BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 2.16

PRODUCTION PROCESS STANDARD

Installation of NAS Type Lockbolt Fasteners

Issue 21
- This standard supersedes PPS 2.16, Issue 20.
- Vertical lines in the left hand margin indicate technical 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)	April 11, 2014
	Production Process Standards (PPS)	
Approved By:	(L.K. John)	April 12, 2014
	Materials Technology	
	(Adam Gordon)	April 15, 2014
	Quality	

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for installation of lockbolt fasteners. Refer to PPS 2.35 for the procedure and requirements for installation of titanium lockbolt fasteners.

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

3.5 PPS 1.14 - Use of Pneumatic Rivet Guns.

3.6 PPS 1.32 - Set-Up and Operation of Spacematic Drillmotor Models 1600 and 6000.

3.7 PPS 1.33 - Countersinking for Flush Head Fasteners.

3.8 PPS 1.37 - Set-Up and Operation of Portable Automatic Drillmotors.

3.9 PPS 2.65 - Salvage of Oversize Holes using ACRES Sleeves.

3.10 PPS 13.26 - General Subcontractor Provisions.

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

3.12 PPS 21.20 - Mixing and Handling Two Part Sealants.

3.13 PPS 31.17 - Solvent Usage.

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

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

4 Materials and Equipment

4.1 Materials

4.1.1 Lockbolt fasteners and collars as specified on the Engineering Drawing. Refer to Figure 1 for a general description of lockbolt fasteners.

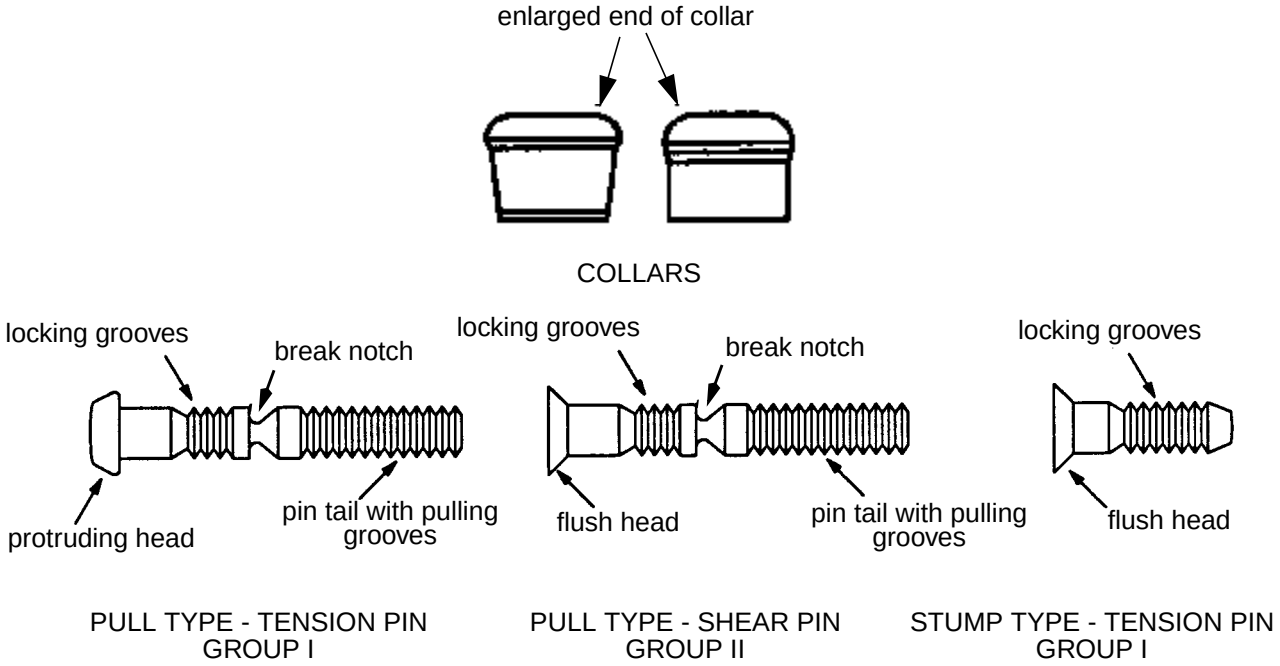


Figure 1 - General Description of Lockbolt Fasteners

4.1.2 DHMS S3.06 Type I, Class C-80 sealant. DHMS S3.06 Type I sealant supersedes PR1431G sealant. If the engineering drawing specifies 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).

4.1.3 Pin insertion lubricant - Cetyl Alcohol to MIL-L-87132 (e.g., Pennwalt Corp. Lube Stick).

4.2 Equipment

4.2.1 The following tools are used in-house at Bombardier Toronto (de Havilland) for the installation of lockbolts. It is acceptable to use alternative equipment provided that all the requirements specified in section 6 are met.

- Lockbolt installation tools as specified in Table 7 or Table 8).
- Lockbolt grip scale, Huck No. 105093.
- Pin position and swage gauge as specified in Table 11.
- Soft metal faced rivet snap caps and bucking bars SD8853 and standard flush rivet squeeze sets.
- Lockbolt fastener removal tools as specified in Table 10.
- Pintail catchers, Huck model 111247.
- Special lockbolt rivet sets TS.411.05.11.
- Hole deburring tool TS.561.35.10.

5 Procedure

5.1 General

5.1.1 Lockbolts are permanent fasteners designed for use in high strength structural joints. Installation of these fasteners involves fitting the fastener in a close tolerance hole (either a transition or interference fit) and cold swaging a locking collar into the annular locking grooves using the applicable installation tools. This provides a permanent, tight, sealed and vibration resistant installation. As the effectiveness of the lockbolt is dependent upon the correct installation, it is essential that the procedure specified herein is strictly adhered to.

5.1.2 Lockbolts are lubricated by the manufacturer. Protect fasteners at all times from dust, dirt, moisture and excessive heat. If possible, keep fasteners in their original containers. If this is not possible, use non-absorbent containers. Handle fasteners only from the threaded portion of the shank. Use the oldest stock at first.

5.2 Hole Preparation

5.2.1 If the hole locations for lockbolt fasteners are determined by pre-drilled holes in one of the components in the assembly, prepare holes as follows:

Step 1. For dimpled installations, pre-drill for dimpling as specified in Table 1 according to PPS 1.09.

Step 2. For dimpled installations, ram coin dimple according to PPS 1.01 or 1.07, as applicable.

Step 3. Pre-drill the fastener holes according to PPS 1.09. Refer to Table 2 for the recommended pre-drill size.

Step 4. For flush head fastener installations which are not dimpled, countersink using a micro-stop countersink fitted with the correct size pilot according to PPS 1.33 to the countersink diameter recommended in Table 3.

Step 5. Open the fastener hole to the final size specified in Table 4 for the type of fit (interference or transition) specified on the Engineering Drawing according to PPS 1.09.

Step 6. For protruding head fasteners, manually break the edge of the hole 0.015" - 0.025" on the side that the fastener head will seat as shown using a hole deburring tool.

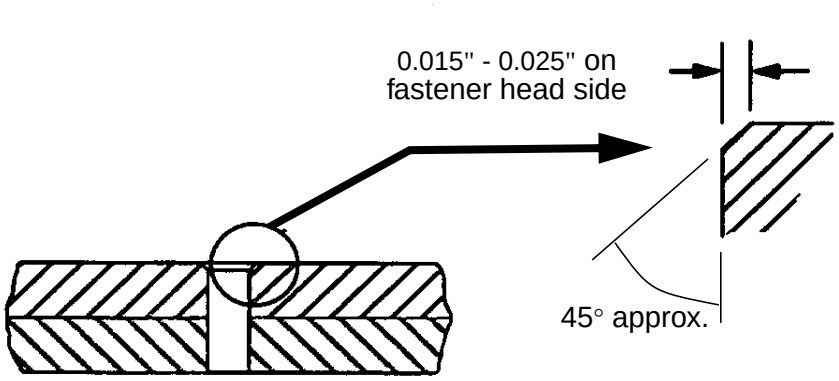


Figure 2 - Edge Relief (Edge Break) for Protruding Head Fasteners

Step 7. Prime countersinks with F1 zinc chromate primer according to PPS 34.02 or F19 Type 2 epoxy-polyamide primer according to PPS 34.08.

Table 1 - Pre-Drill for Dimpling

LOCKBOLT	NOMINAL DIAMETER	PRE-DRILL FOR DIMPLING
NAS 1436	3/16"	#17 (0.173")
NAS 1438	1/4"	#1 (0.228")
NAS 1440	5/16"	9/32" (0.281")
NAS 1456	3/16"	#24 (0.152")
NAS 1458	1/4"	#6 (0.204")
NAS 1460	5/16"	1/4" (0.250")
NAS 1475	5/32"	#30 (0.1285")
NAS 1476	3/16"	#20 (0.161")
NAS 1478	1/4"	#10 (0.194")
NAS 1516	3/16"	#24 (0.152")

LOCKBOLT	NOMINAL DIAMETER	PRE-DRILL FOR DIMPLING
NAS 1518	1/4"	#6 (0.204")
NAS 1520	5/16"	1/4" (0.250")
NAS 1535	5/32"	#30 (0.1285")
NAS 1536	3/16"	#20 (0.161")
NAS 1538	1/4"	#10 (0.194")
NAS 2106	3/16"	#24 (0.152")
NAS 2108	1/4"	#6 (0.204")
NAS 2110	5/16"	1/4" (0.250")
2L509YDT8	1/4"	1/4" (0.250")

Table 2 - Recommended Pre-Drill Size

NOMINAL LOCKBOLT PIN DIAMETER	PRE-DRILL SIZE
-5 (5/32")	#27 (0.144")
-6 (3/16")	#16 (0.177")
-8 (1/4")	#1 (0.228")

