BOMBARDIER
Toronto (de Havilland)
PROPRIETARY INFORMATION

PPS 2.11

PRODUCTION PROCESS STANDARD

Installation of Self-Retaining Nuts and Studs

Issue 9
- This standard supersedes PPS 2.11, Issue 8.
- Vertical lines in the left hand margin indicate changes over the previous issue.
- Direct PPS related questions to PPS.Group@aero.bombardier.com or (416) 375-4365.
- This PPS is effective as of the distribution date.

Prepared By:	(Michael Wright)	January 24, 2013
	Production Process Standards (PPS)	
Approved By:	(L.K. John)	January 24, 2013
	Materials Technology	
	(B. DeVreede)	January 24, 2013
	Quality	

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1 Scope

1.1 This Production Process Standard (PPS) specifies the procedure and requirements for the installation of self-retaining clinch nuts and studs, spline nuts, and stake nuts in aluminum and aluminum alloy material.

1.1.1 This PPS complements the engineering drawings that specify its use as an authorized instruction and the procedure specified 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. Similarly, the procedure and requirements specified in this PPS are not applicable when use of a BAPS, MPS, LES or P. Spec. is specified.

2 Hazardous Materials

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

3 References

3.1 PPS 1.09 - Drilling and Reaming.

3.2 PPS 13.26 - General Subcontractor Provisions.

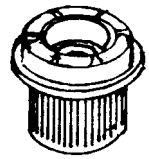
3.3 PPS 18.01 - Limitations on Shearing, Blanking and Piercing Aluminum and Magnesium Alloy Sheet.

3.4 PPS 27.02 - Edge Finishing Aluminum Alloy Parts.

4 Materials and Equipment

4.1 Materials

4.1.1 ESNA spline nuts, ESNA clinch nuts, Kaylock stake nuts, PEM flush-head self-clinching hexagon nuts, and PEM flush-head self-clinching studs as specified on the Engineering drawing. Refer to Figure 2 through Figure 5 for the part number breakdown of Kaylock stake nuts ESNA spline nuts, ESNA clinch nuts, PEM flush-head self-clinching hexagon nuts and PEM flush-head self-clinching studs, respectively.



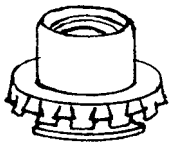
ESNA SPLINE NUT

2 2 ND 8 02

Material
2 = Steel, AISI C-1212 (for thread sizes 8-32 & 10-32) 4 = Steel, AISI C-1212 (for thread sizes 8-32 & 10-32)
Finish: 2 = Cadmium Plated
Type of Nut: ND = Spline nut
Shank Length: in 1/64th of an inch Ranging from 8 (0.125 inch) to 32 (0.5 inch)

Thread Sizes	
82 = #8-32 UNC	054 = 5/16-24 UNF
02 = #10-32 UNF	064 = 3/8-24 UNF
048 = 1/4-28 UNF	

Figure 1 - Part Number Breakdown of Kaylock Stake Nuts



KAYLOCK STAKE NUT

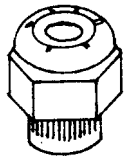
K72 00 06

Manufacturer's Code
K72 = Non-floating Stake Nuts

Finish
00 = Carbon or Alloy Steel, Heat Treated, Cadmium Plated and Dry Lubricant Coated 01 = A286 Corrosion Resistant Steel, Heat Treated, Dry Lubricant Coated 31 = A286 Corrosion Resistant Steel, Heat Treated, Silver Plated

Thread Sizes	
04 = #4-40 UNC	08 = 8-32 UNC
06 = #6-32 UNC	3 = 10-32 UNF

Figure 2 - Part Number Breakdown of ESNA Spline Nuts



ESNA CLINCH NUT

Material (See Note 1)	
2 = Carbon Steel 6 = Aluminum Alloy 7 = Stainless Steel 9 = Brass	Note 1. The available material and finish combinations are 22, 68, 79, and 92.

