BOMBARDIER Toronto (de Havilland) PROPRIETARY INFORMATION	**PPS 19.01** PRODUCTION PROCESS STANDARD

Safetying Devices

Issue 22
- This standard supersedes PPS 19.01, Issue 21.
- Vertical lines in the left hand margin indicate technical changes over the previous issue.
- This PPS is effective as of the distribution date.
- Validation of issue status is the responsibility of the user.

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Core Methods - PPS

Issue 22 - Summary of Changes (over the previous issue)

The following summaries are not detailed and are intended only to assist in alerting PPS users to changes which may affect them; refer to the applicable sections of this PPS for detailed procedure and requirements.

- Corrected typo - all reference to M20995 replaced with reference to MS20995.

Table of Contents

Section & Title **Page**

Figures

Tables

1 Scope

1.1 This PPS (Production Process Standard) specifies the procedure and requirements for the installation of safetying devices.

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 Aerospace Toronto, all materials must be approved and assigned Material Safety Data Sheet (MSDS) numbers by the Bombardier Aerospace Toronto 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 Aerospace Toronto 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 2.20 - Bolts and Screws.

3.2.2 PPS 13.26 - General Subcontractor Provisions.

3.2.3 PPS 13.28 - Storage Life of Adhesives, Sealants, Paints and Composite Products.

3.2.4 PPS 14.01 - Torquing - Method and Identification.

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 Tamper proof sealant, white:

- Dykem Cross Check tamper proof torque mark, p/n 83319 (white)
- Organic Products Co. F-900 or F-925 Torque Seal
- 3M EC-1252 tamper proof sealant

4.1.2.1 Refer to PPS 13.28 for the storage life of tamper proof sealant. The tamper proof sealants specified herein are resistant to splashes of hydraulic fluid (e.g., Skydrol) but are not resistant to immersion. After application, allow tamper proof sealant to cure undisturbed according to the manufacturer's recommendations. Apply tamper proof sealant sparingly, do not apply more than needed, especially in overhead applications.

4.1.3 MS20995 lock wire to NASM20995. See Figure 1 for a part number breakdown.

4.1.4 Safety cable as specified in Table 3. See Figure 2 for a part number breakdown.

4.1.5 Turnbuckle locking clips to MS21256, as specified in section 5.2.

4.1.6 Cotter pin (split) to MS24665.

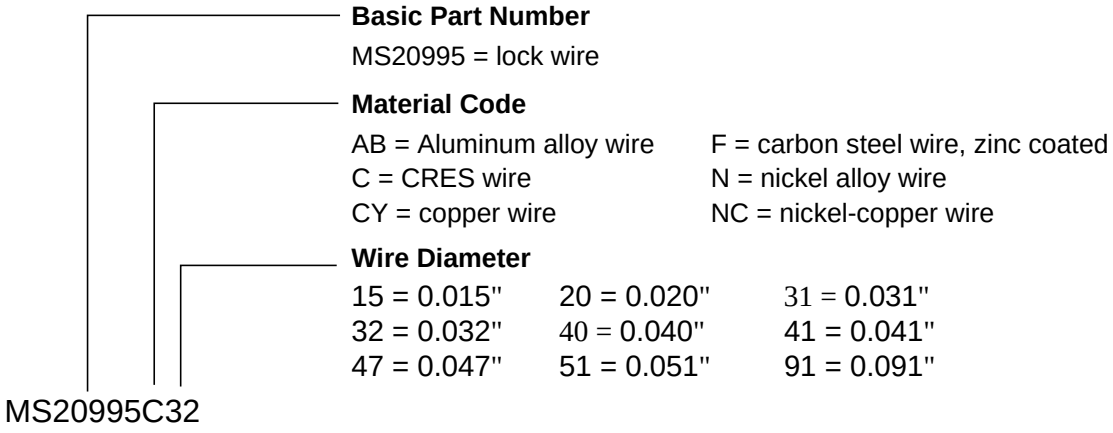


Figure 1 - Lock Wire Part Number Breakdown

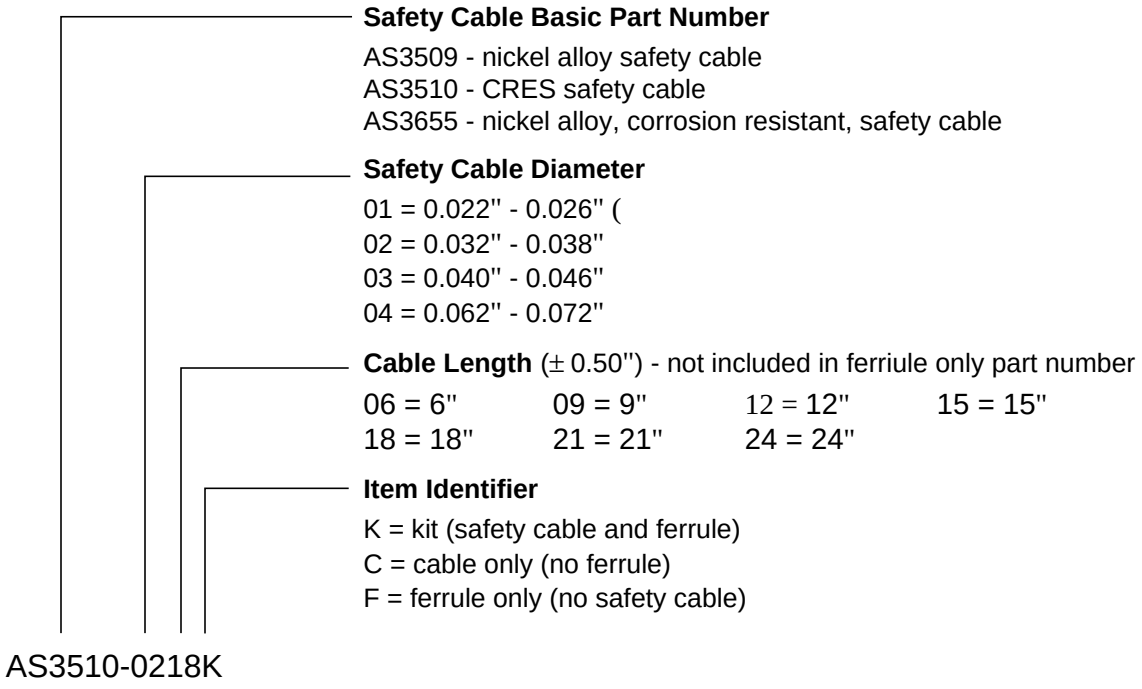


Figure 2 - Safety Cable Part Number Breakdown

4.2 Equipment

4.2.1 Wire twister pliers (e.g., Glenair Ltd. M-84 or Snap-On Tools WT11 (8 1/2") or GAC311 (10 1/2")).

4.2.2 Safety cable ferrule crimping tools (e.g., Daniels SCTR 207, SCTR 323, SCTR 327, etc.). Except as noted below, tools must be qualified every month. Qualify tools by preparation and tensile testing of a test sample for each tool to ensure the minimum safety cable crimp requirements as specified in Table 1 are met. Maintain a record of test results for each tool. Crimping tools which have successfully passed 12 consecutive tests may be qualified every 3 months; however, if a tool fails, resume monthly qualification testing.

Table 1 - Tensile Testing of Safety Cable Crimp Tool Qualification Samples

Safety Cable Nominal Diameter	Minimum Pull-Off Load
0.020"	30 lbs
0.032"	70 lbs

5 Procedure

5.1 General

5.1.1 Except as noted in para. 5.1.2.1, use the safetying method specified by the engineering drawing.

5.1.2 Wire locking is the application of lock wire or safety cable to prevent the relative movement of structural or critical components subjected to vibration, tension, torque, etc. When wire locking, use the material and diameter or gauge of wire specified on the engineering drawing or, when not specified, according to Table 2.

Table 2 - Lock Wire Selection

Application		Lock Wire	Lock Wire Diameter (Notes 1, 2 & 3)
Area	**Temperature**		
Airframe	Up to 450°F	MS20995C** (CRES)	0.020", 0.032", 0.041" or 0.047"
	450°F and above	MS20995N** (nickel alloy)	0.020", 0.032", 0.040" or 0.051"
Emergency Devices	All temperatures	MS20995CY** (copper)	0.020"
Engine	All temperatures	MS20995N** (nickel alloy)	0.020", 0.032", 0.040" or 0.051"
in contact with Magnesium Alloy	All temperatures	MS20995AB** (aluminum alloy)	0.032", 0.041" or 0.047"
Turnbuckle Assemblies	All temperatures	MS20995C** (CRES)	As specified in Table 6

Notes
1. Except as specified in Note 2 or Note 3, for general purposes use 0.032" minimum diameter wire.
2. If listed, 0.020" diameter lock wire may be used on parts having a nominal hole diameter of less than 0.045", on parts having a nominal hole between 0.045" and 0.062" with a space of less than 2" between parts, or on closely spaced screws and bolts of 1/4" diameter and smaller.
3. For single wire locking, use the largest nominal diameter lock wire listed herein which the hole will accommodate.

5.1.2.1 Except when wire locking Wiggins fittings located inside the fuel tank, it is acceptable to use the safety cable specified in Table 3 in place of the lock wire specified by the engineering drawing or Table 2.

Table 3 - Safety Cable Substitution for Lock Wire

Lock Wire	Safety Cable	Lock Wire	Safety Cable
MS20995AB**	None	MS20995N20	AS3509-01**K
MS20995C15	AS3510-01**K	MS20995N32	AS3509-02**K
MS20995C20	AS3510-01**K	MS20995N40	AS3509-03**K
MS20995C32	AS3510-02**K	MS20995N51	None
MS20995C41	AS3510-03**K	MS20995NC20	AS3655-01**K
MS20995C47	AS3510-03**K	MS20995NC32	AS3655-02**K
MS20995CY**	None	MS20995NC40	AS3655-03**K
MS20995F**	None	MS20995NC51	None

5.1.3 Before safetying, tighten all fasteners and if specified, torque according to PPS 14.01. Apply safetying at the final stage of installation or functional testing.