NOMINAL LOCKBOLT PIN DIAMETER	PRE-DRILL SIZE
-10 (5/16")	L (0.290")
-12 (3/8")	S (0.348")

Table 3 - Recommended Countersink Diameter

LOCKBOLT	NOMINAL DIAMETER	COUNTERSINK DIAMETER
NAS 1436	3/16"	0.292" - 0.306"
NAS 1438	1/4"	0.386" - 0.398"
NAS 1440	5/16"	0.465" - 0.477"
NAS 1442	5/16"	0.554" - 0.563"
NAS 1456	3/16"	0.374" - 0.386"
NAS 1458	1/4"	0.495" - 0.506"
NAS 1460	5/16"	0.622" - 0.632"
NAS 1462	3/8"	0.750" - 0.759"
NAS 1475	5/32"	0.280" - 0.294"
NAS 1476	3/16"	0.345" - 0.357"
NAS 1478	1/4"	0.468" - 0.479"
NAS 1480	5/16"	0.556" - 0.566"
NAS 1482	3/8"	0.686" - 0.695"
NAS 1486	3/16"	0.362" - 0.372"
NAS 1488	1/4"	0.483" - 0.493"
NAS 1490	5/16"	0.610" - 0.620"

LOCKBOLT	NOMINAL DIAMETER	COUNTERSINK DIAMETER
NAS 1492	3/8"	0.738" - 0.748"
NAS 1516	3/16"	0.374" - 0.386"
NAS 1518	1/4"	0.495" - 0.506"
NAS 1520	5/16"	0.622" - 0.632"
NAS 1522	3/8"	0.750" - 0.759"
NAS 1535	5/32"	0.280" - 0.294"
NAS 1536	3/16"	0.345" - 0.357"
NAS 1538	1/4"	0.468" - 0.479"
NAS 1540	5/16"	0.556" - 0.566"
NAS 1542	3/8"	0.686" - 0.695"
NAS 2105	5/32"	0.320" - 0.332"
NAS 2106	3/16"	0.374" - 0.386"
NAS 2108	1/4"	0.495" - 0.506"
NAS 2110	5/16"	0.622" - 0.632"
NAS 2112	3/8"	0.750" - 0.759"
2L509YDT8	1/4"	0.495" - 0.506"

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 paragraph 6.1.7.

Table 4 - Final Reaming/Drilling of Fastener Holes

NOMINAL LOCKBOLT PIN DIAMETER	INTERFERENCE FIT		TRANSITION FIT	
	RECOMMENDED DRILL/REAMER	HOLE LIMITS	RECOMMENDED DRILL/REAMER	HOLE LIMITS
-5 (5/32")	0.1615"	0.1615" - 0.1635"	0.1650"	0.1645" - 0.1665"
-6 (3/16")	0.1865"	0.1860" - 0.1880"	0.1895	0.1890" - 0.1910"
-8 (1/4")	0.2465"	0.2460" - 0.2480"	0.2495"	0.2490" - 0.2510"
-10 (5/16")	0.3090"	0.3085" - 0.3105"	0.3120"	0.3115" - 0.3135"
-12 (3/8")	0.3710"	0.3705" - 0.3725"	0.3745"	0.3740" - 0.3760"

5.2.2 If the hole locations are determined by Spacematic drill templates, prepare holes using portable automatic drillmotors as follows:

Step 1. After placing the drill template in position, pre-drill the **starting hole** as specified in Table 2 manually according to PPS 1.09.

Step 2. Open the **starting hole** manually according to PPS 1.09 to the final size specified in Table 4 for the type of fit (interference or transition) specified on the Engineering Drawing.

Step 3. Insert the collet of the drillmotor into the starting hole and the template boss into the next hole in the template.

Step 4. Drill all holes to the sizes specified in Table 4, according to the procedure specified in PPS 1.32 or PPS 1.37, as applicable.

Step 5. Remove the drill template.

Step 6. For flush head fasteners, countersink the starting hole (and other holes, if necessary) using a micro-stop countersink according to PPS 1.33.

Step 7. For protruding head fasteners, manually break the edge of the hole on which the fastener head will seat as shown in Figure 2 according to PPS 27.05.

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 of Table 4 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 Requirements

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

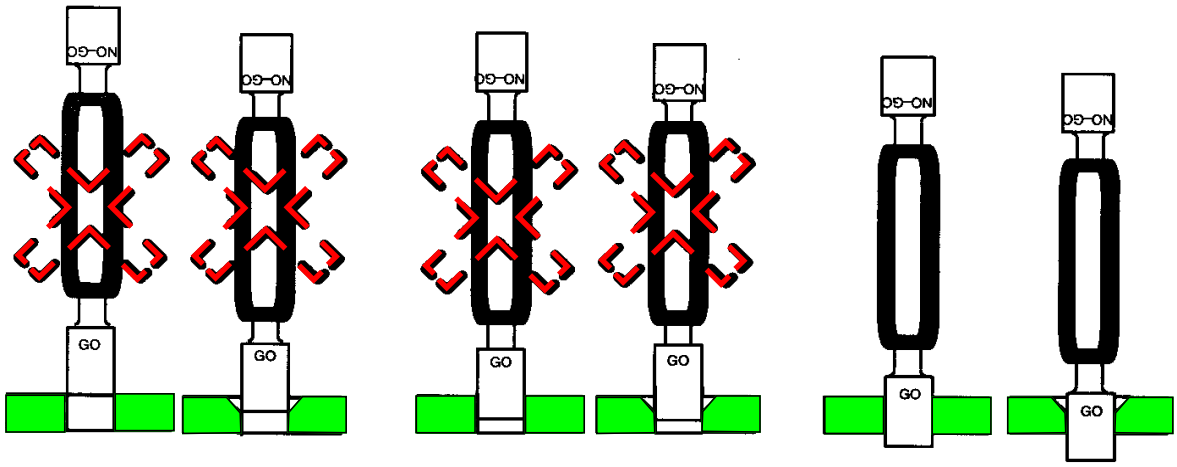
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of GO/NO-GO Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of Table 4 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 4 for the type of fit (interference or transition) specified on the Engineering Drawing.

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

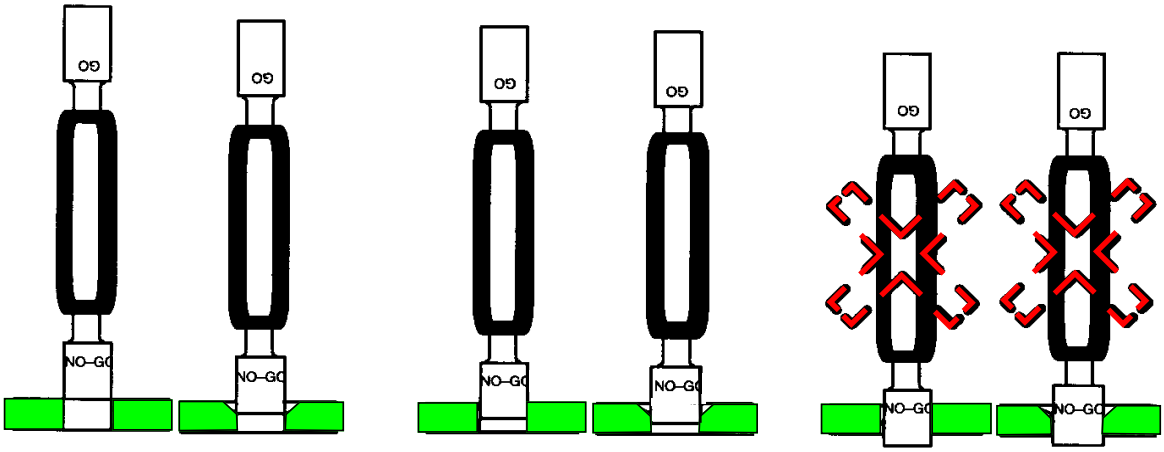


Does not go in.
UNDERSIZE HOLE

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 3 - Use of Go/No-Go Gauges

5.4 Fastener Selection

5.4.1 The fastener grip length specified on the engineering drawing, work order or assembly manual is only a reference length. To verify that the specified grip length is correct, ensure that the sheets are pulled up such that no gap exits and measure the hole depth using a lockbolt grip scale. The hole depth number shown on the grip scale corresponds to the lockbolt pin grip length dash number. Always read to the next higher number as shown in Figure 4 (i.e., if the reading is past the **end** of the -3 marking then use a -4 fastener). If a tapered sheet condition exists, use the grip length indicated for the thickest section. Refer to Table 6 for a listing of the grip length ranges for each grip dash number. If the required length of the lockbolts are not available, refer to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for written authorization (e.g., via fastpath RNC) to use the next longer pin length and shim to the correct length using washers.

