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BOMBARDIER
Toronto Site
PROPRIETARY INFORMATION

PPS 2.65

PRODUCTION PROCESS STANDARD

SALVAGE OF OVERSIZE HOLES USING ACRES SLEEVES

Issue 9
- This standard supersedes PPS 2.65, Issue 8.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS related questions to michael.wright@aero.bombardier.com or (416) 375-4365.
- This PPS is effective as of the distribution date.

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for salvage of oversize holes using ACRES sleeves. ACRES sleeves may only be used for salvage of oversize holes if specified, in writing, by Bombardier (Toronto Site) MRB or Bombardier Aerospace delegated MRB.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction. The procedure specified in this PPS must be followed to ensure compliance with all applicable specifications. In general, if this PPS conflicts with the engineering drawing, follow the engineering drawing. The requirements specified in this PPS are necessary to fulfil the engineering design and reliability objectives.

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

1.1.3 Procedure or requirements specified in a Bombardier BAPS, MPS, LES or P. Spec. **do not** supersede the procedure or requirements specified in this PPS.

2 Hazardous Materials

2.1 Before receipt at Bombardier (Toronto Site), all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier (Toronto Site) Environment, Health and Safety Department. Refer to the manufacturer's MSDS for specific safety data on any of the materials specified in this PPS. If the MSDS is not available, contact the Bombardier (Toronto Site) Environment, Health and Safety Department.

3 References

3.1 General

3.1.1 Unless a specific issue is indicated, the issue of the reference documents specified in this section in effect at the time of manufacture shall form a part of this specification to the extent indicated herein.

3.2 Bombardier (Toronto Site) Specifications

3.2.1 PPS 1.09 - Drilling and Reaming.

3.2.2 PPS 1.33 - Countersinking for Flush Heat Fasteners.

3.2.3 PPS 2.03 - Installation of Hi-Shear Rivets.

3.2.4 PPS 2.16 - Installation of Lockbolt Fasteners.

3.2.5 PPS 2.20 - Installation of Bolts and Screws.

3.2.6 PPS 2.35 - Installation of BACB Titanium Lockbolts.

3.2.7 PPS 2.67 - Installation of Hi-Lok/Hi-Tigue Fasteners.

3.2.8 PPS 13.26 - General Subcontractor Provisions.

3.2.9 PPS 21.20 - Mixing and Handling of Two Part Sealants.

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 ACRES sleeves as specified in Table 2. Refer to Figure 1 for general description of ACRES sleeves and to Figure 2 for a breakdown of ACRES sleeves part numbers.

4.1.3 Sealing compound DHMS S3.06, Type I, Class C-80 supersedes PR-1431-G Type II. However, PR-1431-G Type II sealant may be used to depletion of stock.

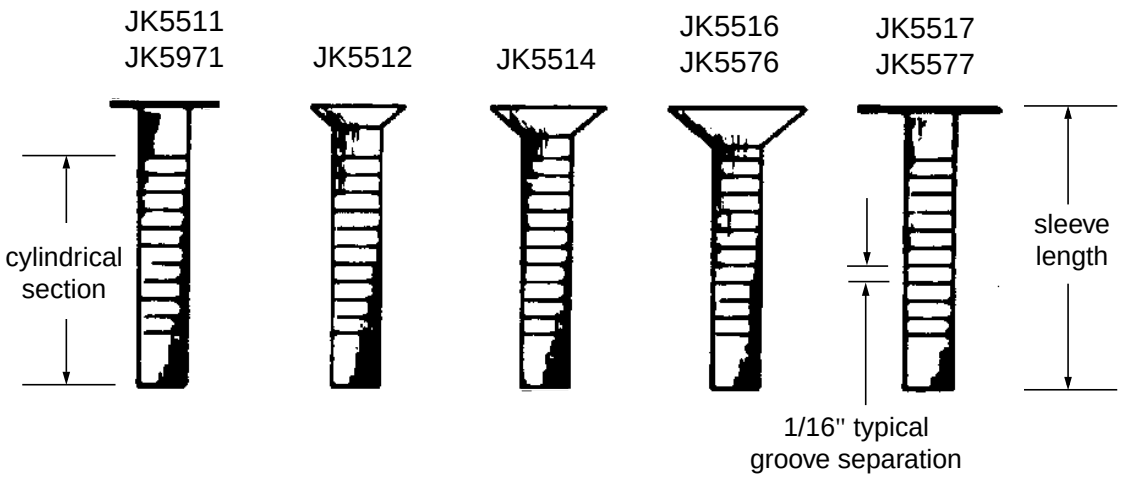
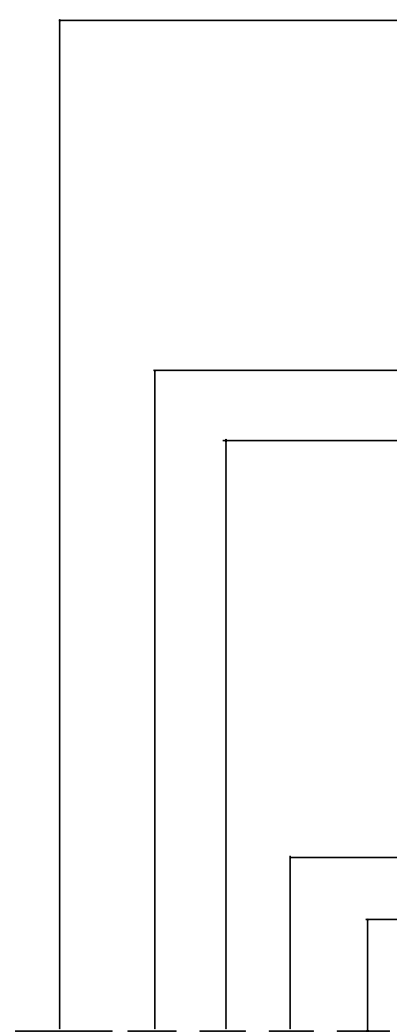