Finish (See Note 1)
2 = Cadmium Plated 8 = Anodized 9 = Plain

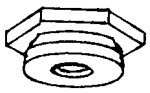
Type of Nut: NC = Clinch Nut

Shank Length (inch)	
1 = 0.063 2 = 0.085 3 = 0.105	4 = 0.135 5 = 0.165 6 = 0.195

Thread Sizes	
40 = #4-40 UNC 62 = #6-32 UNC 82 = #8-32 UNC	02 = #10-32 UNF 048 = 1/4-28 UNF 054 = 5/16-24 UNF

2 2 NC 2 82

Figure 3 - Part Number Breakdown of ESNA Clinch Nuts



PEM FLUSH-HEAD SELF-CLINCHING HEXAGON NUT

Manufacturer's Code
F: Stainless Steel flush head hexagon nut

Thread Sizes	
440 = #4-40 UNC 632 = #6-32 UNC	832 = #8-32 UNC 032 = #10-32 UNF

Nut Length (inch)
1 = 0.060 2 = 0.090

F 632 2

Figure 4 - Part Number Breakdown of PEM Flush-Head, Self-Clinching, Hexagon Nuts

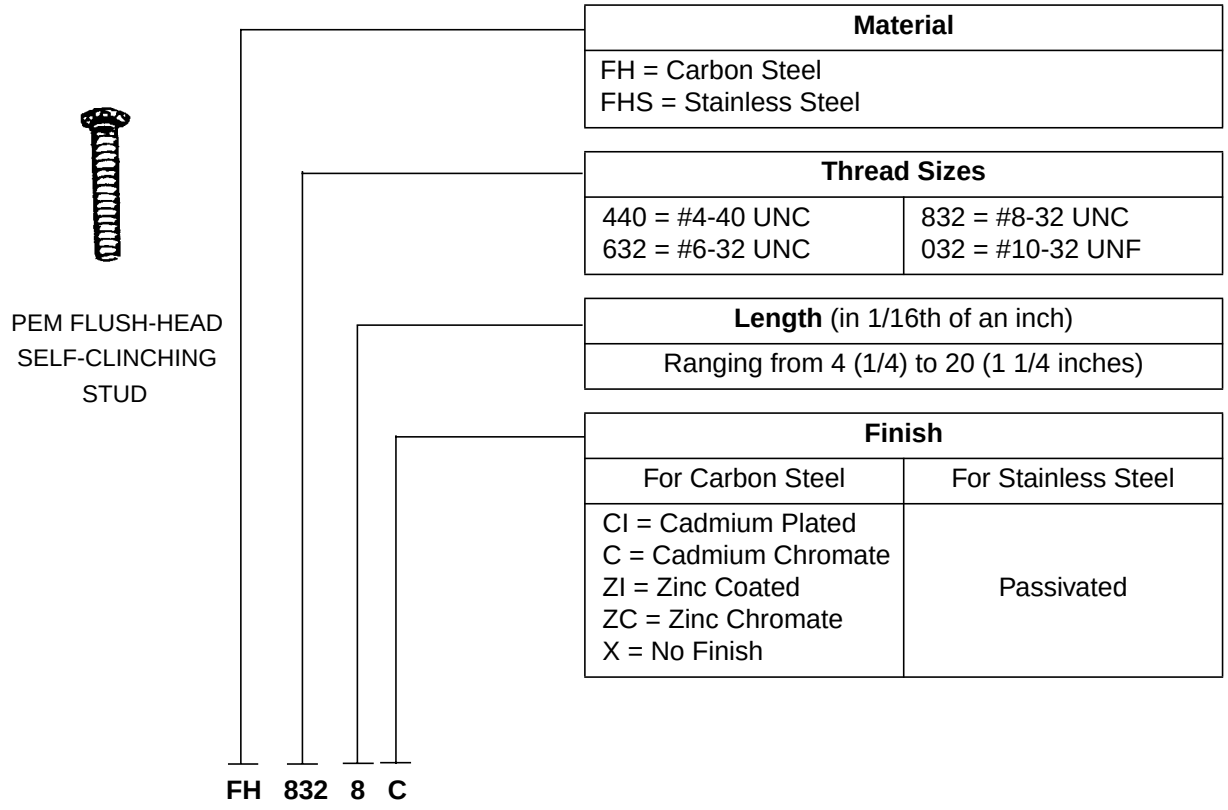


Figure 5 - Part Number Breakdown of PEM Flush-Head, Self-Clinching Studs

4.2 Equipment

4.2.1 Installation tools as listed in Table 1.

5 Procedure

5.1 General

5.1.1 Self-retention of the fastener is obtained by squeezing the fastener into a punched or drilled hole in the material. This operation causes displacement of material into the fastener's locking feature that self-locks the fastener in place.