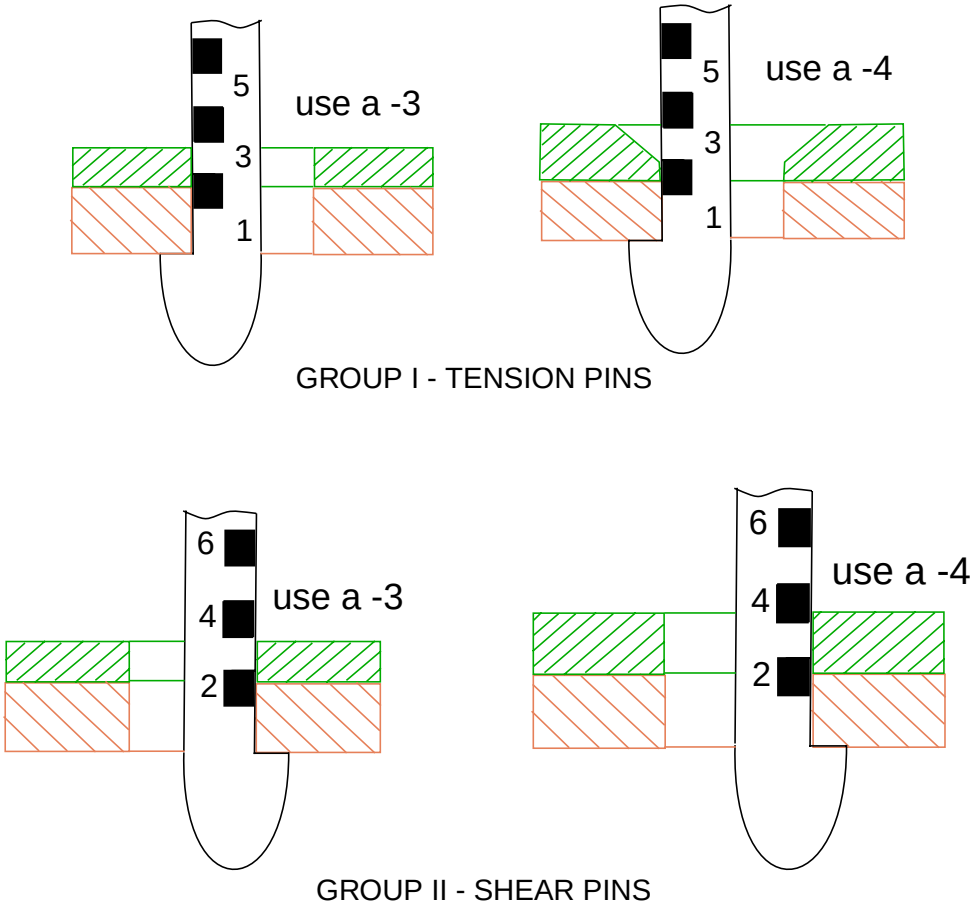


Figure 4 - Use of Huck No. 105093 Grip Scale

Table 6 - Lockbolt Grip Ranges

GRIP NUMBER	TENSION PINS GROUP 1	SHEAR PINS GROUP 2
1	0.031" - 0.094"	0.020" - 0.062"
2	0.095" - 0.156"	0.063" - 0.125"
3	0.157" - 0.219"	0.126" - 0.188"
4	0.220" - 0.281"	0.189" - 0.250"
5	0.282" - 0.344"	0.251" - 0.312"
6	0.345" - 0.406"	0.313" - 0.375"
7	0.407" - 0.469"	0.376" - 0.438"
8	0.470" - 0.531"	0.439" - 0.500"
9	0.532" - 0.594"	0.501" - 0.562"
10	0.595" - 0.656"	0.563" - 0.625"
11	0.657" - 0.719"	0.626" - 0.688"
12	0.720" - 0.781"	0.689" - 0.750"
13	0.782" - 0.844"	0.751" - 0.812"
14	0.845" - 0.906"	0.813" - 0.875"
15	0.907" - 0.969"	0.876" - 0.938"
16	0.970" - 1.031"	0.939" - 1.000"

GRIP NUMBER	TENSION PINS GROUP 1	SHEAR PINS GROUP 2
17	1.032" - 1.094"	1.001" - 1.062"
18	1.095" - 1.156"	1.063" - 1.125"
19	1.157" - 1.219"	1.126" - 1.188"
20	1.220" - 1.281"	1.189" - 1.250"
21	1.282" - 1.344"	1.251" - 1.312"
22	1.345" - 1.406"	1.313" - 1.375"
23	1.407" - 1.469"	1.376" - 1.438"
24	1.470" - 1.531"	1.439" - 1.500"
25	1.532" - 1.594"	1.501" - 1.562"
26	1.595" - 1.656"	1.563" - 1.625"
27	1.657" - 1.719"	1.626" - 1.688"
28	1.720" - 1.781"	1.689" - 1.750"
29	1.782" - 1.844"	1.751" - 1.812"
30	1.845" - 1.906"	1.813" - 1.875"
31	1.907" - 1.969"	1.876" - 1.938"
32	1.970" - 2.031"	1.939" - 2.000"

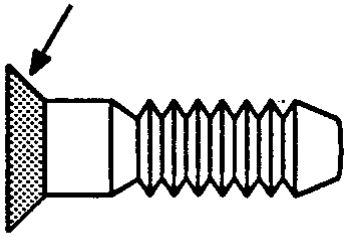
Refer to Table 11 for a listing of lockbolt group.

5.5 Installation of Lockbolts

5.5.1 Install stump type lockbolts as follows (see Figure 5). Use only the stump type lockbolts specified; do not substitute pull type lockbolts from which the pin tail has been broken off.

Step 1. If specified on the engineering drawing, apply a thin brush coat of DHMS S3.06 Type I sealant to the underside of flush head lockbolts as shown immediately before insertion of the lockbolt pin into the prepared hole. Mix and handle DHMS S3.06 Type I sealant according to PPS 21.20.

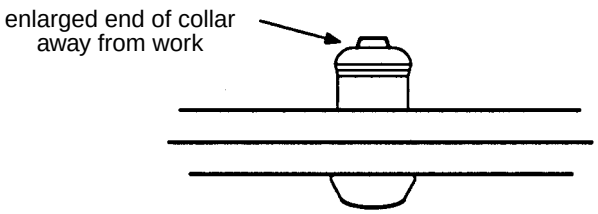
DHMS S3.06 type I sealant on underside of flush head



Step 2. Fully insert the lockbolt into the prepared and inspected hole so that the head is seated against the structure. Pins installed in transition fit holes can normally be fully seated using normal thumb pressure. Install lockbolt pins in interference fit holes by light driving with a rivet gun fitted with a flush rivet set for flush head lockbolts or a flush or cupped rivet set for protruding head lockbolts. Use a special rivet set (see paragraph •) in places where accessibility to the fastener head is restricted. If the driving force required to seat the pin is high (i.e., maximum interference or thick material gauge), use SD8853 -11 aluminum snap caps to prevent any damage to the lockbolt head and support the reverse side of the structure using SD8853 -3 or -5 aluminum faced support blocks (this is particularly important when inserting lockbolts into bonded structures as delamination may occur if the reverse side is not properly supported).

Step 3. Immediately before slipping the collar over the locking grooves of the lockbolt, clean the locking grooves by solvent cleaning according to PPS 31.17.

Step 4. Place the collar over the locking grooves of the lockbolt with the enlarged end of the collar away from the work as shown.



Step 5. Swage the collar in place using a squeeze riveter or percussion riveter fitted with the appropriate tool set. Use of a squeeze riveter (stationary or portable rivet squeezer) according to PPS 1.14 is preferred. Use of the percussion rivet method according to PPS 1.12 is recommended for installation only when the fastener is not accessible to a rivet squeezer. Use of the reaction riveting method is not acceptable for installation of stump type lockbolts. Refer to for a listing of suitable installation tools.

When using a squeeze riveter, adjust the working pressure and stroke of the squeezer to fully swage the collar onto the lockbolt. If necessary, make a test installation on a scrap piece of material, equal in thickness to the production part, to determine the correct settings.When using a rivet squeezer, hold the lockbolt head square against the flush rivet set and the squeezer set over the collar. Operate the squeezer and swage the collar into the locking grooves of the stump lockbolt.

When using percussion riveter, if possible use straight rivet drive sets. In limited access areas use offset, double offset or goose neck drive sets. Before connecting the tool, check the air line connectors to ensure that they are free of contamination. Use a SD8858 aluminum faced flat bucking bar approximately one and a half times the weight of the rivet gun to support the head of the stump lockbolt. Hold the bar squarely and securely against the head of the stump lockbolt and position the rivet set, mounted in the riveting gun, squarely over the collar for swaging.

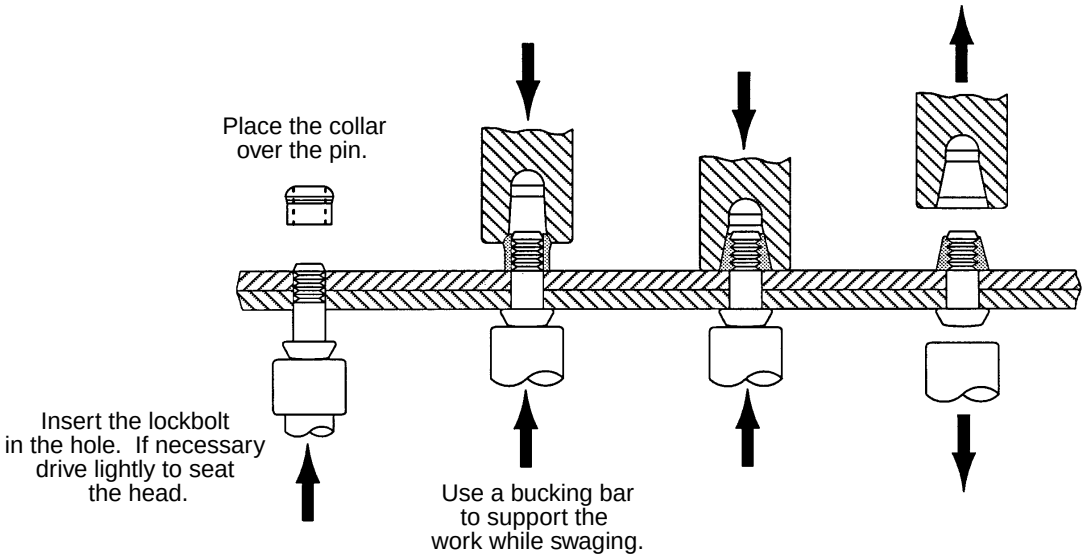


Figure 5 - Installation Sequence for Stump Type Lockbolts

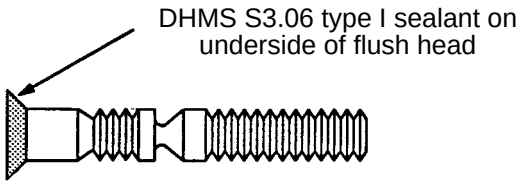
Table 7 - Stump Type Lockbolt Installation Tools

NOMINAL FASTENER DIAMETER	RIVET SQUEEZER COLLAR SQUEEZE SET		NOMINAL FASTENER DIAMETER	PERCUSSION RIVETING DRIVE SET		
	SHANK DIA.	TOOL NUMBER		DESCRIPTION	LENGTH	TOOL NUMBER
3/16"	0.312"	SMH245-6	3/16"	Straight	3 1/2"	SMH10-6
	0.375"	SMH265-6			5 1/2"	SMH11-6
1/4"	0.312"	SMH245-8		Offset	5 1/2"	SMH21-6
	0.375"	SMH265-8		Double Offset	5 1/2"	SMH130-6
5/16"	0.250"	SMH225-10		Gooseneck Insert	Gooseneck: 4 1/2"	SMH465-6
	0.312"	SMH245-10	1/4"	Offset	5 1/2"	SMH41-8
	0.375"	SMH265-10			5 1/2"	SMH81-8
				Double Offset	5 1/2"	AT118Kl8B
					7 1/2"	SMH131-8
				Gooseneck Insert	Gooseneck: 4 1/2"	SMH465-8
			5/16"	Straight	5 1/2"	SMH31-10
					5 1/2"	SMH71-10
				Offset	5 1/2"	SMH41-10
				Double Offset	5 1/2"	SMH137-10

SMH - Schaefer tool number; HS - Hi-Shear tool number; AT - ATI Industries tool number.