Figure 1 - General Description of ACRES Sleeves



Basic ACRES Sleeve Part Number

JK5511 - 1/64" O/S Protruding Head, Shear Type
JK5512 - 1/64" O/S 100° Flush Head, Shear Type
JK5514 - 1/64" O/S, AN426/MS20426 100° Flush Head, Tension Type
JK5516 - 1/64" O/S, AN509/MS24694 100° Flush Head, Tension Type
JK5517 - 1/64" O/S, Protruding Head, Tension Type
JK5576 - 1/32" O/S, AN509/MS24694 100° Flush Head, Tension Type
JK5577 - 1/32" O/S, Protruding Head, Shear Type
JK5971 - 1/32" O/S Clearance, Protruding Head, Shear Type

Material: C - A286 Corrosion Resistant Steel

Diameter Code

Code	Sleeve Inside Diameter (-0.0000" / + 0.0015")	
	1/64" and 1/32" Sleeves	1/32" Clearance Sleeves
05	0.1550"	---
55	0.1620"	---
06	0.1880"	---
08	0.2480"	0.2530"
10	0.3105"	---
12	0.3730"	---

Finish: P- Cadmium Plating, N - None

Sleeve Length, Stock, in 16^{ths} of an inch (Note 1)

Code	Length	Remarks
12	3/4"	for sleeve size 05 and 5
16	1"	for sleeve size 06 and UP

Note 1. To obtain the required length for installation, refer to section 5.5.

Figure 2 - ACRES Sleeve Part Number Breakdown

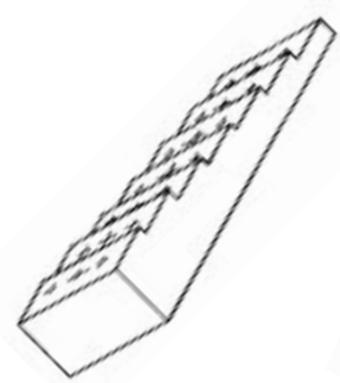
4.2 Equipment

4.2.1 ACRES sleeve preparation, installation and removal tools (e.g., as shown in Figure 2).

Double Margin Drill
TS.561.11.16

Depth Gauge
TS.465.10.12

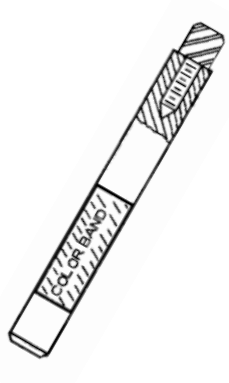
Break Off Tool
TS.465.10.13



Step Plate
TS.465.10.13

Flush Head
Installation Tool
TS.465.10.14

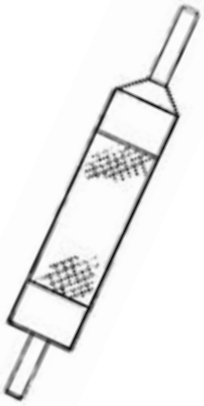
Protruding Head
Installation Tool
TS.465.10.15



Removal Tool
TS.465.10.16

Hook Removal Tool
TS.465.10.17
MK 1

Wedge Removal Tool
TS.465.10.17
MK 2



Combination Tool
TS.465.10.18

Figure 3 - TS.465.10.10 Tool Kit Contents

5 Procedure

5.1 General

5.1.1 ACRES sleeves are used for the repair of holes (tapered, bellmouth, elongated, etc.) for Hi-Lok fasteners, Hi-Shear rivets, threaded bolts and lockbolts. Use ACRES sleeves only as directed by Liaison Engineering. The 1/64" oversize sleeves are used to repair holes that are oversize by up to 1/64" and the 1/32" oversize sleeves are used to repair holes that are oversize by up to 1/32".

5.1.2 The oversize hole is drilled to approximately 1/64" or 1/32" larger (depending on the oversize sleeve used, see Table 1) than the required original fastener hole diameter and a sleeve is installed to allow the installation of the standard fastener. The fit of the fastener (degree of clearance) may not match the original fit specified in the fastener PPS.