5.1.4 Do not loosen or over-tighten a fastener to accommodate the safetying device.

5.1.5 Castellated nuts must be either wire locked according to section 5.3 or cotter pinned according to section 5.4.

5.1.6 Turnbuckle assemblies must be either clip locked according to section 5.2 or wire locked according to section 5.3.

5.1.7 Unbroken tamper proof sealant indicates that the assembly is correctly torqued/tensioned and has not been tampered with.

5.2 Clip Locking of Turnbuckle Assemblies

5.2.1 Unless otherwise specified, use clip locking when the turnbuckle assembly is comprised of the items listed in the following table. If the turnbuckle assembly includes one or more items not listed in the following table, wire lock the assembly according to section 5.3.

Table 4 - Clip Locking of Turnbuckle Assemblies

Barrel (Note 1)	Terminal (Note 1)					Clip (Note 2)
	Clevis End	Clevis End (for bearing)	Eye End (for Pin)	Eye End (for Wire rope)	Stud Swaged	
MS21251 (NAS649)	MS21252 (NAS645)	MS21253 (NAS646)	MS21254 (NAS648)	MS21255 (NAS647)	MS21260 (NAS650)	MS21256 (NAS651)

Notes 1. A turnbuckle assembly is comprised of one barrel and two of any of the terminals listed herein.
2. Use two clips for safetying one turnbuckle assembly.

5.2.2 Use the locking clips specified on the engineering drawing. If a locking clip is not specified on the engineering drawing, select from the following table. Locking clips are

for one-time use only and are not to be reused.

Table 5 - Turnbuckle Locking Clip Selection

Turnbuckle Barrel (Note 3)		**Locking Clip** (Notes 1, 2 & 3)	
NAS649 OR NAS649B	**MS21251B**	**MS21256 (NAS651)**	**Straight End Length** (reference only)
8S, 16S, 32S OR 46S	2S, 3S, 5S OR 6S	-1 (-167S)	0.965"
8L, 16L, 32L OR 80L	2L, 3L, 5L, 6L OR 8L	-2 (-16L)	1.875"
125L OR 175L	9L OR 10L	-3 (-125L)	2.045"

Notes
1. Material for locking clips: Corrosion Resistant Steel Wire, QQ-W-423, Composition 302, Condition B.
2. Two locking clips required for each turnbuckle assembly.
3. NAS parts are superseded by MS parts.

5.2.3 Clip lock turnbuckle assemblies as follows:

Step 1. Before safetying, with the cable assembly rigged and tensioned, screw both terminals of the turnbuckle assembly an equal distance into the barrel, such that not more than 3 threads of either terminal are exposed outside the barrel.

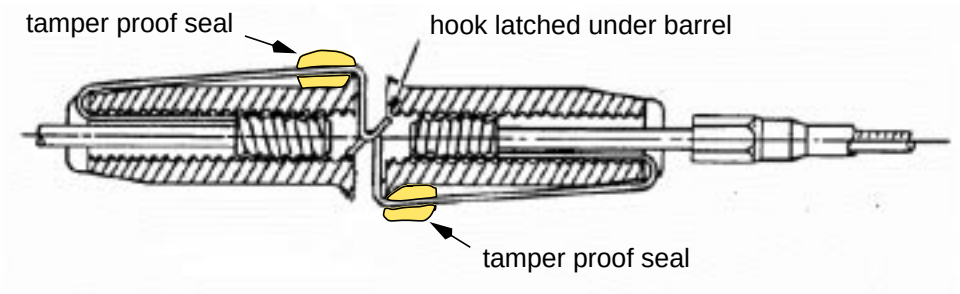
Step 2. With alignment of the terminal indicator groove and the barrel slot indicator notch, insert the straight end of the locking clip into the aligned groove and slot until the hook is over the hole in the centre of the barrel.

Step 3. Press the hook end of the locking clip into the hole to its fullest extent. The hook will spring open and latch under the barrel.

Step 4. Install a clip to lock the other terminal. The hook end of this clip may be inserted into either the hole from the entry of the previous hook or the opposite hole.

Step 5. To ensure the clip is latched properly, attempt to remove it using fingers only (removal should not be possible). Do not use tools for this check as the clips could become permanently distorted.

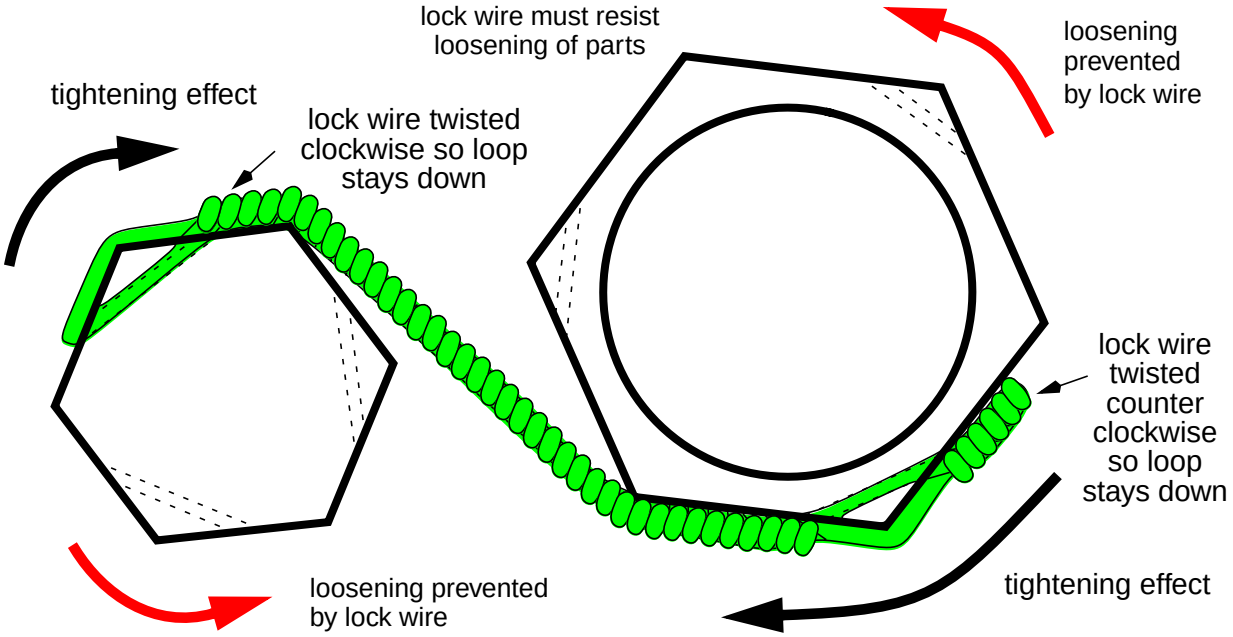
Step 6. Verify that the cable tension is correct according to the values specified on the engineering drawing, and then apply white tamper proof sealant (ref. para. 4.1.2) as shown in the following figure.



5.3 Wire Locking

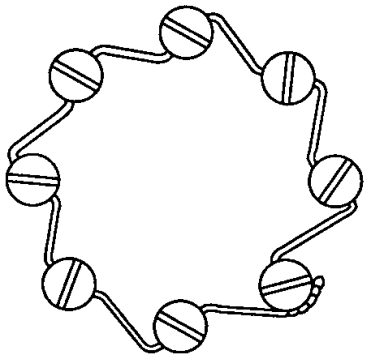
5.3.1 Wire Locking using Lock Wire

5.3.1.1 Install the lock wire in such a manner as to resist loosening of the parts (i.e., such that tension on the lockwire will exert a tightening effect on the parts being locked), for example as shown below. Take care to ensure that the wire is taut but not over-stressed. If applicable, use wire twister pliers (ref. para. 4.2.1). The figures in this section show various wire locking methods for right hand threads: wire lock left hand threads in the opposite manner, so as to ensure the lock wire resists loosening.



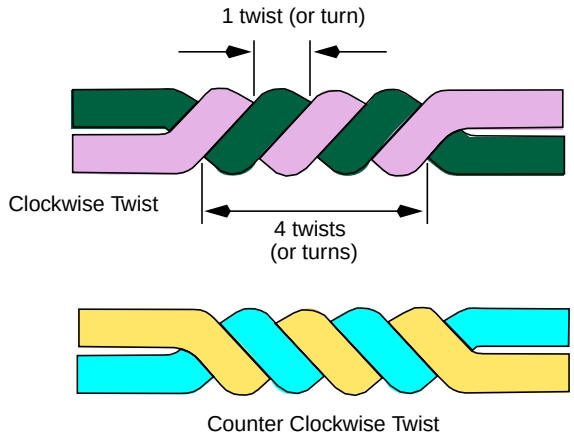
5.3.1.2 In general, use the double twist method (e.g., as shown above) whenever wire locking is used as a safetying technique.

5.3.1.3 Except for fasteners used to secure hydraulic or air seals, to hold hydraulic pressure or in critical areas of clutch mechanisms or superchargers, it is acceptable to use the single wire method for closely-spaced closed geometric patterns (as shown in the adjacent figure) on parts in electrical systems, in shear applications or in places difficult to reach. Consider closely-spaced as a maximum of 2" between centres.



5.3.1.4 Rigidly tie the end of the lock wire to a tie point on the assembly or to the structure. The tie point may be a hole in the assembly or part of the structure.

