the appropriate gun set in the riveting gun and the appropriate dowel pin set in the bucking bar.

Step 2. Position the gun set squarely over the collar and position the dowel pin set over the opposite end of the dowel pin, squarely against the work surface.

Step 3. Operate the rivet gun and swage the collar onto the groove of the dowel pin until the trimming edge trims the surplus collar material. Swage the collar quickly, using short, high-pressure bursts. The tightness of the installed dowel pin depends upon the time taken to swage the collar. Long, weak bursts work-harden the collar, making it more difficult to swage.

Step 4. Exchange the pin set for a suitable gun set, slip the collar over the other end of the dowel pin and swage as in Step 3, while supporting the previously swaged collar with the other gun set.

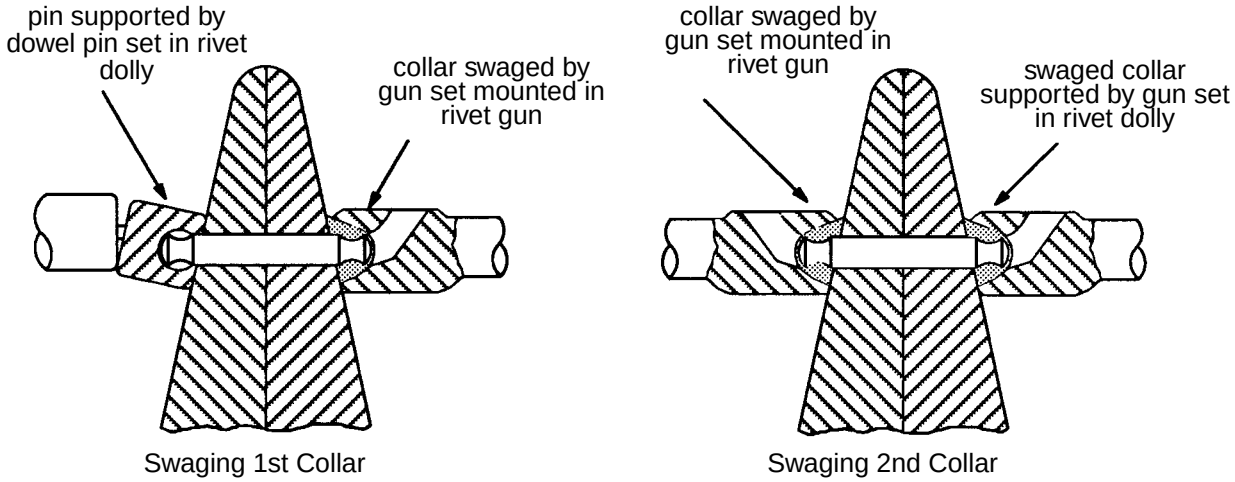


Figure 17 - Percussion Riveting Method for Dowel Pins

5.7 Post Installation Procedure

5.7.1 After swaging the collar, remove any excess extruded sealant from around the rivet head by wiping with a clean cloth dampened with the solvent specified in PPS 31.17.

5.8 Installation of Oversize Hi-Shear Rivets

5.8.1 Only if authorized in writing (e.g., via NCR), by Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB, oversize rivets may be installed, as necessary, for the salvage of oversize holes.

5.8.2 Refer to Table 9 for hole sizes for the installation of oversize Hi-Shear rivets.

5.8.3 Countersink diameters for oversize Hi-Shear rivets are the same as those for standard Hi-Shear rivets (see Table 3).

5.8.4 Install oversize Hi-Shear rivets in the same manner, using the same tools, as standard Hi-Shear rivets.

Table 9 - Hole Preparation Data for Oversize Hi-Shear Rivets

ORIGINAL FASTENER NOMINAL DIAMETER	1ST OVERSIZE		2ND OVERSIZE	
	RECOMMENDED CUTTER SIZE	HOLE LIMITS	RECOMMENDED CUTTER SIZE	HOLE LIMITS
-4 (1/8")	0.1400"	0.1395" - 0.1410"	Ref. -5 standard rivet	
-5 (5/32")	0.1715"	0.1710" - 0.1725"	Ref -6 standard rivet	
-6 (3/16")	0.2025"	0.2020" - 0.2035"	0.2180"	0.2175" - 0.2190"
-8 (1/4")	0.2650"	0.2645" - 0.2660"	0.2805"	0.2800" - 0.2815"
-10 (5/16")	0.3275"	0.3270" - 0.3285"	0.3430"	0.3425" - 0.3440"
-12 (3/8")	0.3900"	0.3895" - 0.3910"	0.4055"	0.4050" - 0.4065"