Table 1 - Tool Kit Selection

FASTENER SIZE			SLEEVE DIAMETER CODE	TOOL KIT		FINAL HOLE LIMITS
LOCKBOLT OR HI-LOK	HI-SHEAR RIVET	THREADED BOLT		TS.465.10.10 MK NUMBER	COLOUR CODE	
1/64" O/S SLEEVES						
---	5/32"	---	05	MK 1	Dark Green	0.171" - 0.173"
5/32"	---	# 8	55	MK 2	Yellow	0.178" - 0.180"
3/16"	3/16"	# 10	06	MK 3	Red	0.203" - 0.205"
1/4"	1/4"	1/4"	08	MK 4	Light Green	0.263" - 0.265"
5/16"	5/16"	5/16"	10	MK 5	Grey	0.326" - 0.328"
3/8"	3/8"	3/8"	12	MK6	White	0.388" - 0.390"
1/32" O/S SLEEVES						
3/16"	---	# 10	06	MK 7	Red/Orange	0.219" - 0.221"
1/32" O/S CLEARANCE FIT SLEEVES						
1/4"	---	1/4"	08	MK 8	Light Green/ Orange/ Blue	0.289" - 0.291"

5.2 Selection of Tools

5.2.1 Refer to Table 1 to select the correct tool kit for the fastener and sleeve size to be installed. The tool kits contain all the necessary tools for preparation of the work, preparation of the sleeves, installation of the sleeves and for sleeve removal, if necessary. Tool kits are colour coded according to the sleeve size. Refer to Figure 3 for a detailed description of the tool kit contents.

5.3 Hole Preparation

5.3.1 Carry out final drilling using a double margin drill, as specified in Table 1. Perform drilling of holes according to PPS 1.09.

5.3.2 For protruding head installations, break the edge of the hole on the side which the fastener head bears using a 60° to 80° countersink (see Figure 4) after drilling. Do not break the edge of the hole on the side opposite the fastener head.

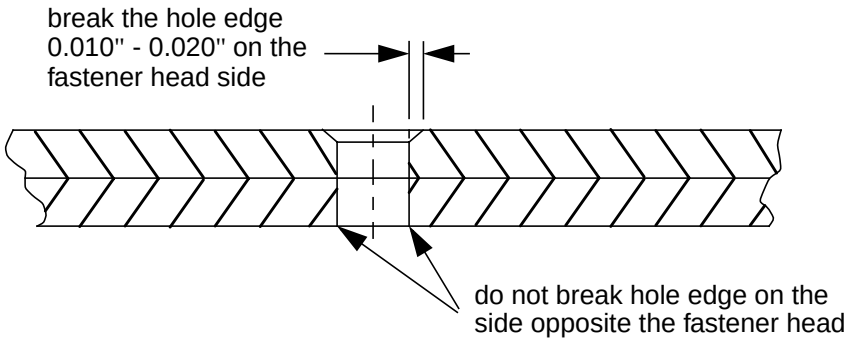


Figure 4 - Hole Edge Breaking

5.3.3 If Liaison Engineering specifies an increase in the countersink diameter for flush head fasteners, increase the countersink diameter to the following dimensions according to PPS 1.33:

- For 1/64" oversize sleeves, increase the countersink diameter by 0.025".
- For 1/32" oversize sleeves, increase the countersink diameter by 0.050".

5.4 Selection of ACRES Sleeves

5.4.1 Use the type and diameter of sleeve as specified in Table 2.

5.4.2 At Bombardier (Toronto Site), only one length of sleeve for each diameter is stocked. Adjust the sleeves to the required length according to section 5.5.

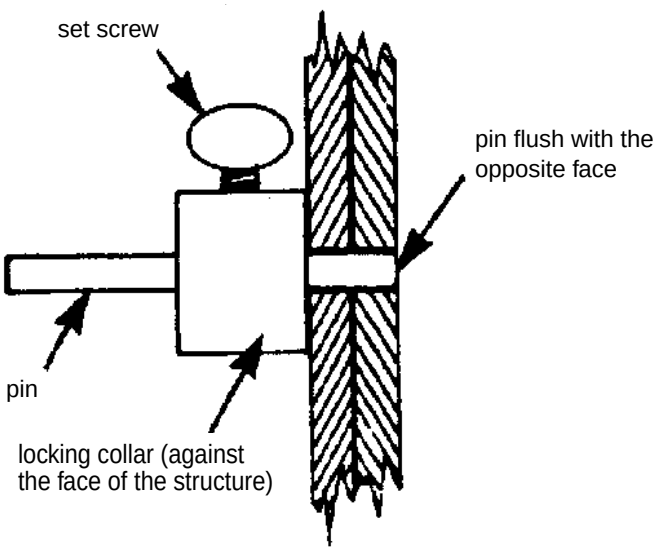
Table 2 - ACRES Sleeve Selection

FASTENER TYPE HEAD STYLE	FASTENER				ACRES SLEEVE PART NUMBER		
	HI-LOK	HI-SHEAR RIVET	LOCKBOLT	THREADED BOLT	1/64" O/S	1/32" O/S	1/32" O/S CLEAR.
shear type, 100° flush head	HL329 HL11V	NAS525 (HS51P) HS23	B0206042A, NAS1436 to NAS1442	Bolts with reduced head as per PPS 2.20	JK5512	---	---
tension type, AN426/MS20426 100° flush head	HL325	---	NAS1475 to NAS1482 & NAS1535 to NAS1542	---	JK5514	---	---
tension type, AN509/MS24694 100° flush head	HL327	---	NAS1456 to NAS1462, NAS1486 to NAS1492, NAS1516 to NAS1522 & NAS2105 to NAS2112	All standard full head bolts as per PPS 2.20	JK5516	JK5576	---
shear type, protruding head	HL328 HL10V	NAS529 (HS52P) HS26	B0206041A, NAS1446 to NAS1452 & NAS2406 to NAS2412	Bolts with small heads or washer faces	JK5511	---	JK5971
tension type, protruding head	HL326	---	NAS1465 to NAS1472, NAS1496 to NAS1502, NAS1525 to NAS1532 & NAS2005 to NAS2012	Bolts with large heads or washer faces	JK5517	JK5577	---