Table 1 - Hole Preparation and Installation Data

SIZE NO.	THREAD SIZE	RECOMMENDED DRILL SIZE	HOLE SIZE	INSTALLATION TOOLS		OTHER INFORMATION
ESNA Spline Nut						
82	#8-32	5/16"	0.312" - 0.316"	Arbor Press		---
02	#10-32					
048	1/4-28	3/8"	0.375" - 0.379"			
054	5/16-24	7/16"	0.437" - 0.441"			
064	3/8-24	1/2"	0.500" - 0.504"			
ESNA Clinch Nut (See Note 1)				**Punch**	**Dolly**	Other installation tools are: SD2513 Adapters, CP450EA Riveter, A12165 Punch Handle, Hammer.
40	#4-40	#14	0.184" - 0.186"	CP3-4	CD3-4	
62	#6-32	#3	0.217" - 0.219"	CP6	CD6	
82	#8-32	H	0.268" - 0.271"	CP8-10	CD8	
02	#10-32				CD10	
048	1/4-28	S	0.352" - 0.355"	CP416	CD416	
054	5/16-24	13/32"	0.408" - 0.412"	CP516	CD516	
Note 1: For sheet thickness requirements and minimum counterbore diameter, see Table 2 and Table 3.						
KAYLOCK Stake Nut				**Rivet Snap**	**Dolly**	Dolly is to be installed in KT7200 Handled and used with Hammer.
04	#4-40	#7	0.200" - 0.205"	KT7203-04	KT7201-04	
06	#6-32	#1	0.227" - 0.232"	KT7203-06	KT7201-06	
08	#8-32	K	0.280" - 0.285"	KT203-08	KT7201-08	
3	#10-32			KT7203-3	KT7201-3	
PEM Flush-Head, Self-Clinching, Hexagon Nut						
440	#4-40	#17	0.172" - 0.175"	Arbor Press		---
632	#6-32	#3	0.212" - 0.215"			
832	#8-32	L	0.289" - 0.292"			
032	#10-32	5/16"	0.311" - 0.314"			
PEM Flush-Head, Self-Clinching Stud						**Proof Torque**
440	#4-40	#34	0.111" - 0.114"	Arbor Press SD7407 Anvil		4-3/4 In-lbs.
632	#6-32	#29	0.137" - 0.140"			9 In-lbs.
832	#8-32	#20	0.163" - 0.166"			18 In-lbs.
032	#10-32	#12	0.189" - 0.192"			32 In-lbs.

5.2 Preparation of Work

5.2.1 Prepare holes for installation of nuts or studs as follows:

Step 1. For ESNA clinch nuts only, if the sheet thickness exceeds the maximum limit specified in Table 2 for the specific shank length of clinch nut to be installed, drill a pilot hole in the sheet and counterbore on the clinch side to the diameter and thickness specified in Table 2 and Table 3.

Table 2 - Sheet Thickness Requirements for ESNA Clinch Nuts

SHANK LENGTH CODE	SHANK LENGTH	SHEET THICKNESS
1	0.063"	0.020" - 0.031"
2	0.085"	0.032" - 0.053"
3	0.105"	0.054" - 0.073"
4	0.135"	0.074" - 0.103"
5	0.165"	0.104" - 0.133"
6	0.195"	0.134" - 0.163"

Table 3 - Counterboring Diameters for ESNA Clinch Nuts

<table>
<tr><th>SIZE NO.</th><th>THREAD SIZE</th><th>PILOT DRILL FOR COUNTERBORING</th><th>MINIMUM COUNTERBORING DIAMETER</th></tr>
<tr><td>40</td><td>#4-40</td><td>#30</td><td rowspan="2">0.501"</td></tr>
<tr><td>62</td><td>#6-32</td><td rowspan="4">#11</td></tr>
<tr><td>82</td><td>#8-32</td><td rowspan="2">0.563"</td></tr>
<tr><td>02</td><td>10-32</td></tr>
<tr><td>048</td><td>1/4-28</td><td>0.626"</td></tr>
<tr><td>054</td><td>5/16-24</td><td>0.688"</td></tr>
</table>

Step 2. Drill or punch holes to the final hole size specified in Table 1. Punching is preferred. Refer to PPS 18.01 for the limitations on punching. Perform drilling according to PPS 1.09. If possible, punch or drill holes from the face side to allow fasteners to be installed from the punch or drill exit side.