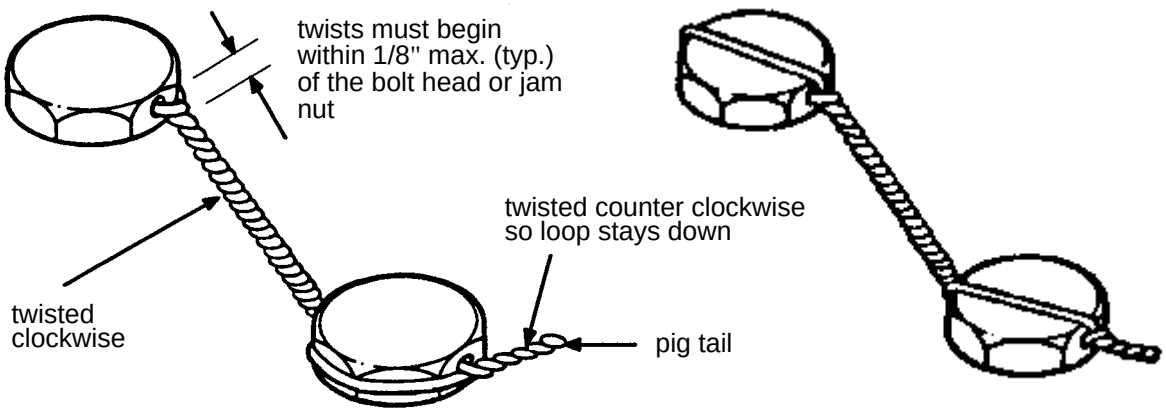
5.3.1.5 For the purposes of this PPS, a “twist” or “turn” of a pair of wires is defined as being produced by twisting the wires through an arc of 180° as shown below:



Wire Diameter:	Twists per Inch
less than 0.019":	11 - 14
0.019" - 0.026"	9 - 12
0.027" - 0.042"	7 - 10
0.043" - 0.065"	5 - 8
more than 0.065"	4 - 7

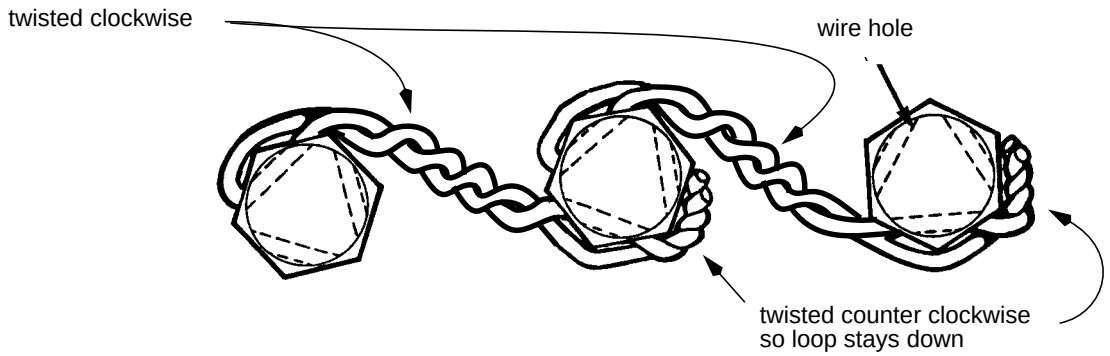
5.3.1.6 For wire locking of electrical connectors, if there are no provisions for a tie point, wire lock jam nuts of the connectors to each other. If tie points are provided, wire lock threaded connectors according to one of the methods specified herein. Unless otherwise specified, use MS20995C20 wire.

5.3.1.7 When wire locking bolt heads or jam nuts (including connector jam nuts) using the double twist method, carry the loops around the heads of the bolts or jam nuts with the wire twisted in such a manner that the loops stay down and do not come up over the bolt heads or jam nuts and become slack (see below). Alternatively, it is acceptable to carry the loop across the head of the bolt, instead of around it, provided there is sufficient clearance with adjacent structure and parts (e.g., connector, adapter or backshell).

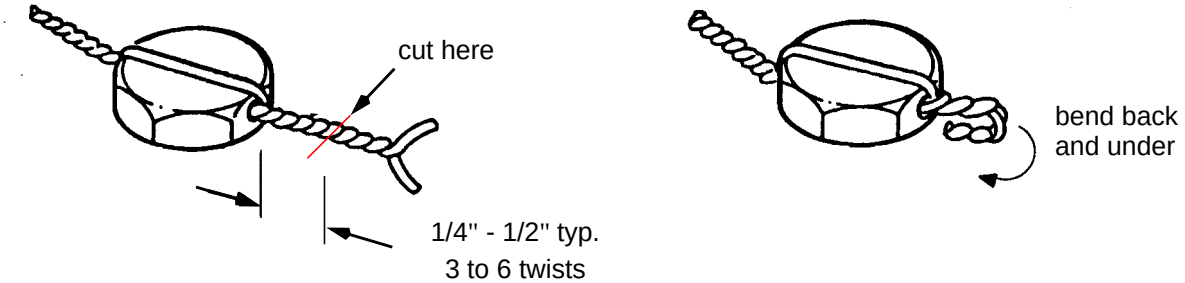


5.3.1.8 When wire locking closely spaced fasteners using the double twist method, do not attempt to safety lock more fasteners than can be locked using a 24 inch length of single wire. When wire locking widely spaced fasteners (i.e., 4 - 6 inches apart) using the double twist method, the maximum number permitted is three units in a series. Do not wire lock fasteners that are more than 6 inches apart unless tie points are provided on adjacent parts to shorten the span of the lock wire to 6 inches or less.

5.3.1.9 Wire lock bolts and jam nuts (including connector jam nuts) with safety wire holes drilled at an angle through the flats of the head, as shown below. Pass the double twist wire through the nearest lock wire hole in the next bolt head or jam nut which will have a tightening effect (ref. para. 5.3.1.1). For very thin jam nuts, where wire locking so as to exert a tightening effect is likely to result in the lock wire "rolling" up over the shoulder of the jam nut (e.g., due to vibration, while in service), refer to Liaison Engineering for disposition.



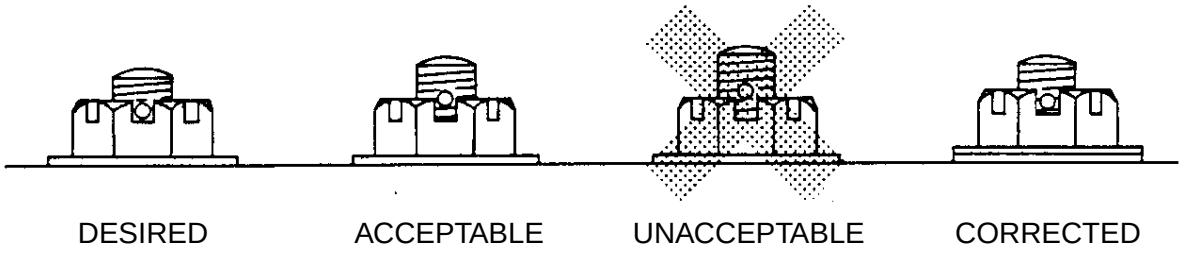
5.3.1.10 Unless otherwise specified, make pigtails 1/4" to 1/2" long (3 to 6 twists) after the wire has been put through the last hole. When wire locking Wiggins fittings located in the fuel tank, make pigtails 3 twists long (**1/4" maximum**). Cut the end of the pigtail cleanly with a diagonal cutter, ensuring the cut-off ends do not fall into any part and become a hazard. After cutting, to prevent the trimmed pigtail from becoming a safety hazard either bend the pigtail along the face of the nut as shown above or bend the pigtail back and under in the direction increasing the tension as shown below:



(3 twists and 1/4" maximum when wire locking
Wiggins fittings located in the fuel tank)

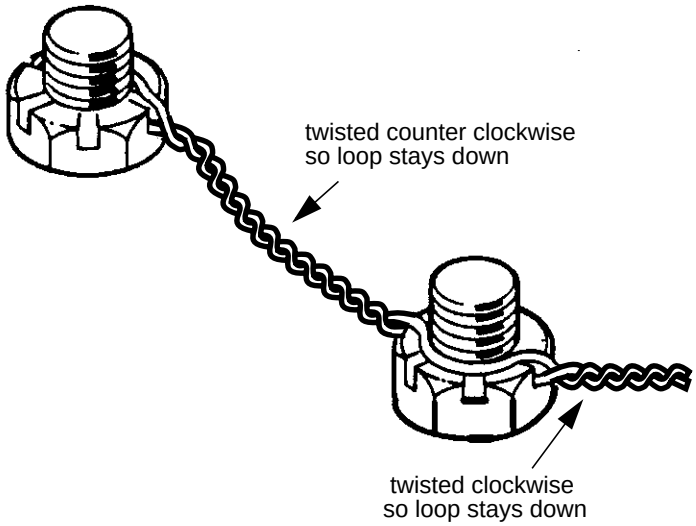
5.3.1.11 Shear applications are those where it is necessary to purposely break or shear the wire to permit the operation or actuation of emergency devices. For shear applications use the locking wire and the material as specified on the engineering drawing. When the material is not specified, use MS20995CY20 wire. Use the single wire method for shear applications.

5.3.1.12 Tighten castellated nuts to the minimum torque value and, if necessary, continue to tighten, without exceeding the maximum torque value, until a slot aligns with the hole. If more than 50% of the locking hole is above the nut castellation as shown below, either install the necessary number of washers under the nut or use a shorter fastener. Use washers of the same size and material as specified on the engineering drawing. Refer to PPS 2.20 for the thickness and number of washers allowed under the nut.