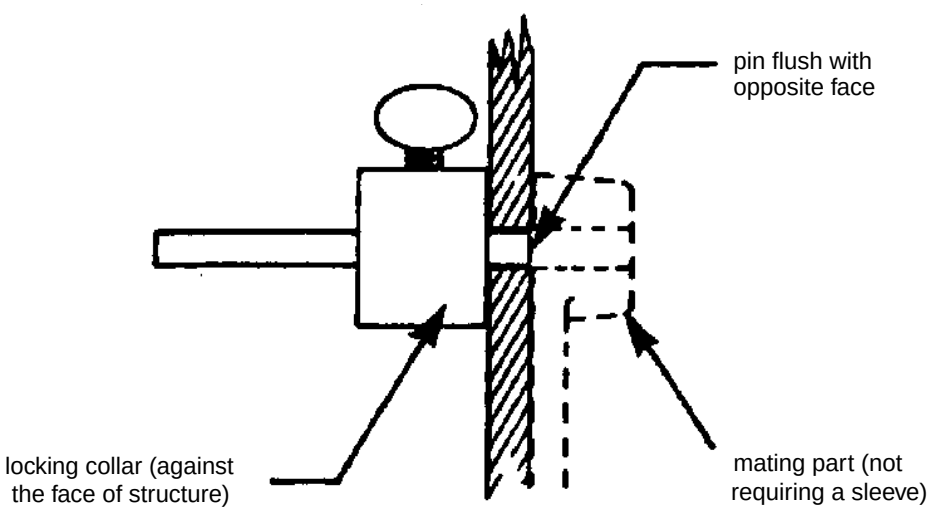
5.5 Preparation of ACRES Sleeves

5.5.1 For standard through holes, adjust the sleeve length so that the end of the sleeve opposite the fastener head is 0.000" - 0.062" above flush, when installed. For installations such as barrel nut bolt holes or holes in a single sheet of a multi-sheet assembly (i.e., where a protruding sleeve would interfere), adjust the sleeve length so that the end of the sleeve opposite the fastener head is flush to 0.031" below flush when installed.

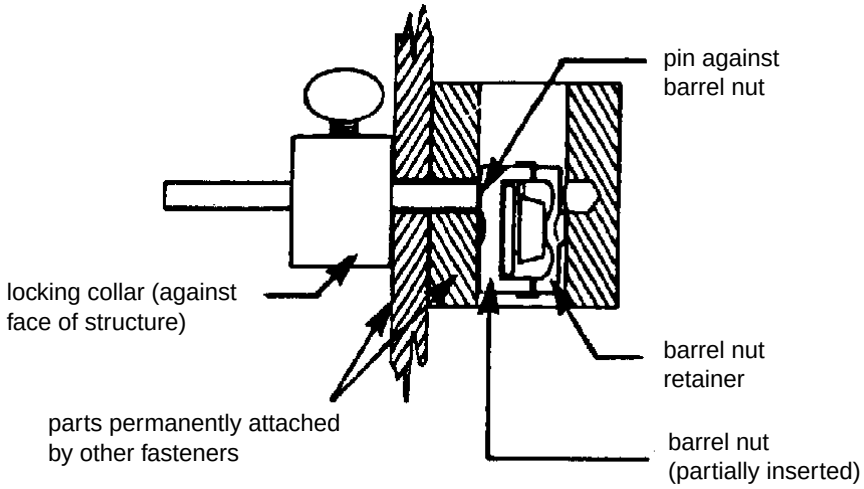
5.5.2 On standard holes, set the depth gauge to the material thickness by setting the pin flush with the opposite face of the structure, sliding the locking collar against the near face and then tightening the set screw as shown below:



5.5.3 For holes in one sheet of multiple sheet installations, set the depth gauge to the material thickness by setting the pin flush with the opposite face of the sheet, sliding the locking collar against the near face and then tightening the set screw as shown below:



5.5.4 On barrel nut bolt holes, set the depth gauge to the material thickness by partially installing a barrel nut, inserting the pin into the hole until it contacts the barrel nut, sliding the locking collar against the surface of the structure and then tightening the set screw as shown below:



5.5.5 If the required sleeve length is less than the stock length of the sleeve, break off or grind the sleeve to the required length using the step plate as follows.

Step 1. If a sleeve is to be used without a head (i.e. cylindrical portion only), break off the head first using the first (lowest) step of the step plate.

Step 2. For standard holes, select the step which will break off the sleeve 0.000" - 0.062" longer than the pin of the depth gauge. For other holes, select the step which will break off the sleeve 0.000" - 0.031" shorter than the pin of the depth gauge.