5.5.2 Install pull type lockbolts as follows. Under no circumstances remove the pin tail from a pull type lockbolt and swage the collar using a stump collar swaging tool. It is not possible to use the stump collar swaging tools to swage pull type collars nor can stump collars be used on pull type pins as the collar and pin locking grooves are dimensionally different. If it is not possible to insert a pull type lockbolt due to inaccessibility caused by the long pin tail, refer to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for resolution of the problem.

Step 1. If specified on the Engineering Drawing, apply a thin brush coat of DHMS S3.06 Type I sealant to the underside of flush head lockbolts as shown immediately before insertion into the prepared hole. Prepare DHMS S3.06 Type I sealant according to PPS 21.20.

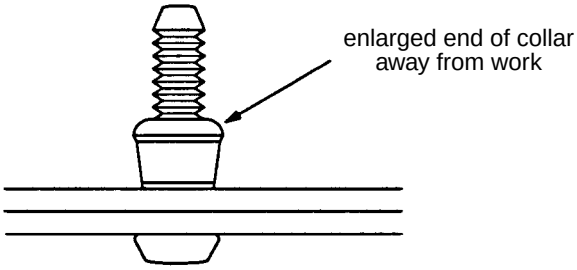


Step 2. Insert the lockbolt fully into the prepared and inspected hole so that the head is seated against the structure.

- Pins installed in transition fit holes can normally be fully seated using normal thumb pressure. Insertion may be aided by applying a light coating of cetyl alcohol lubricant to the shank of the lockbolt (ensure that the locking grooves remain free of lubricant).
- If possible, seat pins in interference fit holes using a model 352 or 353 gun fitted with a “HI-LO” pressure regulator and a self releasing straight nose assembly. It is not possible to use a pull gun to seat the lockbolt when an offset nose is required, as offset noses are not self-retracting or when the necessary pulling force is too high (max. interference or thick material gauge) and would result in breaking the pin tail off. For 352 or 353 guns, select “LO” on the “HI-LO” pressure regulator. Position the nose assembly over the pin tail (with no collar installed) and pull the trigger (the gun will apply the necessary force to depress the trip valve in order to release the pin tail).
- If it is not possible to use a pull gun to seat the pins, install lockbolt pins in interference fit holes by light driving with a rivet gun fitted with a flush rivet set for flush head lockbolts or a flush or cupped rivet set for protruding head lockbolts. Use a special rivet set (see paragraph •) in places where accessibility to the fastener head is restricted. If the driving force required to seat the pin is high (i.e., maximum interference or thick material gauge), use SD8853 -11 aluminum snap caps to prevent any damage to the lockbolt head and support the reverse side of the structure using SD8853 -3 or -5 aluminum faced support blocks (this is particularly important when inserting lockbolts into bonded structures as delamination may occur if the reverse side is not properly supported).

Step 3. Immediately before slipping the collar over the locking grooves of the pin, clean the locking grooves and pulling grooves by solvent according to PPS 31.17.

Step 4. Slip the collar over the locking grooves of the pin with the enlarged end of the collar away from the work as shown.

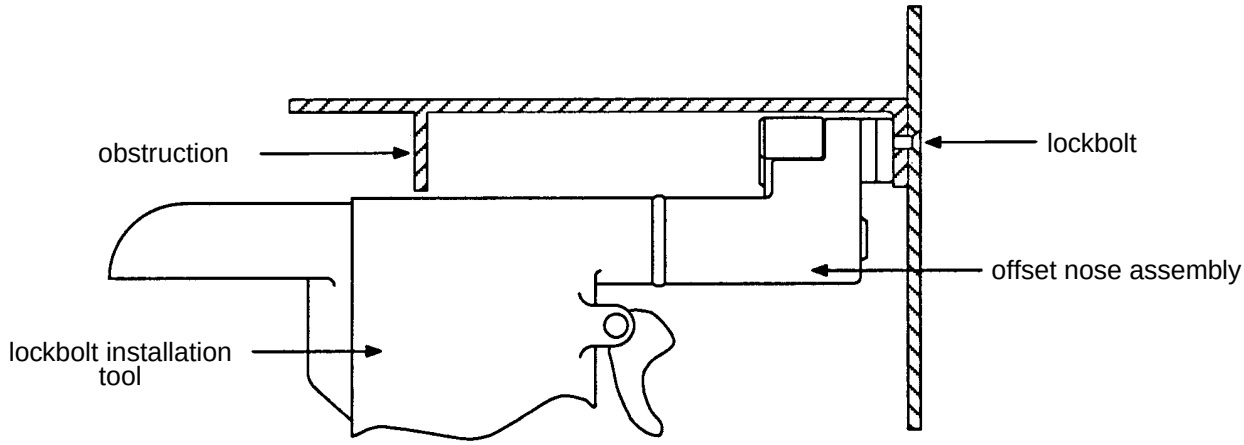


Step 5. Select the appropriate installation tool from Table 8. If using a model 352 or 353 gun fitted with a "HI-LO" pressure regulator, select "HI" on the "HI-LO" pressure regulator. Keep hose lines as short as possible; it is the operator's responsibility to see that a minimum number of air lines are connected to the same outlet. After connecting the installation tool, depress and release the trigger to check the gun action.If possible, use installation guns fitted with a pintail catcher (see paragraph 4.2.1).

Table 8 - Installation Tools for Pull Type Lockbolts

NOMINAL FASTENER DIAMETER	5/32"	3/16"	1/4"	5/16"	3/8"
HUCK INSTALLATION TOOL	352 or 353	352, 353 or 206	353 or 207	353 or 24800	24800

Step 6. Select the nose assembly according to the accessibility of the fastener. Use offset nose assemblies only if the fastener is inaccessible to straight nose assemblies as shown below. Use straight nose assemblies for all other installations.



Step 7. Position the nose assembly over the pin tail, holding the gun in alignment with the fastener.

Step 8. Pull the trigger and the gun will apply the necessary force to swage the collar and break off the pin tail. When using an offset nose assembly, remove the pin tail from the nose assembly immediately after swaging to prevent possible damage to the structure on the next installation