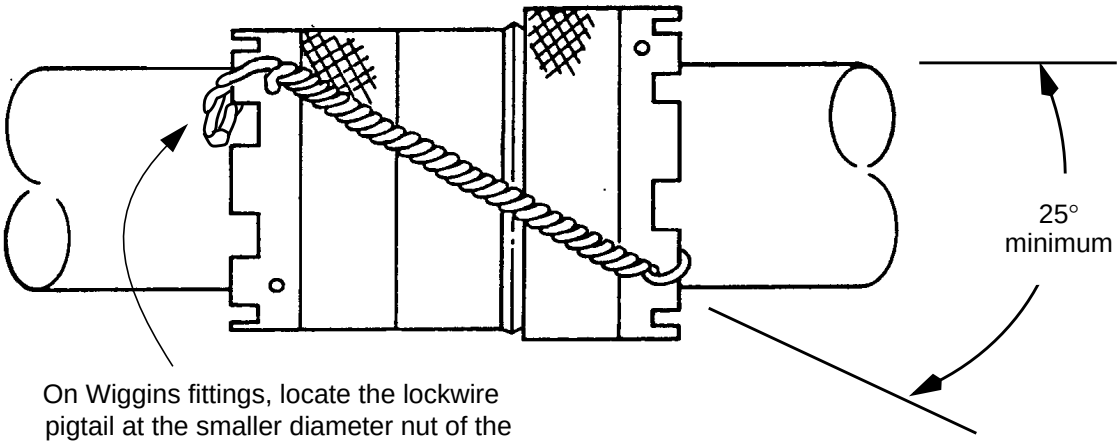
DESIRED ACCEPTABLE UNACCEPTABLE CORRECTED

5.3.1.13 When wire locking castellated nuts using the double twist method, place the loops over the nuts and around the threads as shown in the adjacent figure:



5.3.1.14 Wire lock roll pins only when specified on the engineering drawing. Use the single wire method when wire locking roll pins. Tie the wire through the roll pin hole and around the outer part of the roll pin taking the shortest path. Bend the pigtail so that it will not interfere with the relative movement of adjacent parts.

5.3.1.15 Before wire locking, **hand tighten Wig-O-Flex couplings** (**do not torque Wig-O-Flex couplings**). Lock the two halves of the coupling together as shown below. In general, it is not necessary to wire lock Wig-O-Flex couplings to the adjacent structure; however, when wire locking one-half coupling applications which call for only one-half of the coupling to be threaded onto a valve assembly, wire lock the coupling half to the adjacent part or structure. Do not wire lock in a hole that would make the lock wire longer than necessary. For wire locking Wiggins fittings located in the fuel tank, make pigtails 3 twists long (1/4" maximum); after cutting the end of the pigtail to length, bend the pigtail back and under, in the direction of increasing the tension, towards the body of the connector as shown.

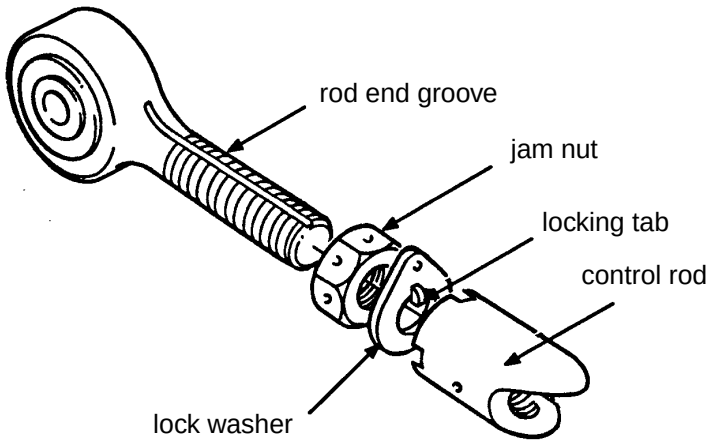


On Wiggins fittings, locate the lockwire pigtail at the smaller diameter nut of the fitting assembly as shown.

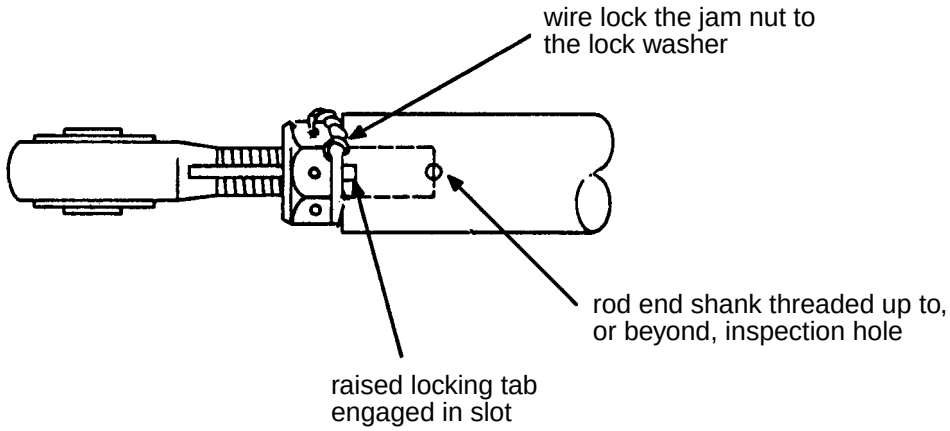
5.3.1.16 Wire lock NAS 513 lock washer assemblies as follows:

Step 1. Assemble the rod end terminal assemblies incorporating NAS 513 lock washers as shown. Note that the raised locking tab faces toward the slots in the control rod.

Step 2. After the rod end has been adjusted to its correct length, align the assembly to locate the lock washer tab in the nearest slot in the piston or control rod.



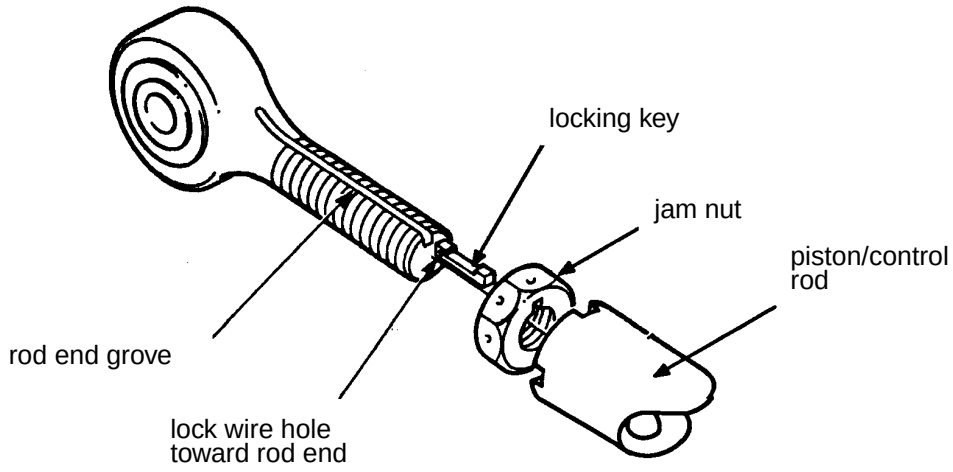
Step 3. Tighten the jam nut to secure the assembly. Use the double twist method when wire locking the jam nut to the lock washer as shown below:



Step 4. Visually check the completed assembly to ensure that the NAS 513 lock washer tab is engaged in a slot in the control rod, and that the rod end shank is threaded up to, or beyond, the inspection hole.

5.3.1.17 Wire lock NAS 559 Key Lock assemblies as follows:

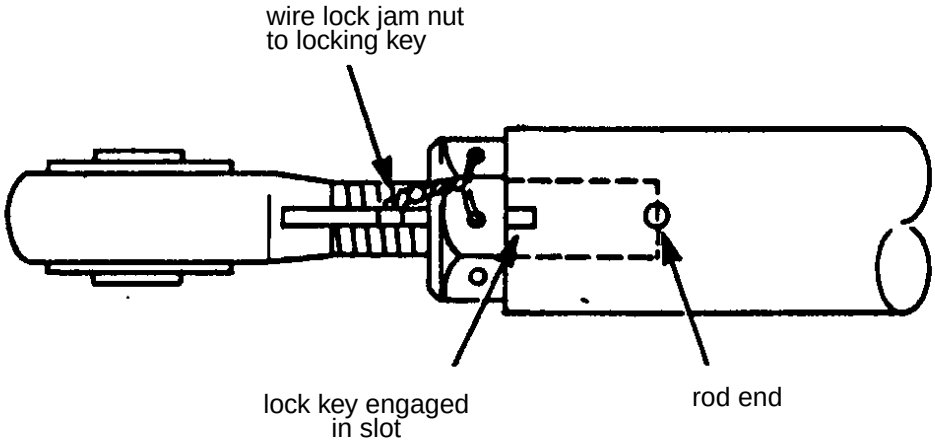
Step 1. Assemble the rod end assemblies incorporating NAS 559 locking keys as shown in the following figure. Note that the lock wire hole in the key faces towards the rod end.



Step 2. After the rod end has been adjusted to its correct length, align the assembly to locate the groove in the rod end precisely in line with the nearest slot in the piston or control rod.

Step 3. Tighten the jam nut to secure the assembly.

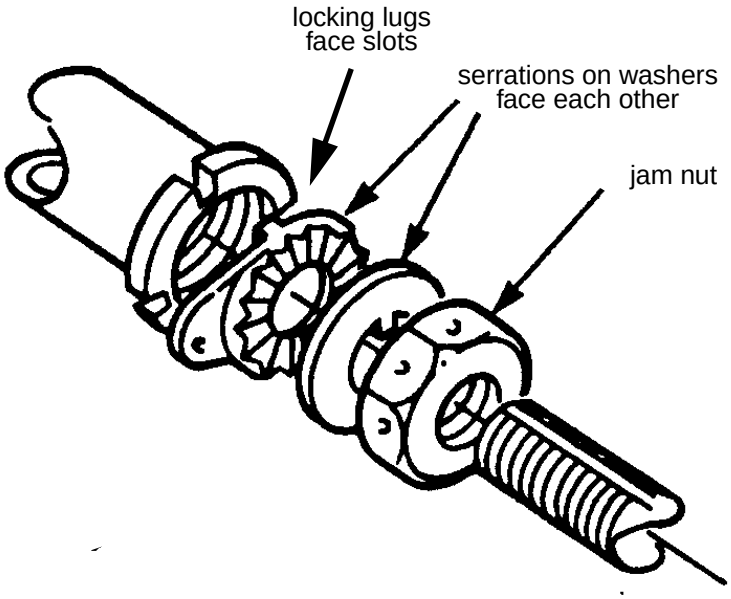
Step 4. Wire lock the jam nut to the locking key, using the double twist method as shown below. Check the completed assembly to ensure that the locking key is engaged in a slot in the piston, or control rod, and that the rod end shank is threaded up to, or beyond, the inspection hole.