Step 3. Insert the sleeve into the applicable hole in the selected step. Each step has three holes: one for protruding head sleeves (no countersink), one for tension type (AN509) flush head sleeves (large countersink) and one for shear type flush head sleeves (small countersink). For AN426 (MS20426) flush head sleeves, use the hole for shear type sleeves (small countersink) For headless sleeves, use the hole for protruding head sleeves (no countersink).

Step 4. Using the break-off tool as shown in Figure 5, break off the excess sleeve. Push the sleeve out using the opposite end of the break-off tool. If the sleeve is slightly too long or the break-off method is not practical (i.e. the sleeve deforms rather than breaking off), grind the sleeve to the correct length using a belt sander. Hold the sleeve in the step tool and grind to the required length. When grinding, avoid overheating the sleeve which can burn the cadmium plating. After grinding, remove burrs as necessary.

Step 5. Check for correct sleeve length by placing the sleeve on the depth gauge pin with the head against the locking collar. For standard holes, the sleeve is to be 0.000" - 0.062" longer than the pin. For installations such as barrel nut bolt holes or holes in one sheet of multiple sheet assemblies, the sleeve length is to be 0.000" - 0.031" below flush. If the sleeve is too short, use the next higher step and prepare another sleeve.

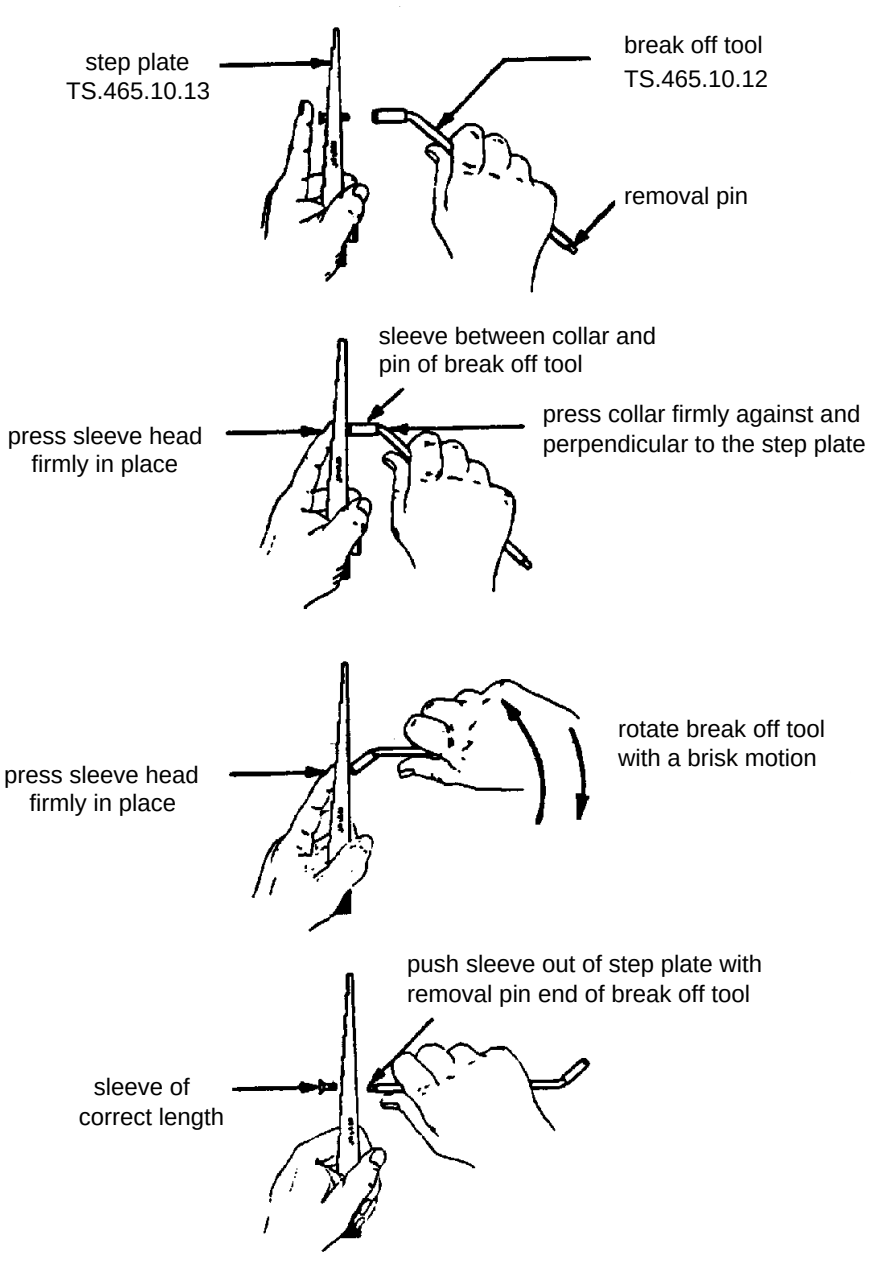


Figure 5 - Breaking Sleeve to the Required Length

5.5.6 Increasing Sleeve Length

5.5.6.1 If the required sleeve length is longer than the stock length of the sleeves, use the cylindrical portion of additional sleeves to make a combined length as required.

5.5.6.2 Do not use sleeve sections less than 1/4" long. Adjust the lengths of the individual sleeve sections accordingly.