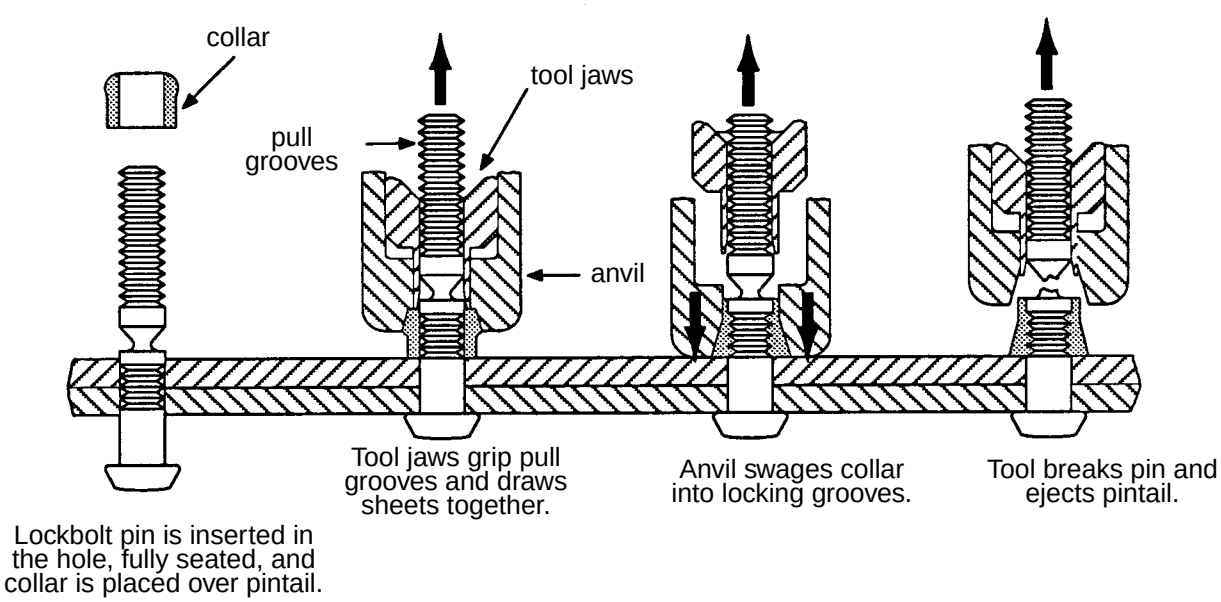
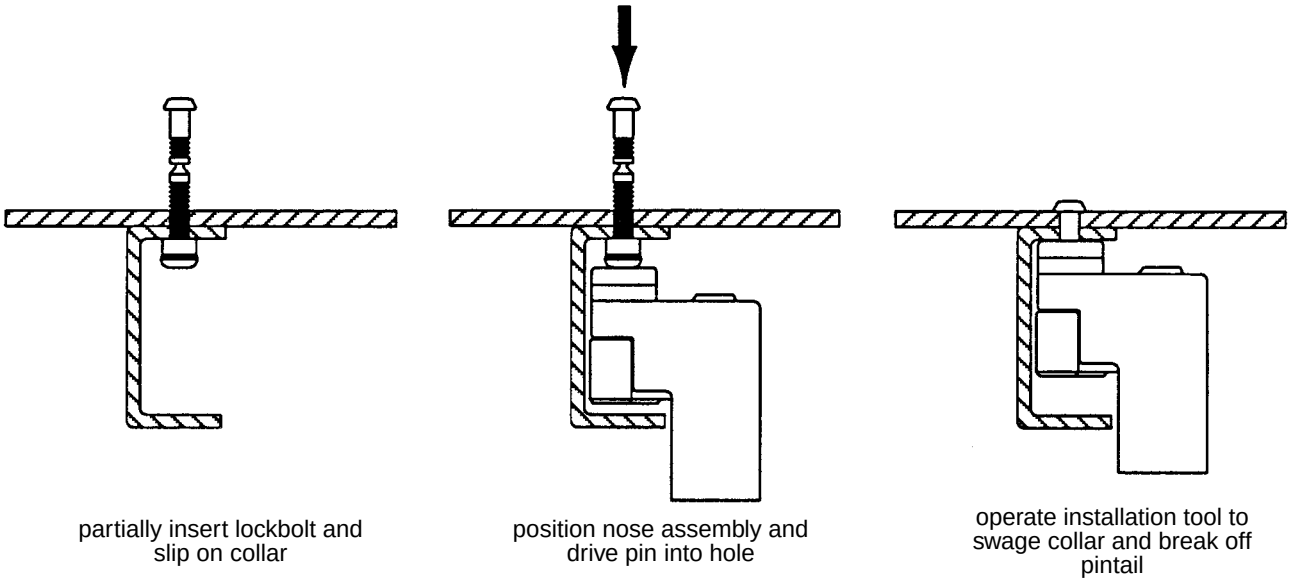


Figure 6 - Installation Sequence for Pull Type Lockbolts

5.5.2.1 If access to the pin tail is limited, it is acceptable to partially insert the lockbolt into the hole, slip on the collar, position the nose assembly over the end of the pin tail and then pull the pin into the hole and swage the collar as shown below.



5.6 Installation of Oversize Lockbolts

5.6.1 Only if authorized in writing by Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB, slightly oversize holes may be salvaged by installation of oversize lockbolts. Use the same grip number and collar size as would be used for the standard size lockbolt.

5.6.2 For oversize lockbolts the final hole limits specified apply if interference or transition fit is specified for the standard size lockbolt. Open the fastener hole to the final size specified in Table 9 according to PPS 1.09. The countersink diameter requirements for oversize lockbolts are the same as those for standard size lockbolts.

5.6.3 Install oversize lockbolts in the same manner and using the same tools as standard size lockbolts.

Table 9 - Final Hole Limits for Oversize Lockbolts

1/64" OVERSIZE LOCKBOLT (NOTE 1)	ORIGINAL NOMINAL LOCKBOLT DIAMETER	RECOMMENDED DRILL/REAMER	FINAL HOLE LIMITS (NOTE 2)
All NAS R3104 R3105	-6 (3/16")	0.1995"	0.1990" - 0.2010"
	-8 (1/4")	0.2620"	0.2615" - 0.2635"
	-10 (5/16")	0.3245"	0.3240" - 0.3260"
	-12 (3/8")	0.3865"	0.3860" - 0.3880"
R3007 R3008 R3020 OAL509	-6 (3/16")	0.2010"	0.2005" - 0.2025"
	-8 (1/4")	0.2600"	0.2595" - 0.2615"
	-10 (5/16")	0.3230"	0.3225" - 0.3245"
	-12 (3/8")	0.3840"	0.3835" - 0.3855"

Note 1. Take special care when determining the required hole diameter for the particular oversize lockbolt specified by Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB. For example, if the engineering drawing specified installation of an NAS 1456 lockbolt but the hole for that lockbolt was found to be oversize, Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB may specify use of either a R3008-6 or a NAS1456-**A oversize lockbolt but the shank diameters of these two lockbolts are different, and therefore require a different final hole size.

Note 2. For oversize lockbolts, the final hole limits specified in this table apply if interference or transition fit is specified for the standard size lockbolt.

5.7 Post Installation Procedure

5.7.1 After swaging the collar, remove excess sealant from the lockbolt and surrounding area by solvent wiping according to PPS 31.17.

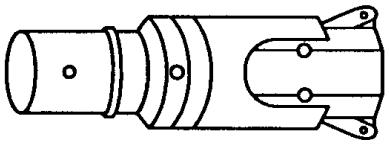
5.7.2 Except as noted, brush touch-up broken pin ends of pull type lockbolts with F19 epoxy Type 2 epoxy-polyamide primer according to PPS 34.08. In fuel tank areas, touch up broken pin ends of pull type lockbolts according to PPS 21.03. For titanium alloy lockbolts, touch up of broken pin ends is not required.

5.8 Lockbolt Removal

5.8.1 If removal of an installed lockbolt is required, remove the lockbolt as follows:

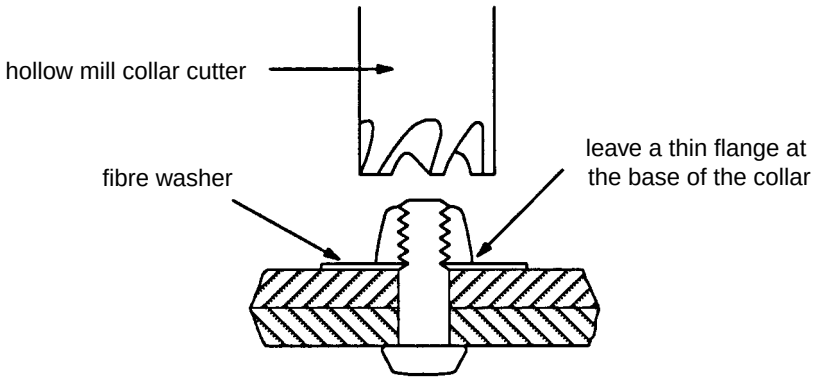
Step 1. Remove the lockbolt collar using one of the following methods. Refer to Table 10 for a listing of collar removal tools.

- Split the collar using a blade-type collar splitter. This is the preferred method of collar removal.

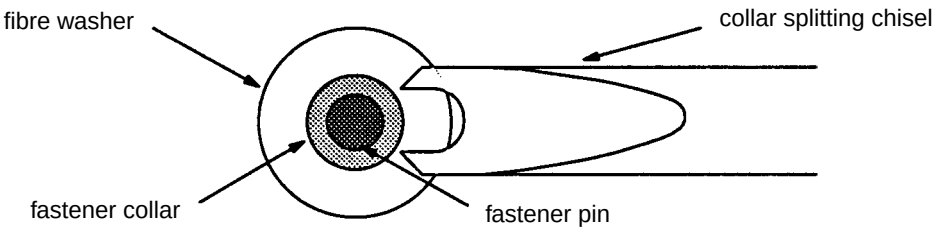


Collar Splitter

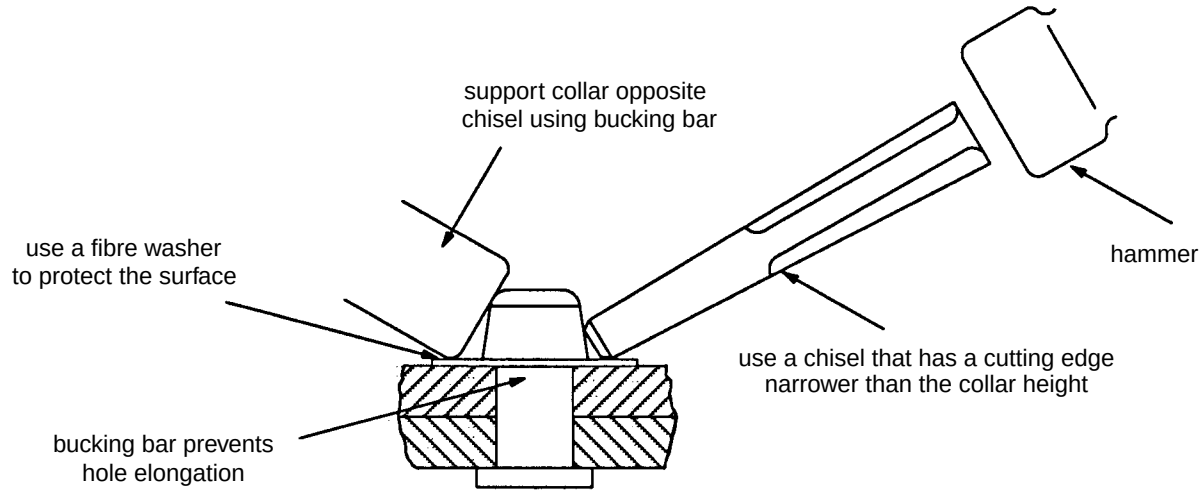
- Protect the surface of the work using a suitable fibre washer, mount a hollow mill collar cutter in a slow speed drillmotor and cut away the collar leaving only a thin flange at the base (to prevent damage to the work) as shown below.