Step 3. Deburr all holes according to PPS 27.02, taking care not to break or chamfer the hole edges. Remove any chips remaining on faying surfaces.

Step 4. On a sample basis, check at random (across the entire pattern) the number of holes specified in Table 4 for conformance to the hole limit requirements of Table 1 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.

While checking holes using a GO/NO-GO gauge or other hole measuring gauge, also check visually for hole ovality. For holes with a visually evident oval or out of round shape, check the hole diameter at several positions using suitable hole measurement equipment (e.g., vernier calliper, hole micrometer, etc.) to determine the minor and major diameters of the hole. The minor and major diameters of the hole must be within the minimum and maximum hole diameter tolerances, respectively. If the minor or major diameters of any oval hole in the sample are not within the minimum and maximum hole diameter tolerance, check every hole in the pattern for conformance to the hole limit requirements and visually for ovality as specified herein. Refer all non-conforming holes to Bombardier Toronto (de Havilland) MRB or Bombardier Toronto (de Havilland) delegated MRB for disposition.

Table 4 - Hole Size Verification Sample Requirements

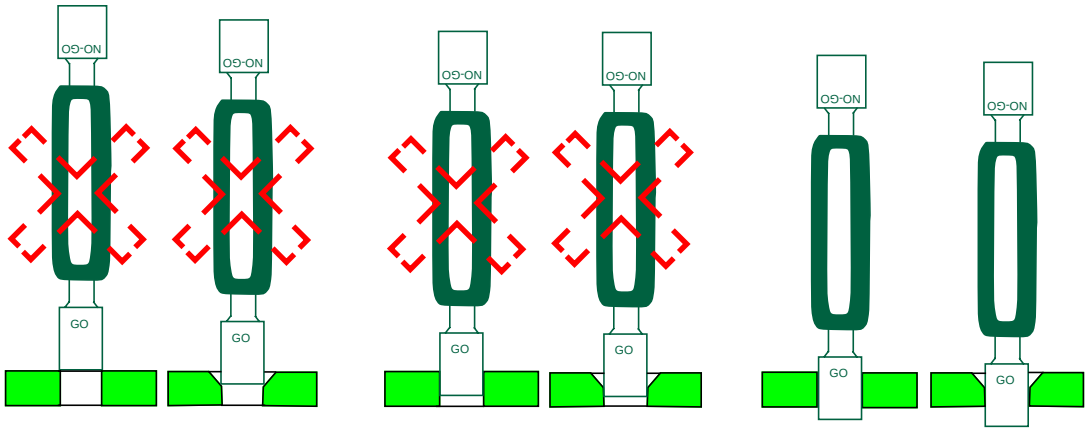
NUMBER OF HOLES IN PATTERN	REQUIRED SAMPLE SIZE
5 or less	all
6 - 50	5
51 - 90	7
91 - 150	11
151 - 280	13
281 - 500	16
more than 500	19

5.3 Use of GO/NO-GO Gauges

5.3.1 Check selected fastener holes for conformance to the requirements of Table 1 using the applicable GO/NO-GO gauge as follows (see Figure 6):

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 1 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.