5.6 Sealing

5.6.1 Unless otherwise specified, wet install all sleeves as shown in Figure 6 using DHMS S3.06, Type I, Class C-80 sealant, prepared according to PPS 21.20.

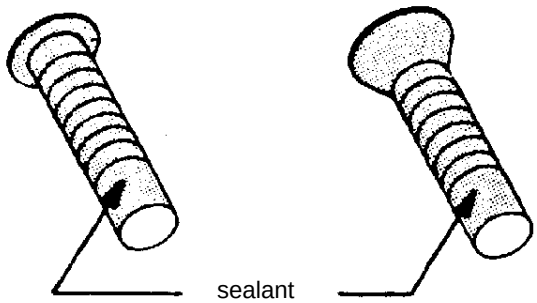


Figure 6 - Application of Sealant

5.7 Installation of ACRES Sleeves

5.7.1 If the sleeve consists of a single sleeve section with a head, place the prepared sleeve on the applicable installation tool (flush head or protruding head) and insert the sleeve into the hole and drive the sleeve in by lightly hitting the installation tool with a rivet gun fitted with a flat snap. Ensure that the sleeve is fully seated. Check for sleeve deformation and flushness as specified in paragraph 6.2.

5.7.2 If the sleeve consists of a single headless sleeve section or a headless sleeve section as part of multiple section sleeve, install the sleeve on the shank of the fastener and then install the sleeved fastener as specified in section 5.8. It is necessary to place headless sleeves on the shank of the fastener because headless sleeve sections placed in the hole would be driven out when the fastener is installed.

5.8 Installation of Fasteners

5.8.1 Install fasteners according to PPS 2.03, PPS 2.16, PPS 2.20, PPS 2.35 or PPS 2.67, as applicable. Use light blows with a rivet gun fitted with a flat snap to drive in the fastener where necessary.

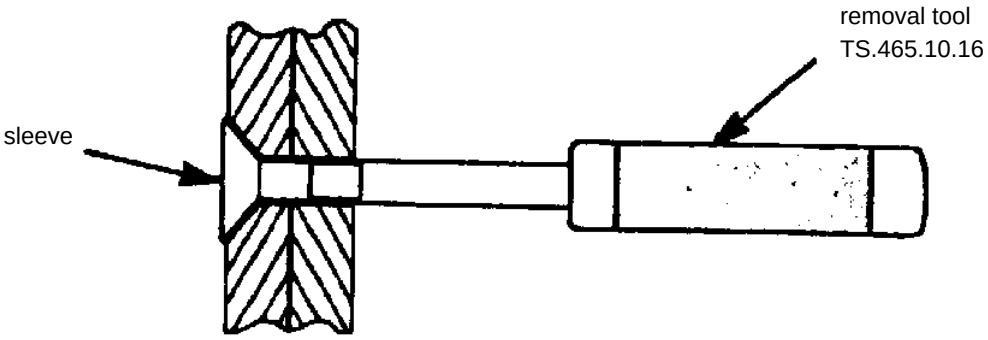
5.8.2 If the use of washers under the collar or nut has been authorized to compensate for deviations in grip length, enlarge the hole in the washer using the drill size specified in Table 3 where necessary to clear a protruding sleeve. Drills for drilling out washers are not included in the tool kits.

Table 3 - Enlargement of Washer Holes

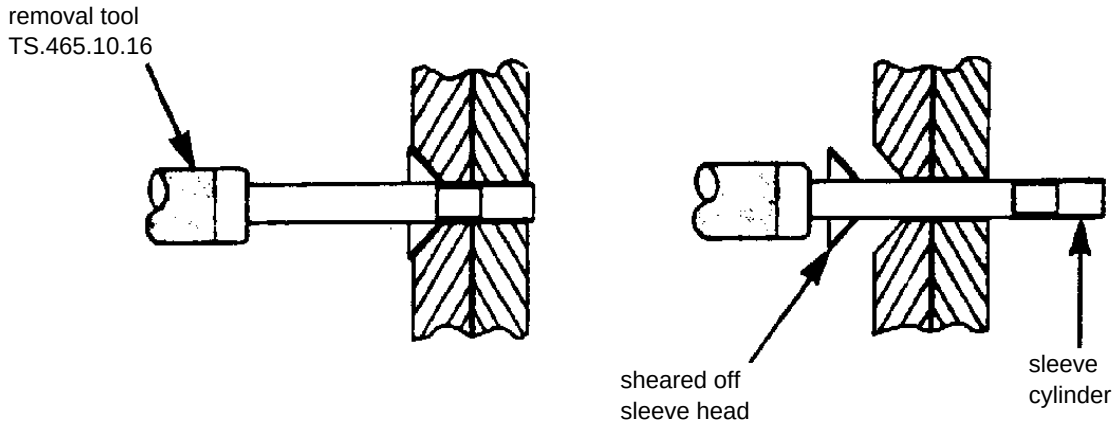
ACRES SLEEVE		DRILL SIZE
SIZE	DIAMETER	
1/64" O/S	05	#15 (0.1800)
	55	3/16 (0.1875)
	06	#3 (0.2130)
	08	J (0.2770)
	10	R (0.3390)
	12	Y (0.4040)
1/32" O/S	06	#1 (0.2280)
1/32" O/S Clearance	08	M (0.2950)