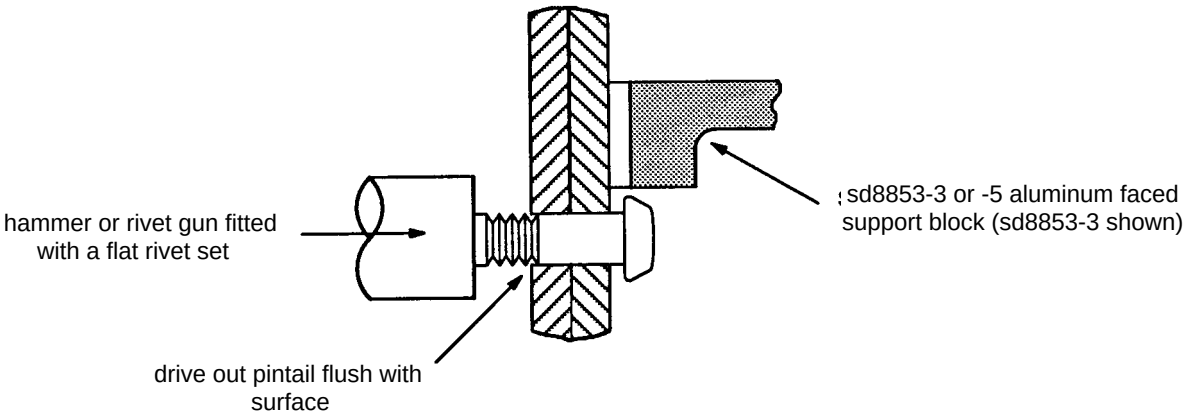
- Protect the surface of the work using a suitable fibre washer, insert a collar splitting chisel into a suitable rivet gun and push the chisel, with the slot approximately centred, firmly against the collar, operate the gun briefly and split the collar.



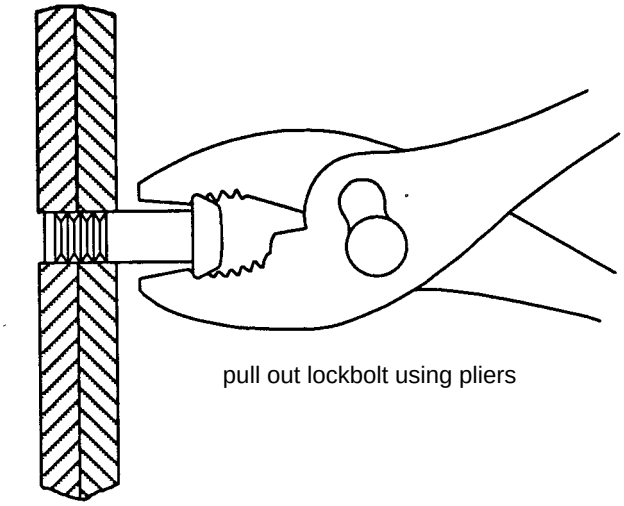
- If none of the other methods are possible, protect the surface of the work using a suitable large diameter fibre washer or a piece of aluminum sheet with a hole drilled equal to the size of the collar (it is acceptable to use masking tape to hold the washer in place) and use a hammer and chisel to crack the collar at opposite points to split it open. Support the collar on the side opposite the chisel with a bucking bar to prevent elongation of the hole.



Step 2. Using a suitable hammer or rivet gun fitted with a flat rivet set, drive out the lockbolt until the end of the pin is nearly flush with the end of the surface of the structure. Support the structure around the lockbolt head using a SD8853 -3 or -5 aluminum faced support block while driving out the fastener as shown below.

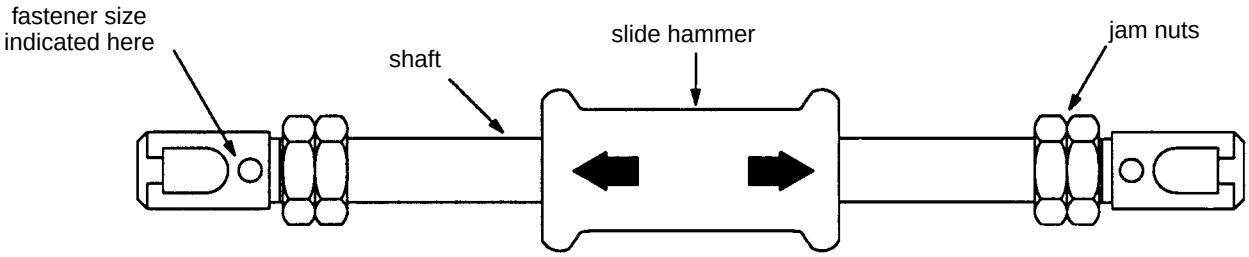


Step 3. Pull the lockbolt out of the hole using a suitable pair of pliers as shown below. If it is not possible to pull the fastener from the hole using pliers, use a SD8865 fastener extraction tool (see Table 10). Do not use a punch to drive out the fastener as damage to the hole may result.



pull out lockbolt using pliers

Note: Do not use a punch to drive out the fastener as damage to the hole may result.



use a series of light strokes to remove the fastener

Table 10 - Lockbolt Removal Tools

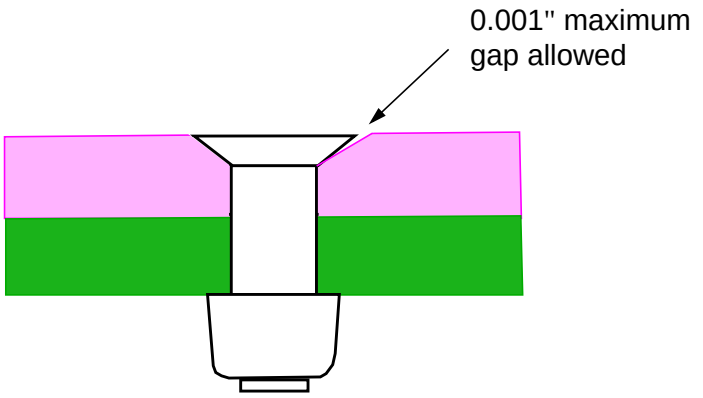
NOMINAL LOCKBOLT PIN DIAMETER	BLADE TYPE COLLAR SPLITTER HUCK #105	HOLLOW MILL COLLAR CUTTER HS92000	COLLAR SPLITTING CHISELS SD8225	STANDARD CHISEL	SD8865 PIN EXTRACTION TOOLS
-5 (5/32")	-5	not available	not available	0.125”	-4
-6 (3/16")	-6	-6	-1	0.125”	-6
-8 (1/4")	-8	-8	-2	0.165”	-8
-10 (5/16")	-10	-10	-3	0.200”	-10
-12 (3/8")	-12	-12	-4	0.250”	-12

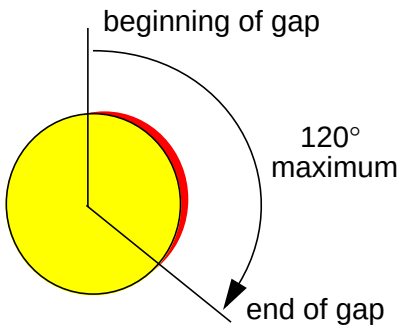
6 Requirements

6.1 Installed lockbolts must meet the following requirements:

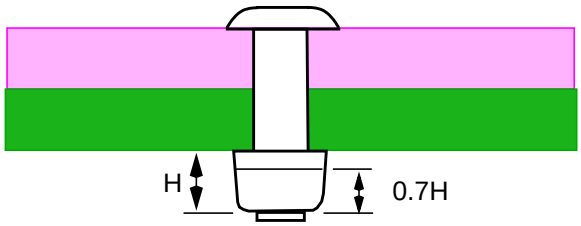
6.1.1 For **stump type** lockbolts, the lockbolt installation is not acceptable if the any of the locking ridges are visible at the top of the collar (excessive pin protrusion) or if the end of the pin is below flush with the top of the collar (insufficient pin protrusion).

6.1.2 For **flush head** lockbolts, any gap under the head must be no more than 0.001", the gap must not extend to the shank of the lockbolt and the bearing surface must extend at least 240° around the circumference of the fastener head. Therefore, if it is possible to insert the edge of a 0.002" feeler gauge into a gap, the gap extends to the shank or if the visible gap extends more than 120°, the lockbolt must be replaced and the countersink diameter checked.



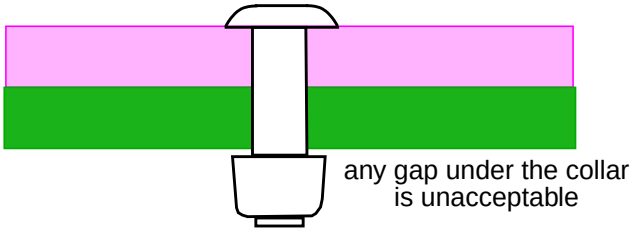


6.1.3 For **pull type** lockbolts with shear pins (Group II), the upper swaged section of the collar must be equal to at least 70% of the swaged collar height as shown below.