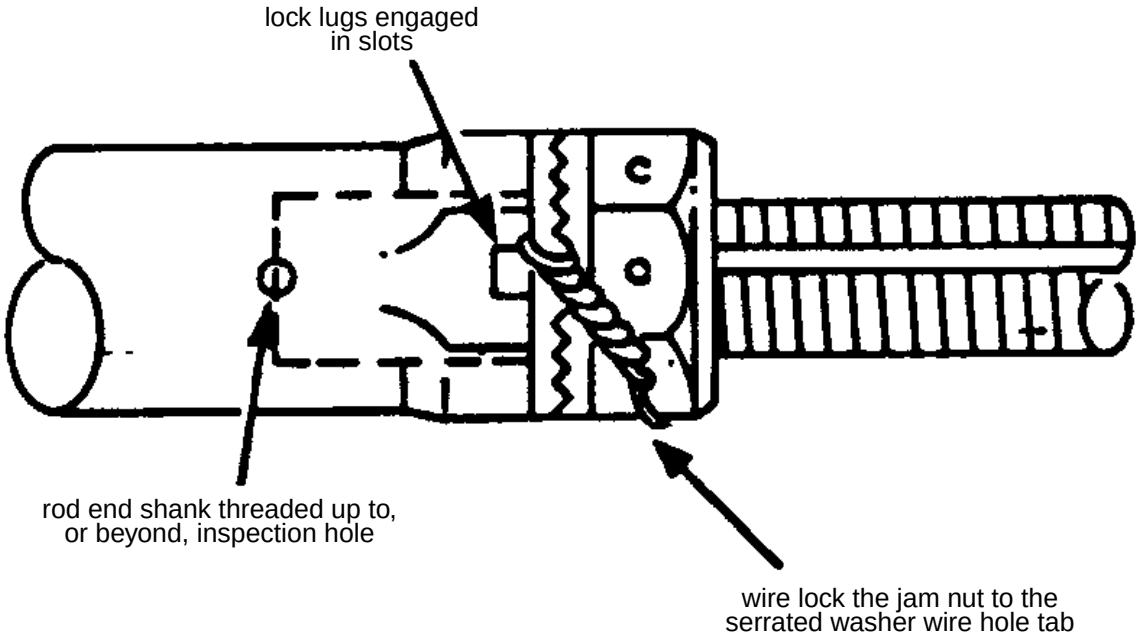
5.3.1.18 Wire lock NAS 1193 indexing lock washer assemblies as follows:

Step 1. Assemble the rod end terminal assemblies incorporating NAS 1193 indexing lock washers as shown below. Note that the serrations on the washers face each other and that the locking lugs on the inside washer face the slots in the piston or control rod.

Step 2. After the rod end has been adjusted to its correct length, align the 2 index lock washers so that the serrations are fully engaged and the lock lugs engage 2 slots in the control rod. Tighten the jam nut to secure the assembly.



Step 3. Wire lock the jam nut to the lug washer, using the double twist method as shown below:



Step 4. Visually check the completed assembly to ensure that the lock lugs are engaged in 2 slots in the piston, or control rod, and that the rod end shank is threaded up to, or beyond, the inspection hole.

5.3.1.19 Wire lock turnbuckle assemblies as follows:

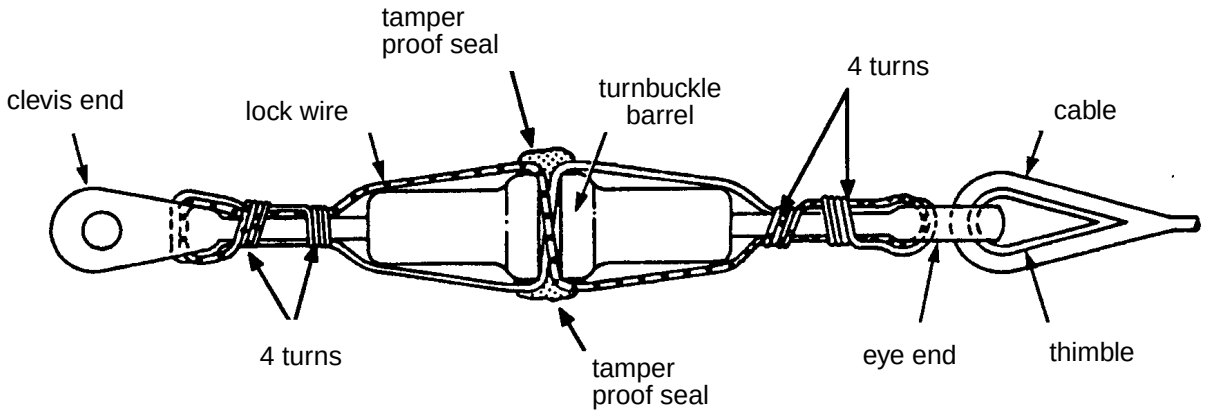
Step 1. Use the lock wire specified on the engineering drawing. If the engineering drawing does not specify which type of lock wire to use, use the lockwire specified in Table 6.

Table 6 - Lock Wire Selection for Turnbuckle Assemblies

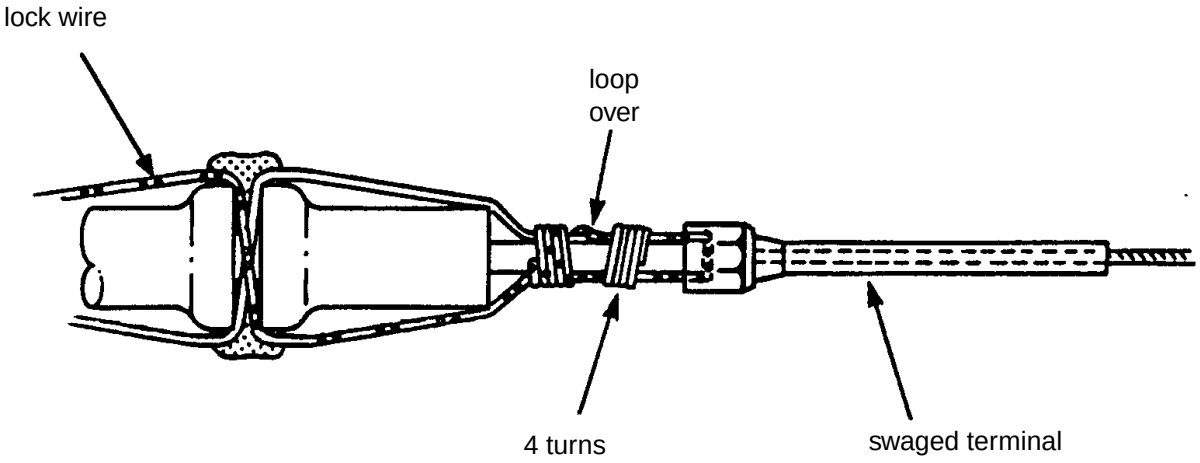
Cable Diameter	Turnbuckle Barrel Size Dash Number		Lock Wire Part Number
	AN155 or NAS649	MS21251	
1/16"	5 or 8	2	MS20995C20
3/32" or 1/8"	16 or 32	3	MS20995C32
5/32" - 5/16"	32, 46, 80,125 or 175	5, 6, 8, or 10	MS20995C41

Step 2. After adjusting the turnbuckle assembly to its locking position, pass the 2 wires through the hole in the centre of the barrel and bend ends 90° in the opposite directions and toward the ends of the barrel.

Step 3. If applicable, pass the wires through the holes in the eye ends or between the jaws of the clevis ends. Bend the wires back toward the centre of the barrel and wrap 4 turns around the shank of the terminal, binding the other lock wire in place as shown below:



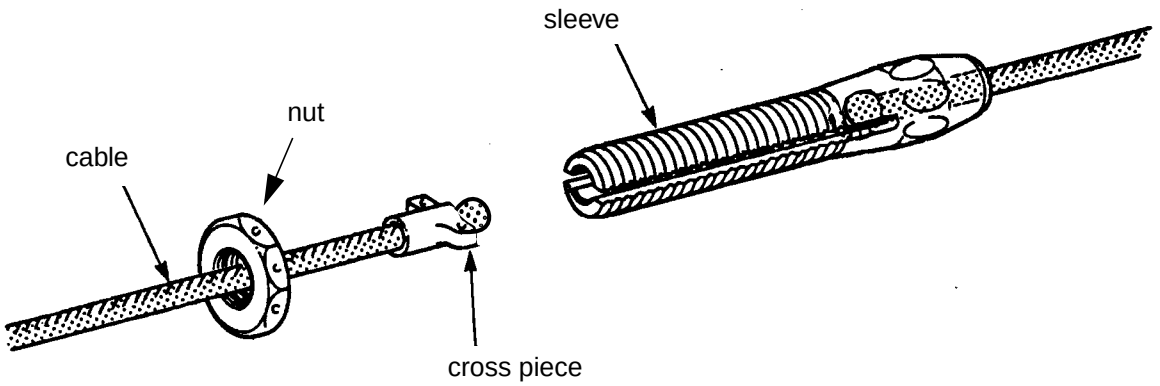
Step 4. When wire locking a swaged terminal, pass one wire through the hole provided in the terminal and loop over the free end of the other wire. Wrap both ends 4 turns around the shank as shown below:



Step 5. Verify that the cable tension is correct to the values specified on the engineering drawing, and then apply the white tamper proof seal (ref. para. 4.1.2).