5.9 Removal of Installed Fasteners

5.9.1 If necessary, remove installed fasteners using the appropriate tools and method listed in Table 10.

Table 10 - Hi-Shear Fastener Removal Tools

REMOVAL METHOD	TOOLS REQUIRED		REMOVAL METHOD	TOOLS REQUIRED	
	DESCRIPTION	HI-SHEAR TOOL		DESCRIPTION	HI-SHEAR TOOL
Punch-Out Method (general) (paragraph 5.9.1.1)	Rivet Gun	---	Drill Out Method (paragraph 5.9.1.2)	Drill Gun	---
	Punch	HS93401		Drill	---
	Guide Bush	HS93400		Drill-Out Bushing	HS91000-68
	Rivet Dolly	HS81401			HS91000-1012
	Hollow Buck	HS95401		Punch	---
Punch-Out Method (alt. support)	Goose neck Insert Adapter	HS41401-48		Hammer	---
	Hollow Insert	HS96531		Support Block	---
Punch-Out Method (alt. support)	Universal Dolly	HS82531-4	Chisel Method **Restricted** (paragraph 5.9.1.4) (Note 1)	Hammer	---
	Hollow Insert	HS96531		Chisel	---
Hollow Mill Method (paragraph 5.9.1.3)	Drill Gun	---		Fibre Washer	---
	Hollow Mill Collar Cutter	HS92000		Support Block	---
	Hammer	---			
	Support Block	---			

Note 1. Use the chisel method only where the structure prevents the use of the other methods. Use a chisel that has a cutting edge narrower than the collar height.
Note 2. It is acceptable to use alternative removal tools provided no damage to the structure results.

5.9.1.1 The preferred method of removing installed fasteners is the punch-out method as follows (see Figure 18):

Step 1. Insert the correct size punch into a suitable riveting gun and slip the guide bushing over the punch.

Step 2. Support the work around the rivet head using a hollow buck or hollow insert.

Step 3. Push the guide bushing firmly against the collar and punch against the shank end of the rivet.

Step 4. Operate the gun briefly to drive out the rivet.