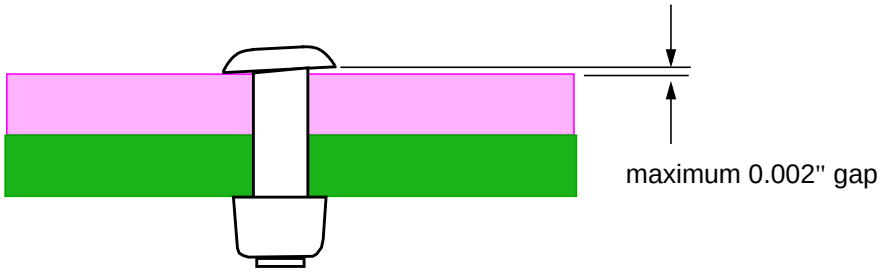


6.1.4 There shall be no visible cracks in swaged collars.

6.1.5 Sheets must be drawn up tightly. The installation is unacceptable if there is any gap under the collar.

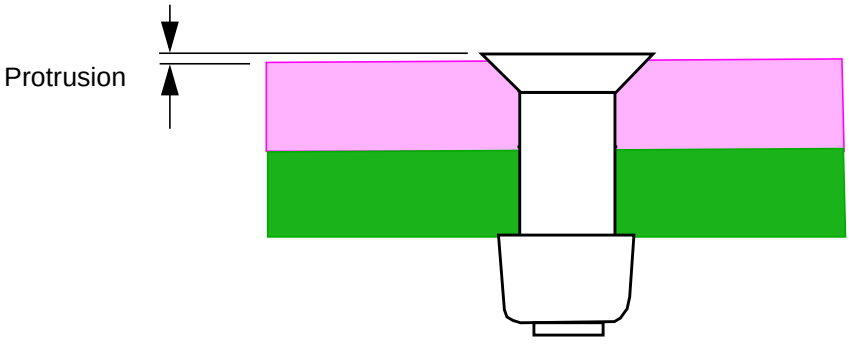


6.1.6 If the gap under a **protruding head** exceeds 0.002" (as shown below) or extends to the shank of the lockbolt, the fastener must be replaced.



6.1.7 For **flush head** lockbolts, the head protrusion must meet the following limits.

- **Pull type** lockbolts: 0.010” above or below flush with surrounding structure.
- **Stump type** lockbolts installed using standard equipment: 0.0005” to 0.010” above flush
- **Stump type** lockbolts installed using automatic equipment with the anvil used to seat the lockbolt head smaller in diameter than the head of the lockbolt: 0.005” below flush to 0.010” above flush.



6.2 Check all installed lockbolts for correct pin length and complete collar swage using the gauge listed in Table 11. To check collars installed on tapered sheet, use the pin position and swage gauge in plane A-A, as shown. Suffix letters on Huck gauge dash numbers are for Huck Manufacturing Company use only and have no bearing on the use of the gauge. Gauge numbers may be preceded by the Huck Manufacturing Company's code "HG" or by the NAS number (e.g., NAS1563); either gauge is acceptable. Refer to Flow Charts 1 through 4 for the use and requirements of pin position and swage gauges.

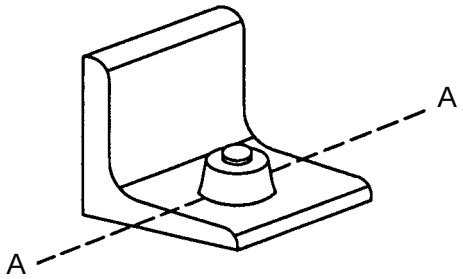


Table 11 - Lockbolt Pin Position and Swage Gauges

LOCKBOLT				PIN POSITION & SWAGE GAUGE
PART NUMBER	**NOMINAL DIAMETER**	**DESCRIPTION**	**HEAD MARK**	
NAS1436	3/16"	Group II, shear pin, pull type, 100 flush head, alloy steel	depressed "H"	76-1
NAS1438	1/4"			76-2
NAS1440	5/16"			76-3
NAS1442	3/8"			76-4
NAS1446	3/16"	Group II, shear pin, pull type, protruding head, alloy steel	depressed "H"	76-1
NAS1448	1/4"			76-2
NAS1450	5/16"			76-3
NAS1452	3/8"			76-4
NAS1456	3/16"	Group I, tension pin, pull type, MS24694 (AN509) flush head, alloy steel	depressed dash	85-10
NAS1458	1/4"			85-2
NAS1460	5/16"			85-8
NAS1462	3/8"			85-9
NAS1465	5/32"	Group I, tension pin, pull type protruding head, alloy steel	depressed dash	85-12
NAS1466	3/16"			85-10
NAS1468	1/4"			85-2
NAS1470	5/16"			85-8
NAS1472	3/8"			85-9
NAS1475	5/32"	Group I, tension pin, pull type, MS20426 (AN426) flush head, alloy steel	two depressed dashes	85-12
NAS1476	3/16"			85-10
NAS1478	1/4"			85-2
NAS1480	5/16"			85-8
NAS1482	3/8"			85-9

Table 11 - Lockbolt Pin Position and Swage Gauges

LOCKBOLT				PIN POSITION & SWAGE GAUGE
PART NUMBER	NOMINAL DIAMETER	DESCRIPTION	HEAD MARK	
NAS1486	3/16"	Group I, tension pin, stump type, MS24694 (AN509) flush head, alloy steel	depressed dash	34D-2
NAS1488	1/4"			34D-4
NAS1490	5/16"			34D-6
NAS1492	3/8"			34D-8
NAS1496	3/16"	Group I, tension pin, stump type, protruding head, alloy steel	depressed dash	34D-2
NAS1498	1/4"			34D-4
NAS1500	5/16"			34D-6
NAS1502	3/8"			34D-8
NAS1516	3/16"	Group I, tension pin, pull type, MS24694 (AN509) flush head, 7075-T6 aluminum alloy	three raised or depressed dots	85-10
NAS1518	1/4"			85-2
NAS1520	5/16"			85-3
NAS1522	3/8"			85-4
NAS1525	5/32"	Group I, tension pin, pull type, protruding head, 7075-T6 aluminum alloy	two raised or depressed dots	85-7
NAS1526	3/16"			85-10
NAS1528	1/4"			85-2
NAS1530	5/16"			85-3
NAS1532	3/8"			85-4
NAS1535	5/32"	Group I, tension pin, pull type, MS20426 (AN426) flush head, 7075-T6 aluminum alloy	two raised or depressed dots	85-7
NAS1536	3/16"			85-10
NAS1538	1/4"			85-2
NAS1540	5/16"			85-3
NAS1542	3/8"			85-4
NAS2005	5/32"	Group I, tension pin, pull type, protruding head, 6AL-4V titanium alloy	2005V	85-12
NAS2006	3/16"		2006V	85-10
NAS2008	1/4"		2008V	85-18
NAS2010	5/16"		2010V	85-8
NAS2012	3/8"		2012V	85-9
NAS2105	5/32"	Group I, tension pin, pull type, MS24694 (AN509) flush head, 6AL-4V Titanium alloy	2105V	85-12
NAS2106	3/16"		2106V	85-10
NAS2108	1/4"		2108V	85-18
NAS2110	5/16"		2110V	85-8
NAS2112	3/8"		2112V	85-9

Table 11 - Lockbolt Pin Position and Swage Gauges

LOCKBOLT				PIN POSITION & SWAGE GAUGE
PART NUMBER	NOMINAL DIAMETER	DESCRIPTION	HEAD MARK	
NAS2406	3/16"	Group II, shear pin, pull type, protruding head, 6AL-4V titanium alloy	2406V	76-1
NAS2408	1/4"		2408V	76-2
NAS2410	5/16"		2410V	76-3
NAS2412	3/8"		2412V	76-4
2L509YDT8	1/4"	Group I, tension pin, pull type, MS24694 (AN509) flush head, alloy steel	depressed dash	85-2
2LPYDT8	1/4"	Group I, tension pin, pull type protruding head, alloy steel	depressed dash	85-2

7 Safety Precautions

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

7.2 If possible, use pull type lockbolt installation guns fitted with pintail catchers.

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

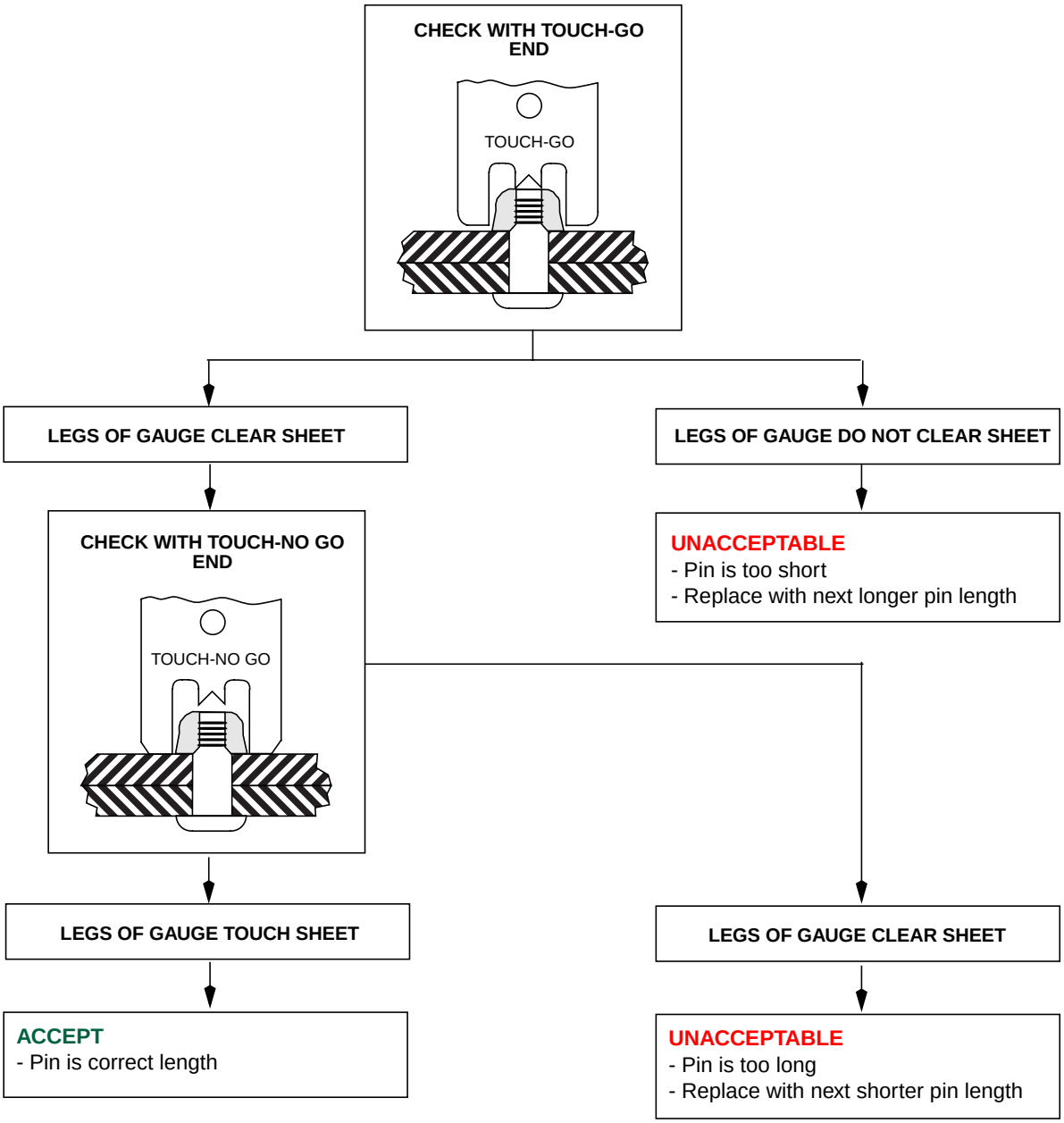
9.1 Keep installation tools clean and dry with moving parts lightly oiled or greased. It is recommended to inject a few drops of light machine oil daily into the air inlet of the pneumatic tools. Periodically check nose piece chuck jaws and clean the jaw grooves thoroughly. Check installation tools periodically for damaged or badly worn parts; replace such parts when detected. Do not alter or rework installation tools or accessories without appropriate authorization.