5.3.1.20 Assemble and wire lock VS100 or VS150 series cabuckles as follows:

Step 1. Assemble cabuckles by aligning the cross piece on the first cable assembly end with the slots in the sleeve which is attached to the end of a second cable assembly. Insert the cross piece into the sleeve and bring up the jam nut and tighten to secure the assembly as shown below. Cabuckles are in position to be wire locked after the cable assembly has been rigged and tensioned and the threaded end of the cabuckle sleeve protrudes a minimum of 1 1/2 threads beyond the cabuckle nut.



Step 2. Use the lock wires specified on the engineering drawing. If the engineering drawing does not specify the type of lockwire to use, use the lockwire specified below.

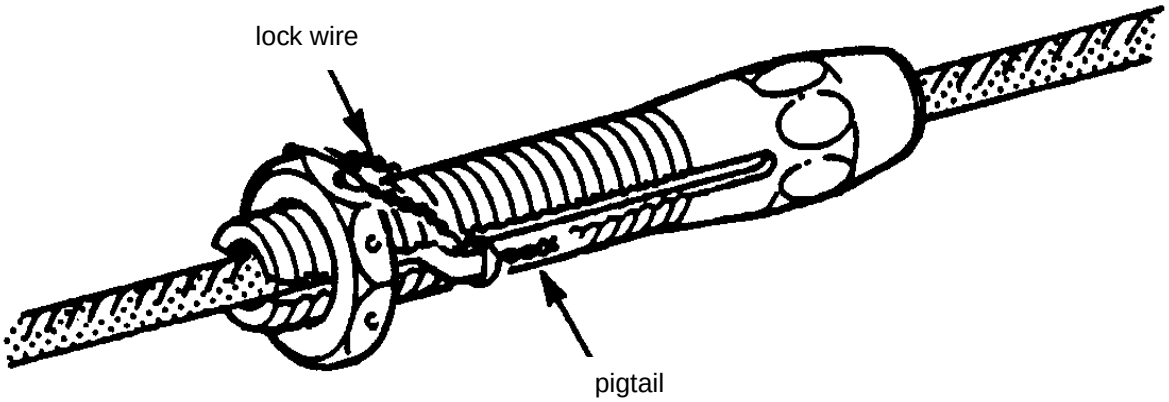
Cable Diameter (inches)	**VS100 and VS150 series cabuckles**			**Lock Wire Part Number**
	Sleeve Dash Number	**Cross Piece Dash Number**	**Nut Dash Number**	
1/16"	S2	C2	N2	MS20995C20
3/32"	S3	C3	N3	MS20995C32
1/8"	S4	C4	N4	
5/32"	S5	C5	N5	MS20995C41
3/16"	S6	C6	N6	

Step 3. Unless otherwise specified, use the double twist method to wire lock cabuckle assemblies.

Step 4. After adjusting the cabuckle assembly to its locking position, push the lock wire through one of the holes in the cabuckle cross piece. Then push the wire through the nearest hole in the cabuckle nut and, finally, through the second hole in the cross piece.

Step 5. Form a pigtail according to para. 5.3.1.10 and bend back the pig tail towards the centre of the cabuckle sleeve.

Step 6. After wire locking, a minimum protrusion of 1 1/2 threads beyond the cabuckle nut must be visible.



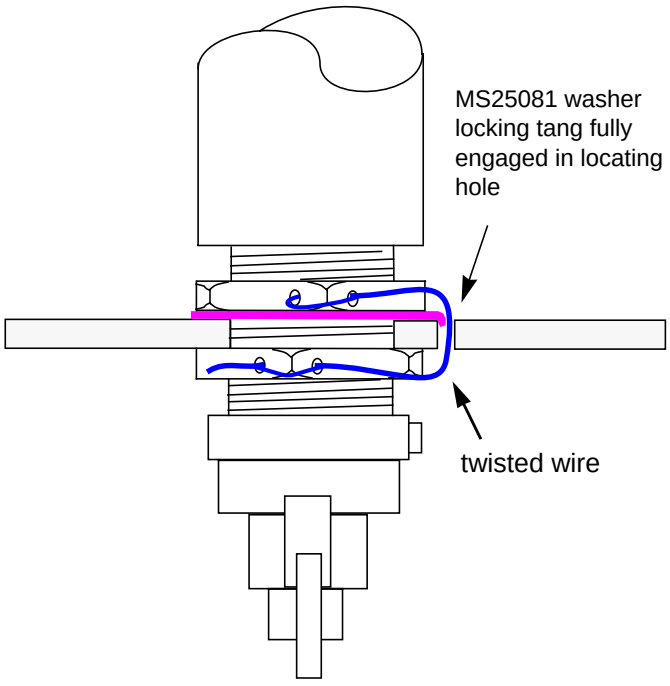
5.3.1.21 After the final adjustment and tightening of jam nuts, wire lock all DSC 167, DSC 168, DSC 169 and DSC 170 limit switches as follows.

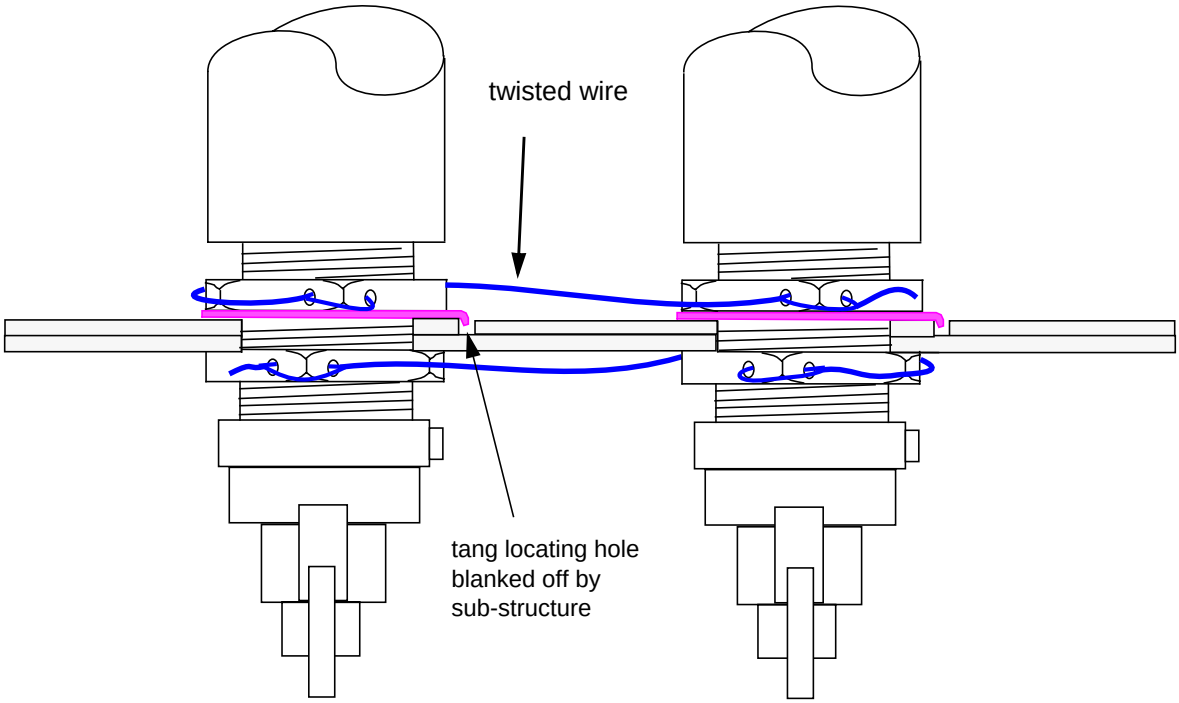
Step 1. Unless otherwise specified, use MS20995C20 lock wire.

Step 2. Wire lock the upper and lower jam nuts on the limit switch together by passing the lock wire through the tang locating hole in the structure as shown below.

Step 3. Ensure that the locking tang on the MS25081 keyed washer is fully engaged in the tang locating hole in the structure.

Step 4. If the assembly prevents wire locking through the tang locating hole, wire lock the limit switch jam nut to the jam nut of the adjacent limit switch as shown in the following figure, on the same side of the structure.





5.3.1.22 Wire lock all limit stop studs or bolts, after the final adjustment and tightening of jam nuts, using one continuous length of double twist wire, as follows:

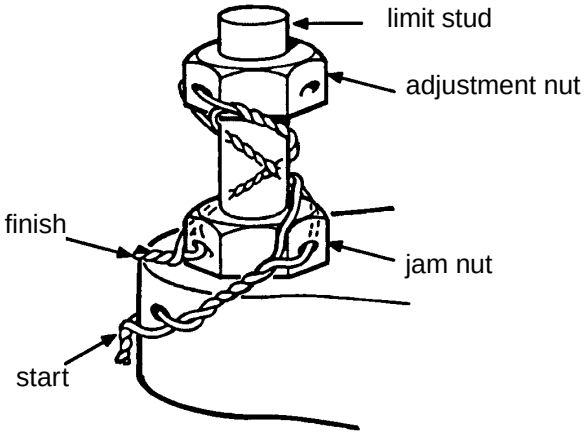
Step 1. Begin wire locking at the lock wire hole on the structure or assembly. If two wire lock holes are provided in the assembly, start at the hole which provides the most resistance to loosening of the wire.

Step 2. Run the wire through one of the jam nut holes.