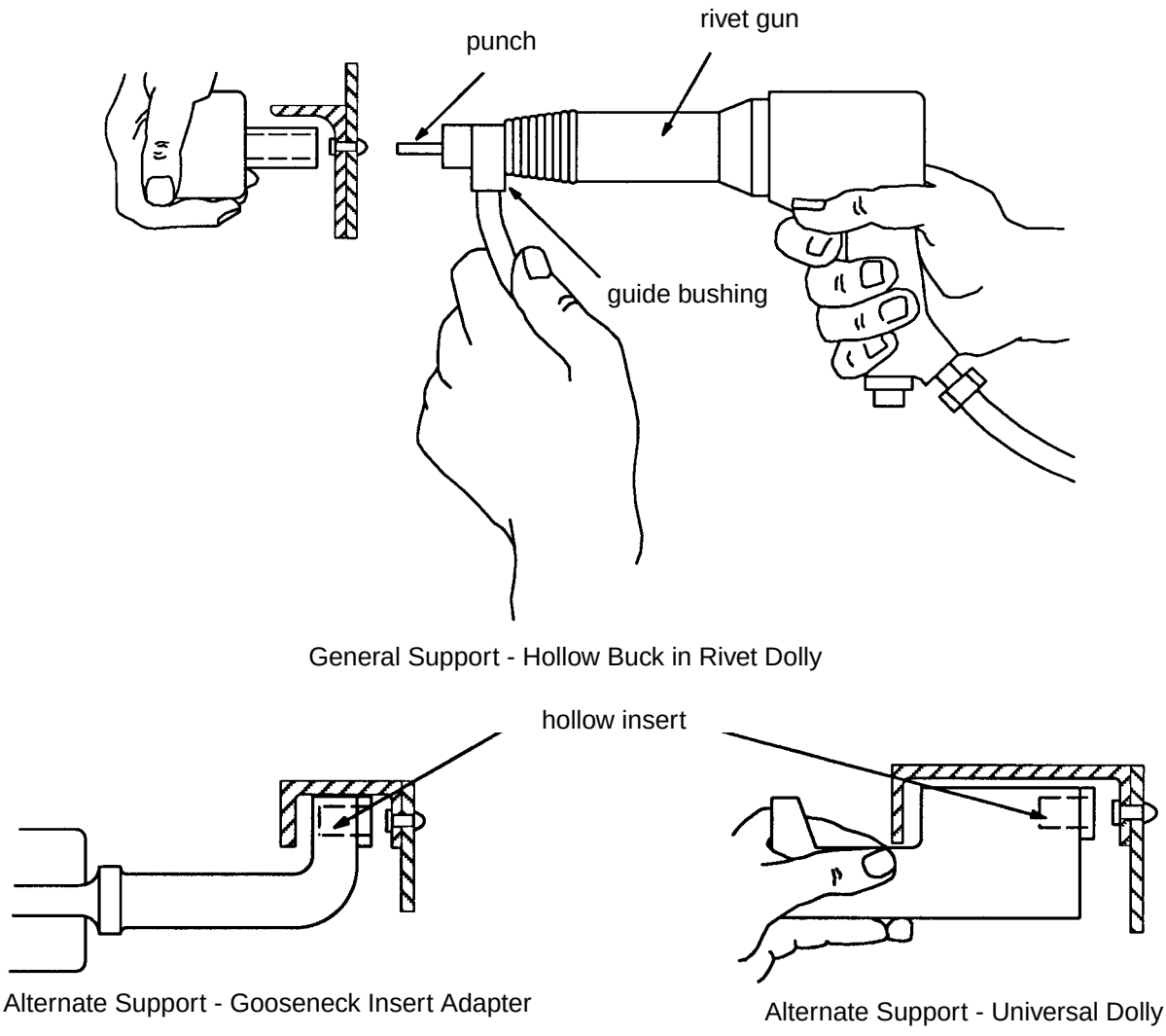


Figure 18 - Punch-Out Removal of Installed Fasteners

5.9.1.2 Alternatively, use of the drill-out method as follows is also acceptable for removal of installed fasteners:

Step 1. Place the end of the drill bushing, which corresponds to the rivet size, over the installed collar.

Step 2. Using a drill of the correct size, as per Table 8 and as stamped on the bushing, drill into the shank end of the rivet to a depth equal to approximately 1/2 the height of the collar.

Step 3. Support the work around the rivet head using a suitable hollow support block and drive out the rivet using a hammer and suitable punch.