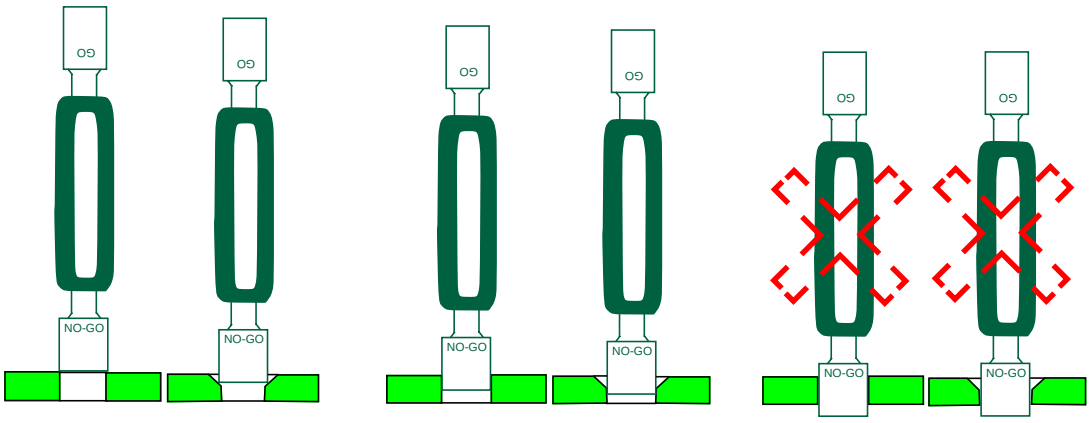


Does not go in.
UNDERSIZE HOLE

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 6 - Use of Go/No-Go gauges

5.4 Installation of ESNA Spline Nuts

5.4.1 Install ESNA spline nuts as follows:

Step 1. Check that the nut is threaded and insert the splined end of the nut into the hole. Ensure that the splines are aligned with the hole (see Figure 7-A).

Step 2. Using a suitable arbor press, press the spline into the hole until the base of the nut is fully seated against the material (see Figure 7-B). Do not apply excessive pressure to the crown of the nut.

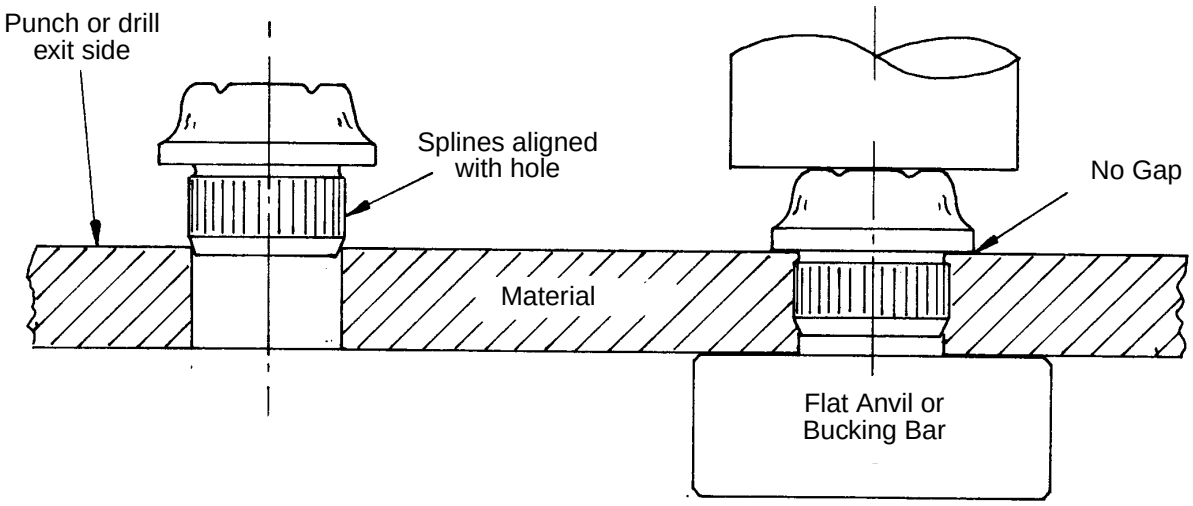


Figure 7-A - Before

Figure 7-B - After

Figure 7 - Installation of ESNA Spline Nuts

5.5 Installation of ESNA Clinch Nuts

5.5.1 Install ESNA clinch nuts as follows:

Step 1. Check that the nut is threaded and insert the serrated end of the nut into the hole.

Step 2. Select the appropriate dolly from Table 1 and install it in a SD2513 adapter.

Step 3. Place the dolly assembly on the crown of the nut. Ensure that the shank of the nut is aligned with the hole and the material is backed by a wooden block (see Figure 8-A).

Step 4. Using light hammer blows on the dolly assembly, drive the shank into the hole until the base of the nut is fully seated against the material (see Figure 8-B). Do not hammer directly on the crown of the nut.