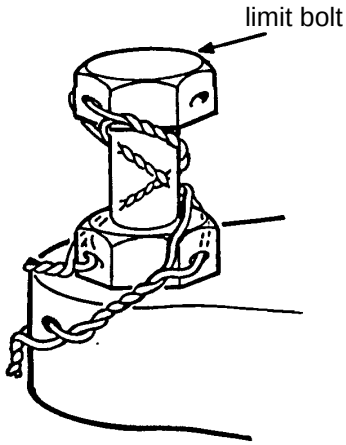
Step 3. Continue the lock wire around the stud, approximately 3/4 of a turn, and through the hole in the stud adjustment nut or the bolt head.

Step 4. Run the lock wire back down the stud, approximately 3/4 of a turn in the same direction, and through the hole on the jam nut adjacent to the first wire lock as shown on the next page.

Step 5. Using a standard pigtail, terminate the lock wire at the jam nut.

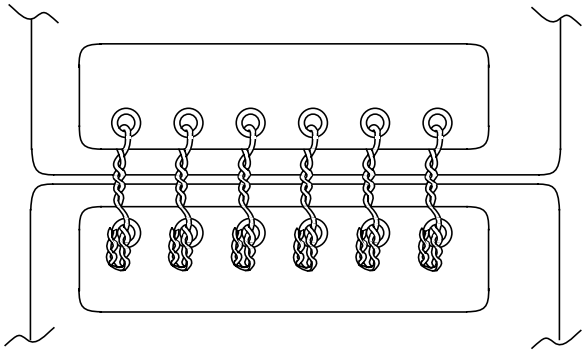


Limit Stud



Limit Bolt

5.3.1.23 If the engineering drawing specifies wire locking of insulation blankets secured using eyelets, wire lock the blanket as shown in the adjacent figure:



5.3.2 Wire Locking using Safety Cable

5.3.2.1 Install safety cable so that any tendency of the wire locked assembly to loosen will be counteracted by the corresponding increase in tension on the cable.

5.3.2.2 Install only new safety cables and ferrules. Reuse is not acceptable.

5.3.2.3 Before installation, ensure safety cables are free of defects (e.g., nicks, fraying, kinks, etc.).

5.3.2.4 Unless otherwise specified on the engineering drawing, do not use safety cable for wire locking if the distance between any two termination points exceeds 6".

5.3.2.5 Install safety cable through the holes intended for wire locking. Under-torquing or over-torquing of a nut or bolt to obtain proper alignment is not acceptable.

5.3.2.6 When wire locking bolts using safety cable, install the safety cable in two or three bolt patterns. Installation in two bolt patterns is preferred when wire locking an even number of bolts.

5.3.2.7 Do not use safety cable for wire locking of Wiggins fittings located inside the fuel tank.

5.3.2.8 Use the following sequence when wire locking using safety cable:

Step 1. Thread a safety cable assembly through the parts to be wire locked.

Step 2. Insert the end of the safety cable through the ferrule.

Step 3. Apply tension to the safety cable so that the following mid span maximum flex limits are met when light finger pressure (approximately 2 lbs) is applied:

Span	0.5"	1.0"	2.0"	3.0"	4.0"	5.0"	6.0"
Maximum Flex	0.062"	0.125"	0.188"	0.188"	0.250"	0.250"	0.312"

Step 4. Crimp the ferrule in place using a safety cable ferrule crimping tool.

Step 5. Cut off the excess safety cable within 0.030" of the end of the ferrule.

5.4 Cotter Pinning

5.4.1 Always use new cotter pins on each application. Do not reuse removed cotter pins.

5.4.2 When wire locking cotter pins, use the cotter pins specified on the engineering drawing. If the engineering drawing does not specify the type of cotter pins, or in cases where the specified cotter pin is not available, select an MS24665 cotter pin of sufficient length, and of the largest nominal diameter which the holes will accommodate, from the following table.

Table 7 - Cotter Pin Selection

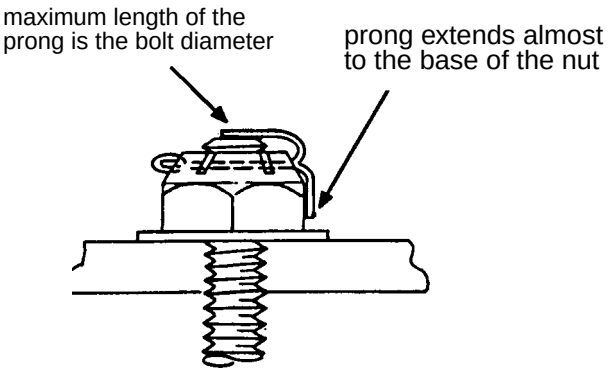
MS24665 Cotter Pin Selection

Length (inches)	**Nominal Diameter** (inches)								
	1/32"	**3/64"**	**1/16"**	**5/64"**	**3/32"**	**1/8"**	**5/32"**	**3/16"**	**1/4"**
3/4"	-24	-88	-153	-229	-300	-368	---	---	---
1 1/2"	-28	-92	-159	-235	-306	-374	-441	-513	---
3"	-32	---	-164	-240	-312	-380	-448	-520	-643

5.4.3 Use a cotter pin whose length is 1 1/2 to 2 times the diameter of the castellated nut, rod end or clevis pin to be safetied. Cotter pins are normally available in 3 standard lengths for each nominal diameter and if required trim to the desired length.

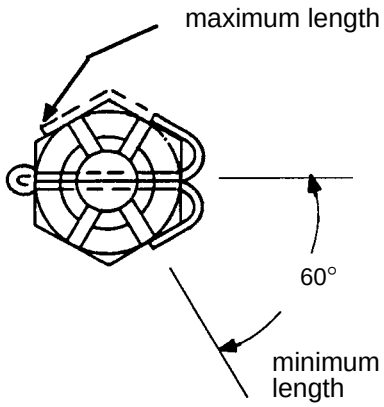
5.4.4 After installation, carefully bend the cotter pin prongs in such a way that the ends of the prongs are tight against the pin or nut.

5.4.5 The preferred method of installing a cotter pin in a castellated nut assembly (including self locking castellated nuts) is with the head of the cotter pin aligned with, and firmly seated in the slot of the nut, with one prong of the pin bent upward and the other downward as shown.

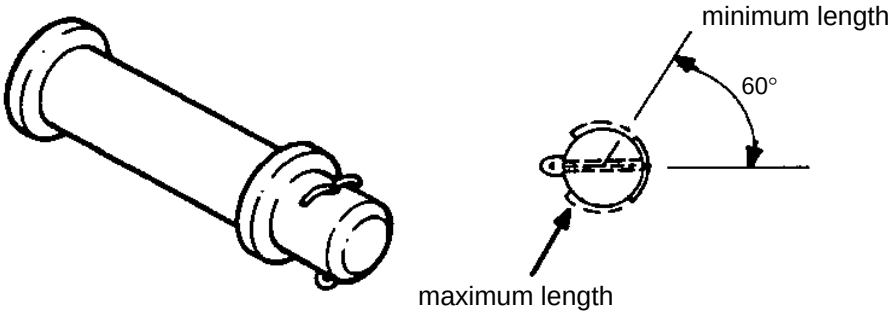


5.4.6 The maximum length of the prong bent over the bolt head shall not extend beyond the outside diameter of the bolt and if necessary cut the prong to length. Cut the prong bent downward to a length that extends almost to the base of the nut and does not touch the surface of the washer.

5.4.6.1 If the preferred method of installation would cause fouling of adjacent structures or mechanisms (i.e., the prong bent over the bolt end is bent open in service), an alternate method may be used, wherein the cotter pin is installed with the axis of the eye parallel to the shank of the bolt and the prongs bent around the nut. If necessary cut the prongs to length as shown.

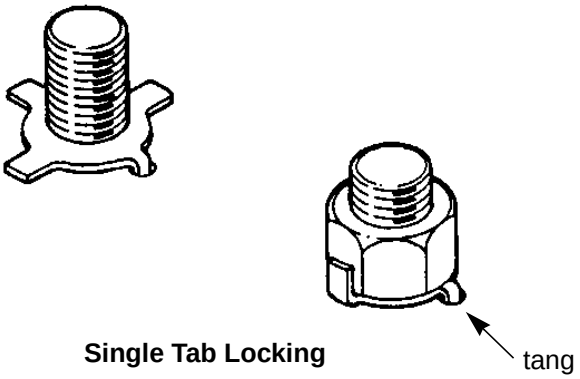


5.4.7 For clevis pins or rod ends, install the cotter pin with the axis of the eye parallel to the shank. Bend the prongs around the shank of the clevis pin or rod end as shown below.

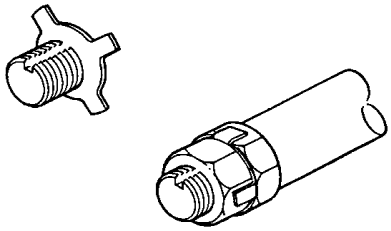


5.5 Tab Locking With Tab Washers or Strap Washers

5.5.1 Tab locking is the application of tab washers to lock installed parts (usually nuts) and prevent them from loosening. To lock a part, bend at least one tab over to the part and, in the case of a washer without a tang, bend another tab to the adjacent part to restrain the relative movement. Use bend tab washers and strap washers only once.