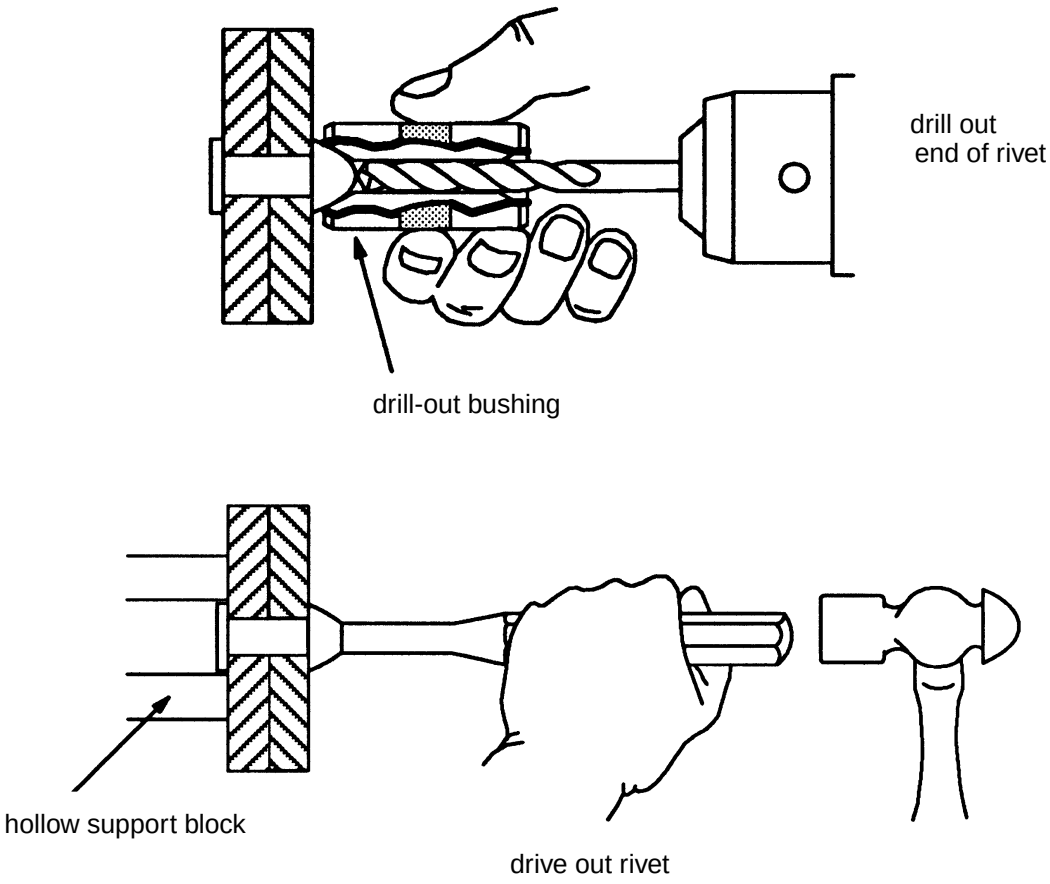


Figure 19 - Drill-Out Removal of Installed Fasteners

5.9.1.3 Alternatively, use of the hollow mill method as follows is also acceptable for removal of installed fasteners:

Step 1. Mount the correct size hollow mill collar cutter in a slow speed drill gun and cut away the collar, leaving only a thin flange at the base, so as to prevent damage to the work.

Step 2. Support the work around the rivet head using a suitable hollow support block and drive out the rivet using a hammer.

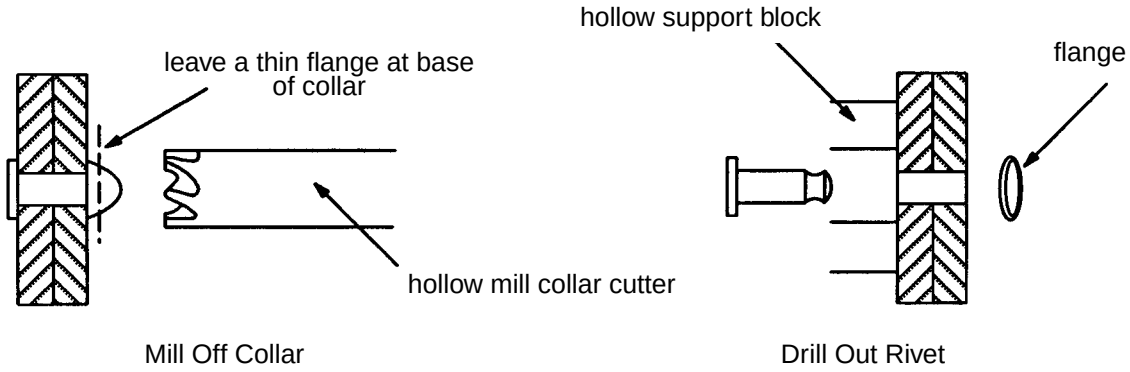


Figure 20 - Hollow Mill Removal of Installed Fasteners

5.9.1.4 Use of the chisel method, as follows (see Figure 21), is restricted to those instances where the structure prevents the use of the other methods of removing installed fasteners:

Step 1. When using a chisel to remove installed Hi-Shear fasteners, take extreme care to prevent damage to the hole or to the surface of the work. Protect the surface with a suitable fibre washer when splitting the collar.

Step 2. Using a hammer and chisel, crack the collar at opposite points to split it open. Ensure that the cutting edge of the chisel is less than the height of the collar (refer to Table 8). Support the collar on the opposite side from the chisel, using a suitable bucking bar, to prevent elongating the fastener hole.