Step 5. Machine or hand clinch the shank of the nut according to paragraph 5.5.2 or paragraph 5.5.3. Machine clinching is preferred.

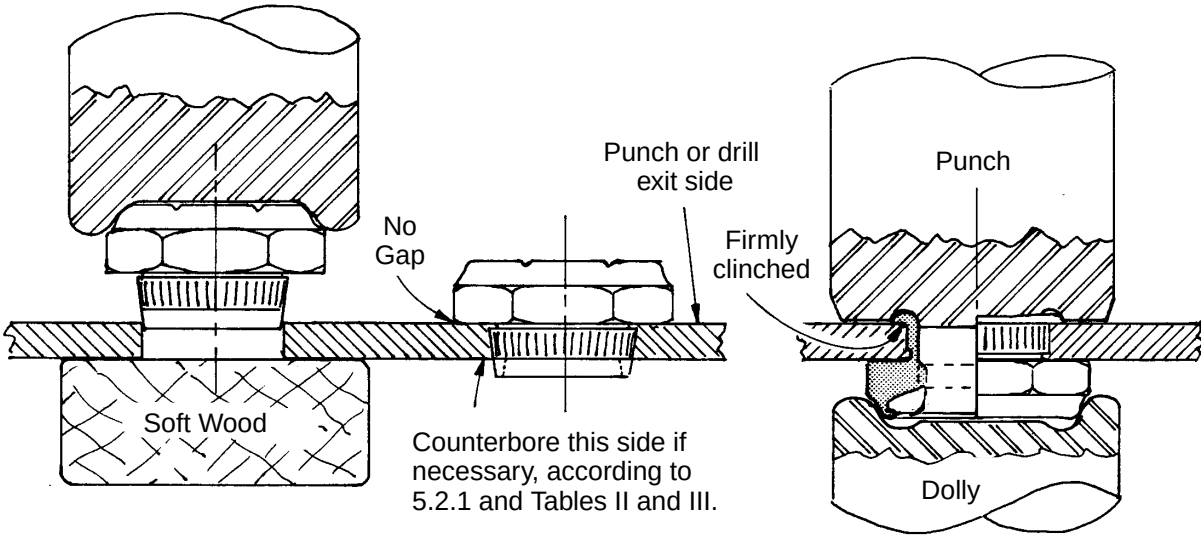


Figure 8-A - Before Pressing In

Figure 8-B - Pressed in Before Clinching

Figure 8-C - After Clinching

Figure 8 - Installation of ESNA Clinch Nuts

5.5.2 Machine clinch the shank of the nut as follows:

Step 1. Select the appropriate punch from Table 1 and install it in an SD2513 adapter.

Step 2. Install the punch assembly in the top post and the dolly assembly in the bottom post of a CP450 EA riveter.

Step 3. Adjust the riveter to apply just sufficient load to clinch the nut shank with one stroke.

Step 4. Place crown of the nut in the dolly grove. Ensuring that the nut is in line with the punch and dolly, operate the riveter to clinch the nut shank. The end part of the nut shank shall be clinched firmly against the material surface (see Figure 8-C).

5.5.3 Hand clinch the shank of the nut as follows

Step 1. Select the appropriate punch from Table 1 and install it in ESNA handle A12165.

Step 2. Secure the dolly in a vise or a suitable mounting block.

Step 3. Place the crown of the nut in the dolly groove.

Step 4. Center the punch assembly on the shank and swage it over by hammering until the end part of the nut shank is clinched firmly against the material surface (see Figure 8-C).

5.6 Installation of Kaylock Stake Nuts

5.6.1 Install Kaylock stake nuts as follows:

Step 1. Place the material face down on a flat anvil or against a bucking bar.

Step 2. Check that the nut is threaded and insert the stake end of the nut into the hole (see Figure 9-A).

Step 3. Select the appropriate rivet snap or dolly from Table 1. Install the dolly in the KT7200 handle.

Step 4. Placing the rivet snap or the dolly assembly on the nut shoulder, rivet or hammer until the lands of the nut are flush with the top surface of the material (see Figure 9-B).

Step 5. The stake end of the nut is not necessarily flush with the bottom surface of the material after installation.