Single Tab Locking

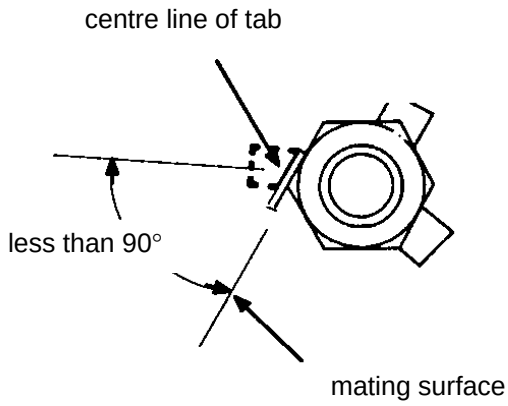


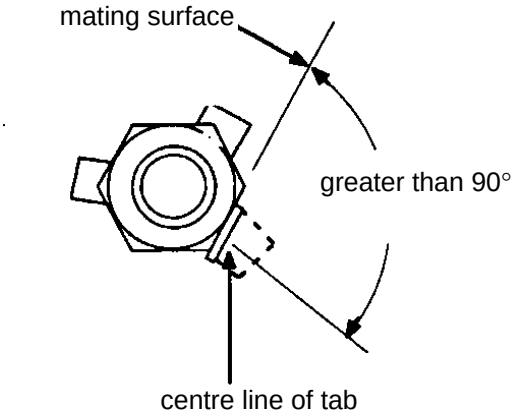
Double Tab Locking

5.5.2 Use tab washers only when specified on the engineering drawing.

5.5.3 Take care not to bend the tab in a radius small enough to cause a crack to develop at the bend.

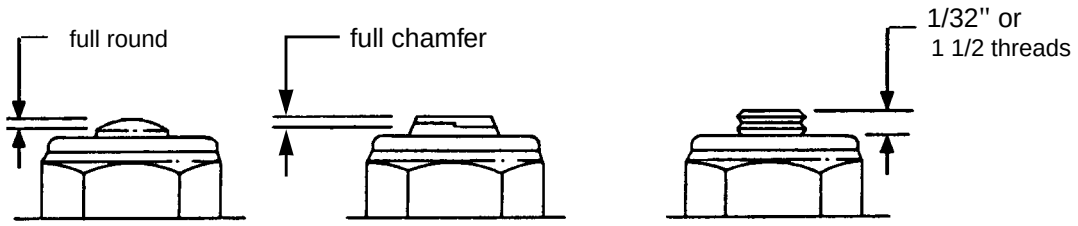
5.5.4 If the tabs are not at 90° angles to the surface over which one must be bent, take care to bend the tab which will tend to tighten the part (see following).





5.6 Installation of Self Locking Nuts

5.6.1 When installing self locking nuts, ensure that the threaded end of installed fasteners protrudes beyond the nut by at least the full round or chamfer or, in the case of flat end fasteners, by at least 1/32" or 1 1/2 threads, whichever is shorter (see below).

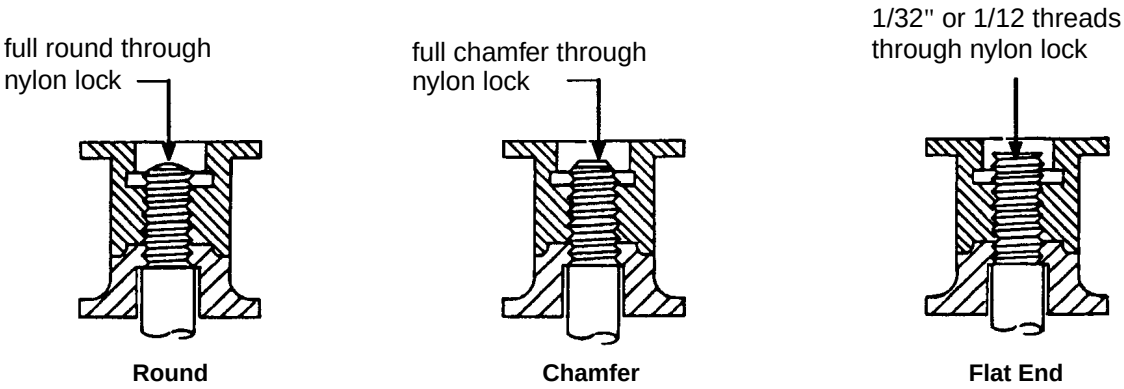


5.6.2 Except when using self locking castellated nuts, do not use self locking nuts on bolts with cotter pin holes in the threaded portion of the shank. When using self locking castellated nuts on cotter pin type bolts, cotter pin self locking castellated nuts after installation.

5.6.3 Do not use thread taps in self locking nuts.

5.7 Delron Sandwich Panel Fasteners

5.7.1 When bolts or screws are being installed into Delron inserts incorporating self-locking nylon inserts, ensure that the threaded end of the fastener protrudes through the nylon locking insert at least the full round or chamfer or, in the case of flat end fasteners, at least 1/32" or 1 1/2 threads, whichever is shorter as shown below.



5.8 Crimping or Staking Hinge Stock

5.8.1 Except when secured with a mechanical hinge pin retainer, secure hinge pins in formed or extruded hinge stock by crimping or staking, as applicable, as follows (see Figure 3). As this technique involves a recessed hinge pin and crimping or staking of the hinge stock, refer to Liaison Engineering for disposition if the width of the last hinge loop is less than 0.250".

Step 1. Trim the hinge pin as necessary to ensure a recess of 0.10" - 0.15" on each end of the hinge between the end of the pin and the end of the hinge stock as shown.

Step 2. Crimp the formed hinge stock and stake or crimp extruded hinge stock, as applicable, on both ends of the hinge as shown.

5.8.2 Take care to prevent the pin from binding against the hinge stock when crimping or staking for pin retention.

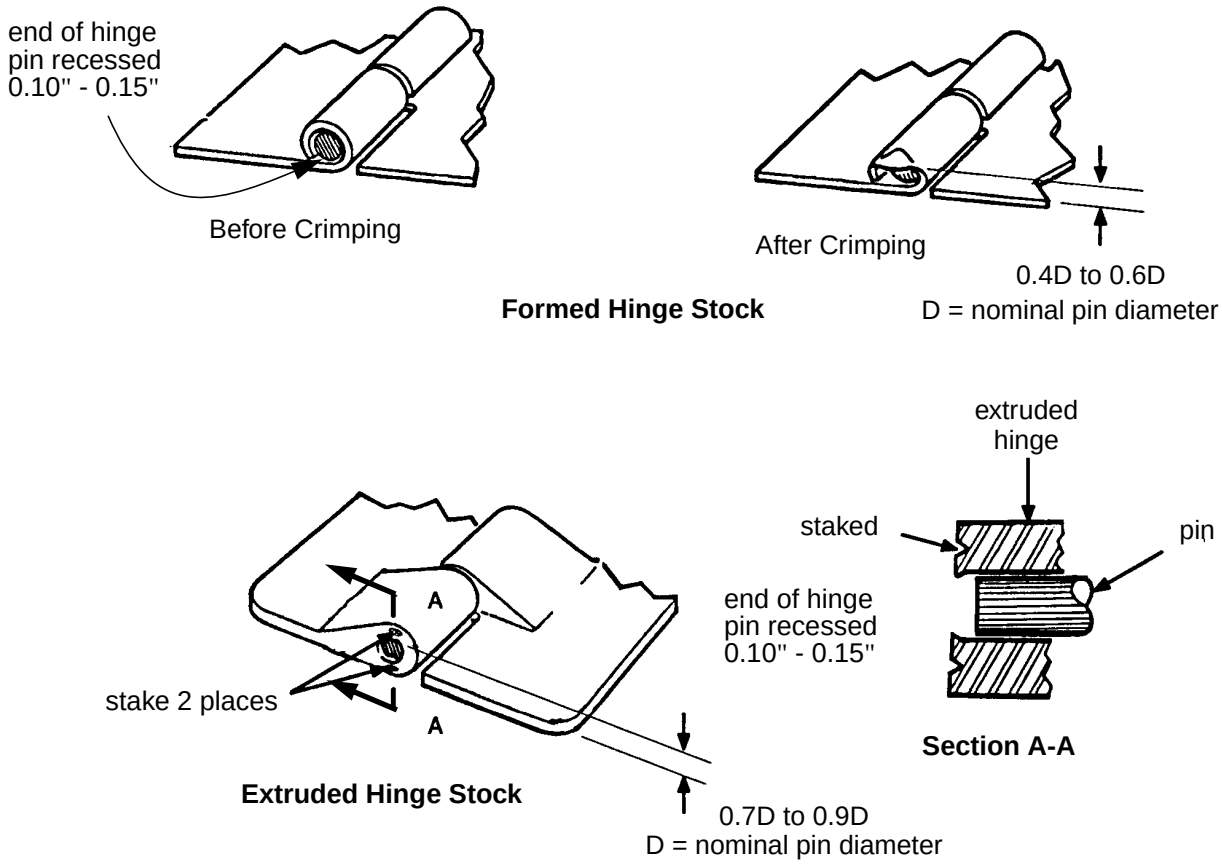


Figure 3 - Crimping/Staking of Hinge Stock

6 Requirements

6.1 All safetying devices shall be so installed as to ensure a positive locking of the assembly being safetied.

6.2 Scored, over-stressed or loose wires are not acceptable.

6.3 Cracked or broken cotter pins or tabs are not acceptable.

6.4 For tensioned turnbuckles that have a clip lock or lock with a broken or missing tamper proof seal, check for correct tension and if necessary, readjust, lock and have a new tamper proof seal applied as specified in section 5.2 or section 5.3, as applicable.

6.5 Tamper proof seals shall only have been applied after verifying correct tension. Take care to ensure that tamper proof sealant is not applied to components inside fuel cells, oxygen components, into Phillips, slotted or Allen recesses and it should not contact any threaded surfaces.

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 Ensure sufficient ventilation when applying tamper proof sealant, especially in confined areas.

7.4 Avoid skin and eye contact with tamper proof sealant. Wear chemical resistant protective gloves when applying tamper proof sealant. If skin contact occurs, wash the affected area immediately and thoroughly with soap and water. If eye contact occurs, immediately flush eyes with large quantities of water at an eye-wash station; after initial flushing, remove any contact lenses and continue flushing for at least 15 minutes. Report any contact with tamper proof sealant to the Health Centre. Take care when applying tamper proof sealant in overhead applications to avoid applying excess sealant, as drips may result.

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.