Step 3. Support the work around the rivet head, using a suitable support block, and drive out the rivet using a hammer.

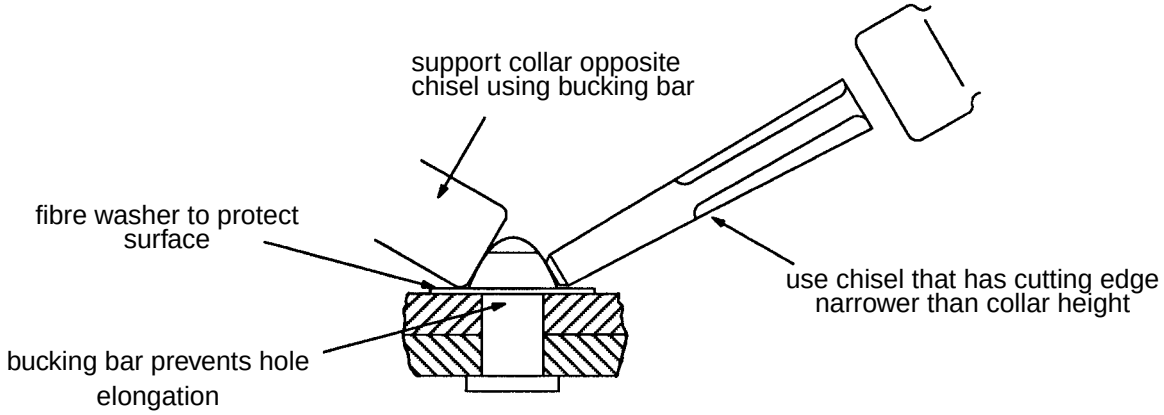


Figure 21 - Chisel Method Removal of Installed Hi-Shear Fasteners

6 Requirements

6.1 Ensure that all installed Hi-Shear rivets and dowel pins meet the requirements specified in Figure 22.

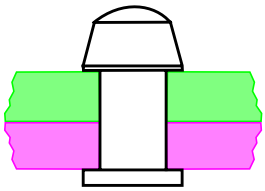
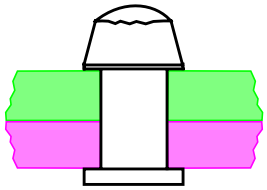
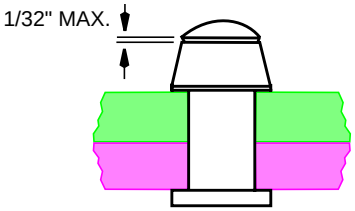
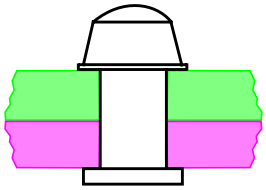
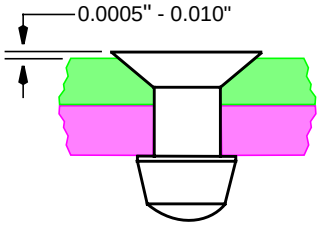
DESCRIPTION	**VISUAL APPEARANCE** (note 1)	**CORRECTIVE ACTION**
- Good rivet, properly driven - Work is drawn up tightly - Pin is correct length - Collar well trimmed and neatly formed		- None required
Collar Trim - A slightly ragged or irregularly trimmed collar is acceptable.		- None required
Over-driven Collar - An over-driven collar is acceptable provided that the over-driven land does not exceed 1/32".		- Replace rivet if the over-driven land exceeds 1/32"
Collar Flange - A slight flange on the base of the collar is acceptable.		- None required
Flush Head Protrusion - Heads of flush type rivets must protrude 0.0005" - 0.010".		- Remove rivet and check countersink diameter if rivet head protrusion less than 0.0005" or greater than 0.010"
Note 1. Swaged collar criteria for rivets and dowel pins are the same.		