5.9 Removal of Installed Sleeves

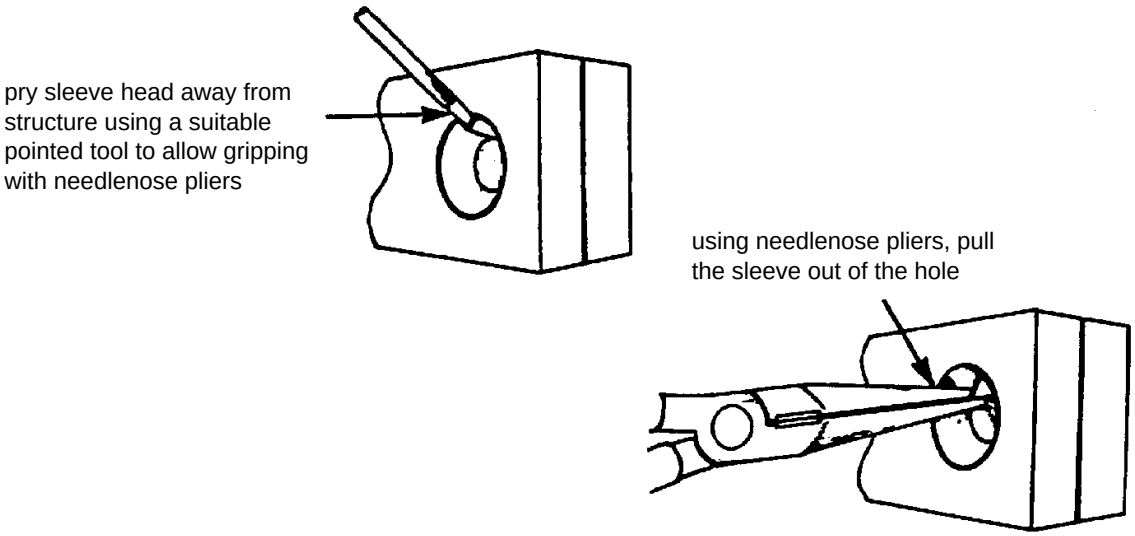
5.9.1 If possible, remove sleeves by driving the sleeve out from the side opposite the sleeve head using a TS.465.10.16 removal tool as shown below.



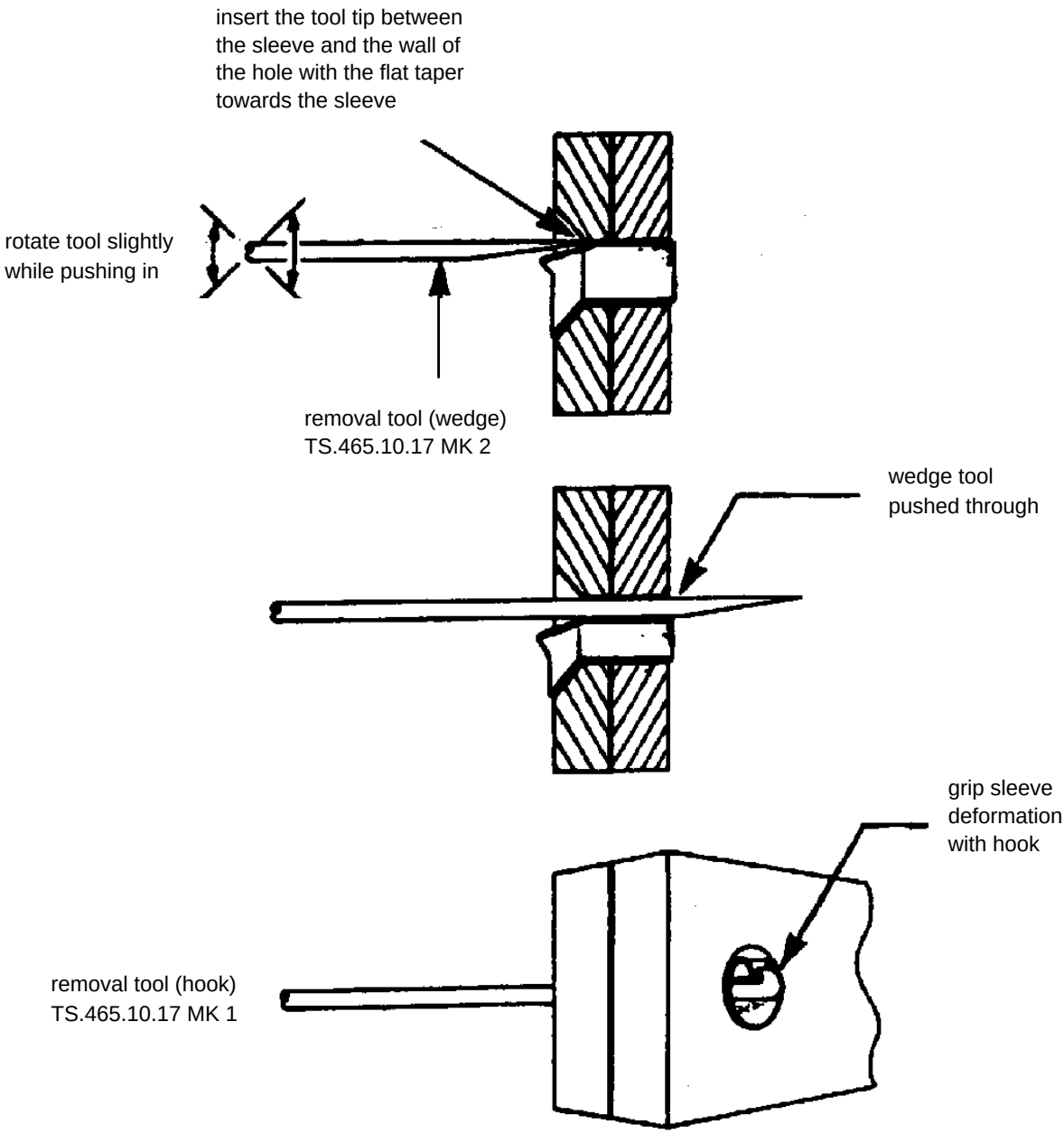
5.9.2 Use a TS.465.10.16 removal tool to remove 1/64" oversize sleeves which cannot be driven out from the side opposite the sleeve head due to lack of accessibility (see following figure).