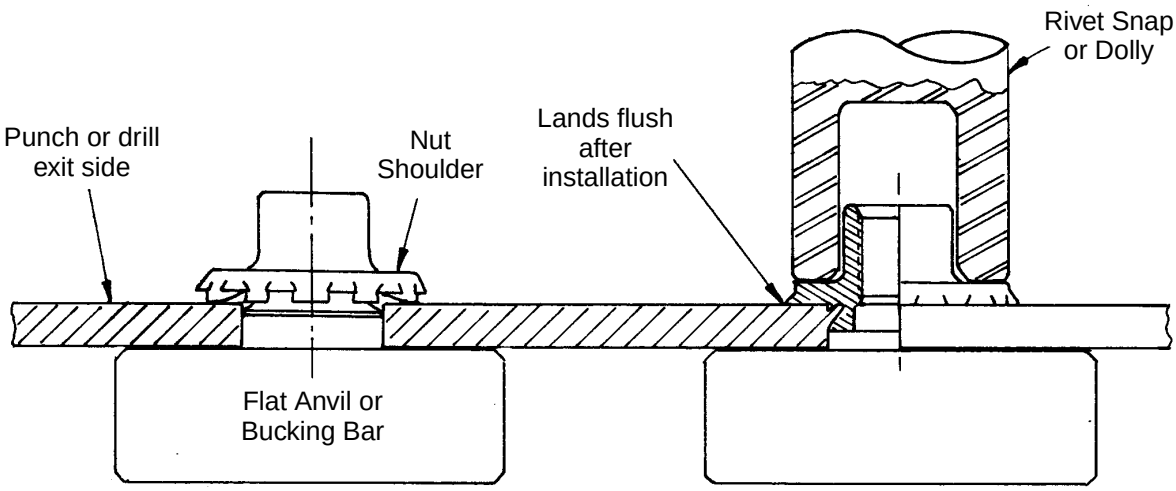


Figure 9-A - Before

Figure 9-B - After

Figure 9 - Installation of Kaylock Stake Nuts

5.7 Installation of PEM Flush-Head, Self-Clinching, Hexagon Nuts

5.7.1 Install PEM flush-head, self-clinching, hexagon nuts as follows:

Step 1. Check that the nut is threaded and place the shank of the nut into the hole (see Figure 10-A).

Step 2. Using a suitable arbor press, press the nut into the material until the hexagonal head is flush with the top-surface of the material (see Figure 10-B).

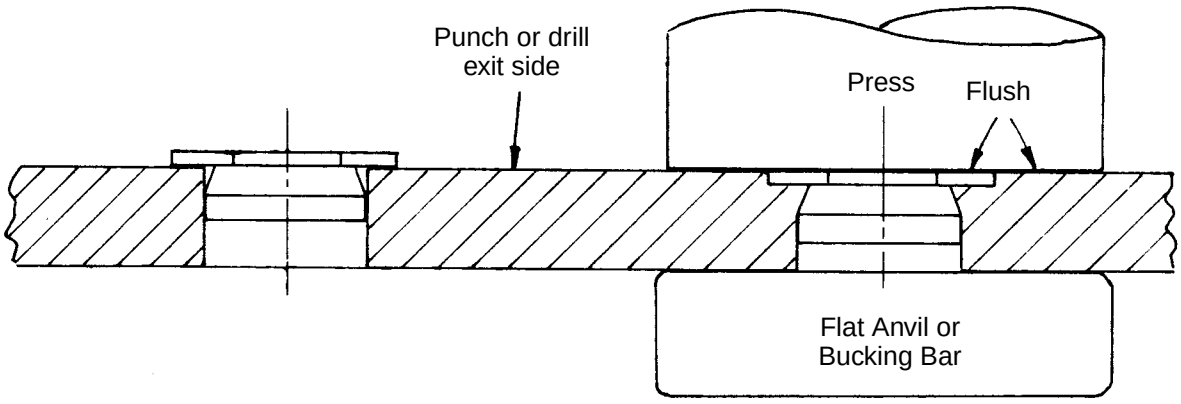


Figure 10-A - Before **Figure 10-B - After**

Figure 10 - Installation of PEM Flush-Head Self-Clinching, Hexagon Nuts

5.8 Installation of PEM Flush-Head, Self-Clinching Studs

5.8.1 Install PEM flush head, self-clinching studs as follows:

Step 1. Select the appropriate side of the SD7407 anvil for the material thickness.