Figure 22 - Requirements for Installed Fasteners

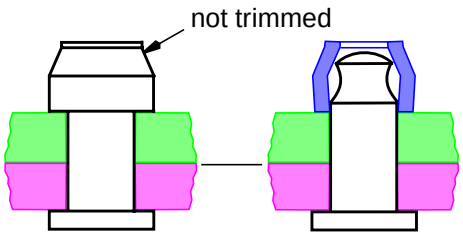
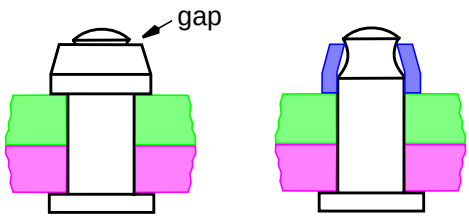
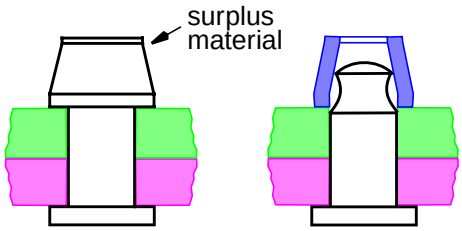
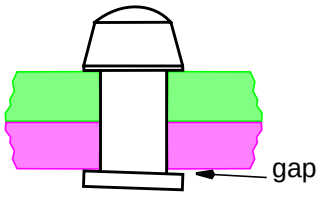
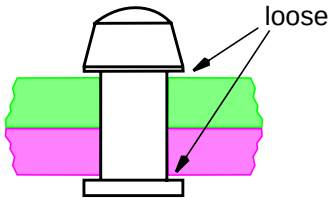
DESCRIPTION	VISUAL APPEARANCE (note 1)	CORRECTIVE ACTION
- Surplus un-trimmed collar material is not acceptable.		- Ensure that the correct pin length for material thickness. - Continue driving until the collar trims.
- Any gap showing between the pin shearing edge and the collar is unacceptable.		- Pin is too long. Remove and replace with next shorter pin length.
- Surplus un-formed or un-trimmed collar material is not acceptable.		- Pin is too short. Remove and replace with next longer pin length.
- A gap under **1 side** of head is acceptable provided it does not exceed 0.002" (i.e., 0.002" feeler gauge does not touch fastener shank).		- If a gap under 1 side of head exceeds 0.002", remove the rivet and refer to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB.
- Any gap under the head or collar of a protruding head fastener is unacceptable.		- Replace rivet.
Note 1. Swaged collar criteria for rivets and dowel pins are the same.		

Figure 22 - Requirements for Installed Fasteners

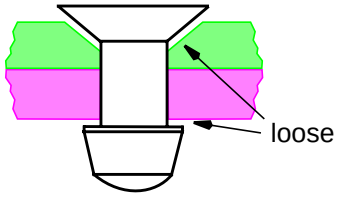
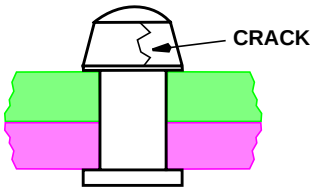
DESCRIPTION	VISUAL APPEARANCE (note 1)	CORRECTIVE ACTION
- Any gap under the head or collar of a flush head fastener is unacceptable.		- Remove rivet and check countersink diameter.
- Any cracks in the collar are unacceptable.		- Replace rivet.
Note 1. Swaged collar criteria for rivets and dowel pins are the same.		

Figure 22 - Requirements for Installed Fasteners

7 Safety Precautions

7.1 The safety precautions specified herein are specific to Bombardier Toronto 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 Do not use pneumatic riveting guns if a snap-retaining spring has not been fitted.

7.4 Disconnect the shop air supply line from pneumatic riveting guns when changing snaps.

7.5 Wear Bombardier Toronto (de Havilland) approved hearing protectors and safety glasses at all times while riveting.

7.6 Wrap the tips of all gun sets with insulation tape or plastic tape to avoid injuries in the case of cracking of the tools.

8 Personnel Requirements

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

9 Recommended Maintenance of Equipment

9.1 Keep installation tools clean and dry. Lightly oil or grease moving parts. Every day a pneumatic tool is to be used, inject a few drops of light machine oil into the air inlet of pneumatic tools.

9.2 Check installation tools periodically for proper operation and replace damaged or badly worn parts.

9.3 Any alterations or rework of installation tools or accessories is prohibited unless appropriately authorized.