5.9.3 If it is not possible to drive out the sleeve from the side opposite the sleeve head, carefully bend away the head of the sleeve using a suitable pointed tool, grip the head of the sleeve with a suitable pair of needle nose pliers and attempt to pull the sleeve out of the hole (see below).



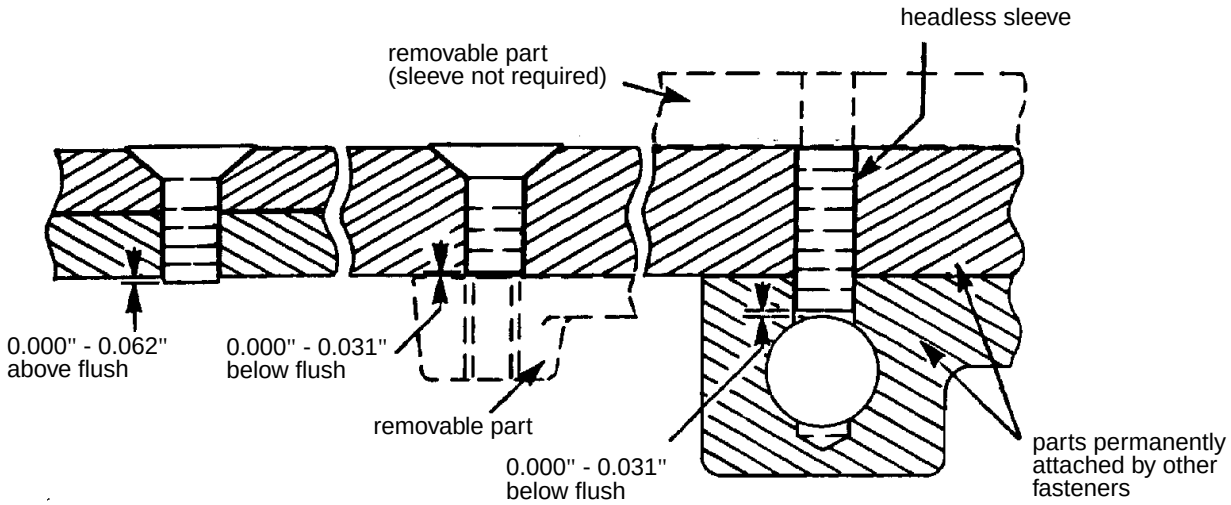
5.9.3.1 If the sleeve cannot be removed with the needle nose pliers, remove the sleeve by inserting a TS.465.10.17 MK 2 removal tool (wedge) between the sleeve and the wall of the hole with the flat taper towards the sleeve and rotate the tool back and forth slightly while applying an even pressure until the entire sleeve is deformed (the sleeve deformation reduces the pressure of the sleeve against the wall of the hole to allow easier removal. Then, insert a TS.465.10.17 MK 1 removal tool (hook) and pull out the sleeve



6 Requirements

6.1 Before installing sleeves, ensure that holes meet the requirements of Table 1. Holes that do not conform to the requirements of Table 1 are not acceptable. Refer oversize holes to Liaison Engineering for authorization to use the next larger diameter Hi-Lok fastener, Hi-Shear rivet, lockbolt or threaded bolt, as applicable.

6.2 Ensure that installed sleeves meet the protrusion requirements shown below:



6.3 Ensure that installed sleeves show no evidence of cracking or deformation.

6.4 Installed fasteners must meet the requirements of PPS 2.03, PPS 2.16, PPS 2.20 or PPS 2.67, as applicable. However, unless Bombardier (Toronto Site) MRB or Bombardier (Toronto Site) delegated MRB has specified an increased countersink diameter for flush head fasteners, the maximum allowable head protrusion is 0.020" above flush.

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 standard plant safety precautions when performing the procedure specified herein.

8 Personnel Requirements

8.1 Personnel responsible for salvage of oversize holes using ACRES sleeves must have a good working knowledge of the procedure and requirements as specified herein and shall have exhibited their familiarity to their supervisor.

9 Maintenance of Equipment

9.1 It is recommend that worn or damaged tools be repaired or replaced. Do not alter or rework tools without appropriate authorization.