10 Special Points to Note

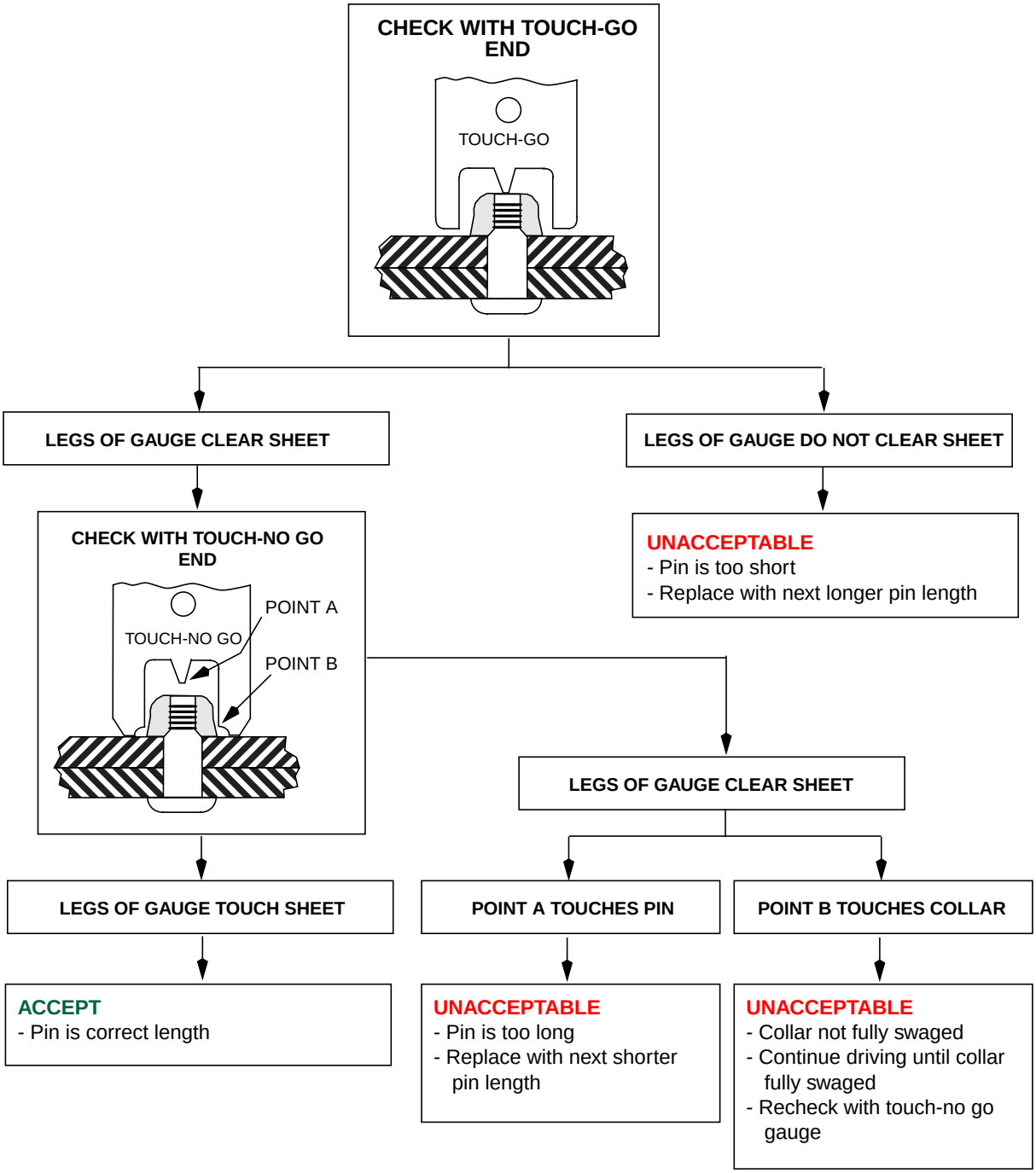
10.1 Each pin tail must be removed from offset nose assemblies immediately after swaging to avoid possible damage on the next installation.

10.2 When using straight nose assemblies, ensure that the rubber pin tail deflector is properly fitted on the rear of the gun to avoid the ejected pin tails causing personal injury or damage to structures.

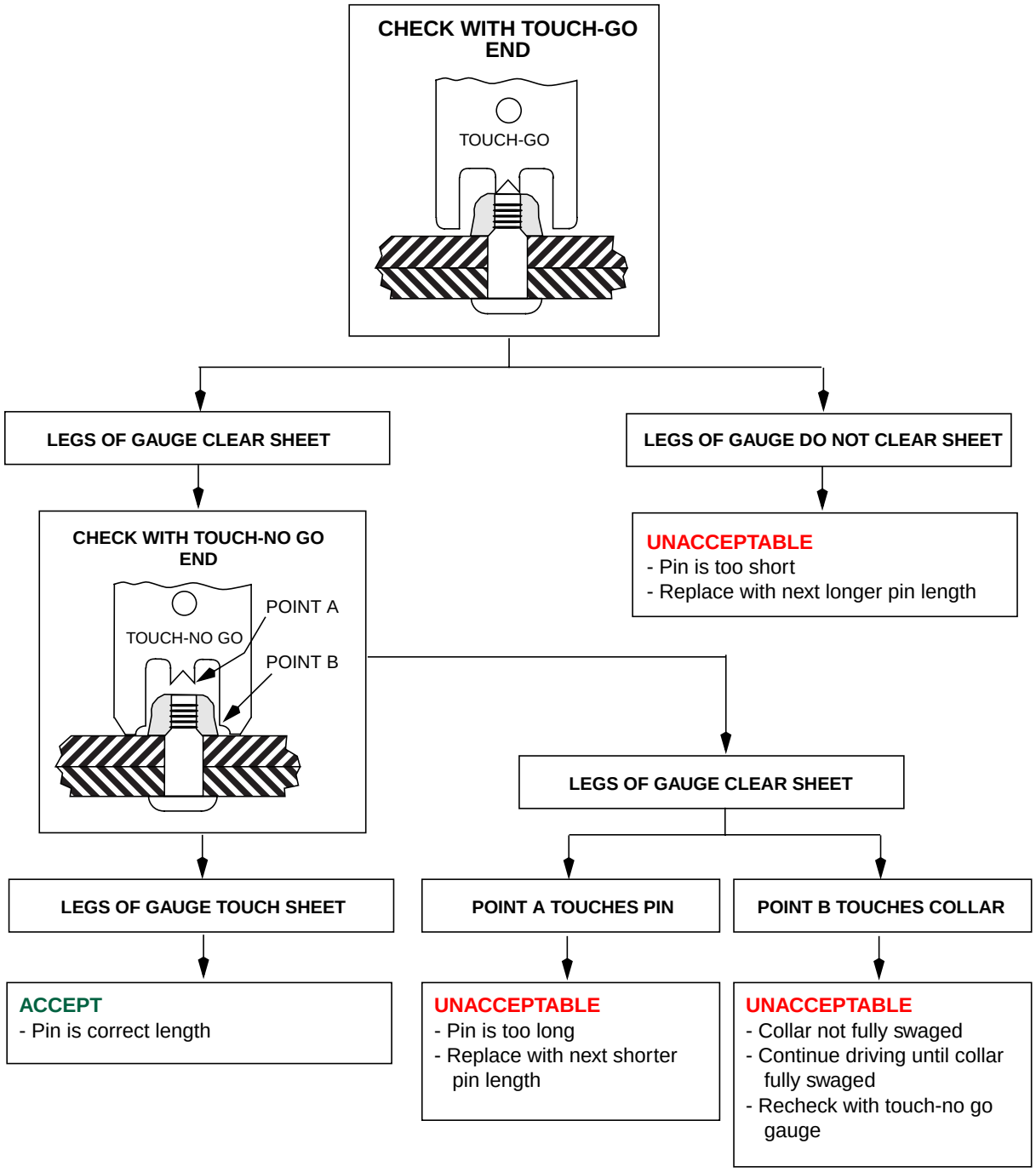
Flow Chart 1 - How to use a #76-X Pin Position & Swage Gauge



Flow Chart 2 - How to use a #34D-X Pin Position & Swage Gauge



Flow Chart 3 - How to use a #85-X (except #85-10) Pin Position & Swage Gauge



Flow Chart 4 - How to use a #85-10 Pin Position & Swage Gauged