Step 2. Place the material over the anvil and insert the PEM stud so that its shank enters the appropriate hole of the anvil (see Figure 11-A).

Step 3. Using a suitable arbor press, press the head of the stud into the material until it is flush with the top surface of the material (see Figure 11-B).

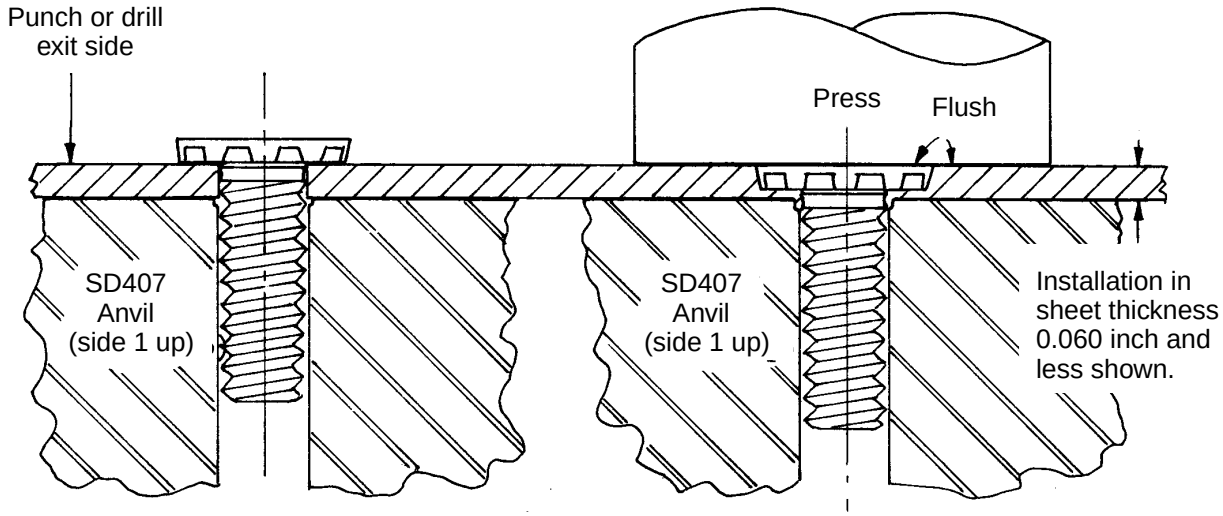


Figure 11-A - Before

Figure 11-B - After

Figure 11 - Installation of PEM Flush-Head, Self-Clinching Studs

6 Requirements

6.1 Ensure that ESNA spline nuts and ESNA clinch nuts are fully seated. There must be no gap between the base of the nut and the surface of the material. Also, check that the nylon inserts in installed spline nuts and clinch nuts are not damaged.

6.1.1 Kaylock stake nuts must be installed so that the lands of the nut are flush with the material surface.

6.1.2 PEM nuts and PEM studs must be installed so that the tops are flush with the surrounding material surface.

6.1.3 Proof torque a minimum of 10% of the installations in each batch. If any of the proof torqued assemblies are found unacceptable, proof torque every assembly in the batch. Refer all unacceptable assemblies to MRB for disposition.

- For ESNA spline nuts, ESNA clinch nuts, Kaylock stake nuts and PEM hexagon nuts, proof torque by threading an appropriate size bolt into the nut until a minimum of 2 threads pass through the nut. If there is evidence of rotation or movement of the nut during this test or during removal of the bolt, the particular assembly is not acceptable.
- For PEM studs, proof torque by installing a minimum of 2 washers secured by an appropriate size non-locking nut torqued to the value specified in the Table 1. If there is evidence of rotation or movement of the stud during this test or during removal of the nut, the particular assembly is not acceptable.

7 Safety Precautions

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

8 Personnel Requirements

8.1 Personnel responsible for installation of self-retaining clinch nuts and studs, spline nuts, and stake nuts in aluminum and aluminum alloy material must have a good working knowledge of the 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.

9.2 Do not operate the CP450EA riveter without material between the punch and dolly.

9.3 Do not rework tools unless suitably authorized.