STANDARD OVERHAUL PRACTICES MANUAL

INSTALLATION OF SAFETYING DEVICES

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STANDARD OVERHAUL PRACTICES MANUAL

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To: All holders of INSTALLATION OF SAFETYING DEVICES 20-50-02.

Attached is the current revision to this STANDARD OVERHAUL PRACTICES MANUAL

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TABLE OF CONTENTS

STANDARD OVERHAUL PRACTICES MANUAL

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Revision		Filed		Revision		Filed	
Number	Date	Date	Initials	Number	Date	Date	Initials

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Temporary Revision		Inserted		Removed	
Number	Date	Date	Initials	Date	Initials

Temporary Revision		Inserted		Removed	
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Number	Date	Date	Initials	Date	Initials

Temporary Revision		Inserted		Removed	
Date	Initials	Number	Date	Date	Initials

INTRODUCTION

1. General

A. The instructions in this manual tell how to do standard shop procedures during maintenance functions from simple checks and replacement to complete shop-type repair.

B. This manual is divided into separate sections:

(1) Title Page

(2) Transmittal Letter

(3) Highlights

(4) Effective Pages

(5) Contents

(6) Revision Record

(7) Record of Temporary Revisions

(8) Introduction

(9) Procedures

C. Refer to SOPM 20-00-00 for a definition of standard industry practices, vendor names and addresses, and an explanation of the True Position Dimensioning symbols used.

D. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.

E. If the component overhaul instructions are different from the data in this subject, use the component overhaul instructions.

INSTALLATION OF SAFETYING DEVICES

1. INTRODUCTION

A. The information in this subject comes from Boeing Process Specification BAC5018 for installation of safetying devices.

B. The data is general. It is not about all situations or specific installations. Use it as a guide to help you write minimum standards.

C. Refer to SOPM 20-00-00 for a list of all the vendor names and addresses.

2. GENERAL

A. Use nickel alloy or CRES wire per MS20995 for all safety wiring unless the overhaul instructions are different.

B. Copper wire, 0.020 inch diameter, must be used on emergency devices, and where a seal is required, such as on portable fire extinguishers, first aid kits, emergency valves and oxygen regulators. Make a 3- to 6-twist pigtail near the ends of the wire, then compress the metal pellet on the wire in such a manner that the wire cannot be removed unless you break the pellet or the wire.

C. To prevent galvanic corrosion, use clad 5056 aluminum alloy wire for safety wire that will touch magnesium.

D. Corrosion and heat resistant safety cable can be used as an alternative to safety wire only when permitted by the overhaul instructions. Such instructions will permit safety cable only on bolts or screws 0.250-inch diameter or smaller, which have the holes drilled through the center of the head. Safety cable will not be permitted on fasteners which have the holes drilled through the corners of the hexagon.

E. Do not use the safety wire, safety cable or ferrule again after it is removed.

F. Install the safety wire or cable so that it will be in tension if the part tries to loosen.

G. Make a three-to-six-twist pigtail at the end of the wiring. Bend the pigtail back or under to give the wire ends protection and not catch something else.

3. SAFETY WIRE INSTALLATION

A. Double-Twist Wire and Cable Application (Figure 1)

(1) The double-twist method is required for all safety wiring, except as specified in the overhaul instructions, when permitted by Paragraph 3.B. below, or when safety cable is used.

(2) Safety wire diameter must be 1/3 to 3/4 the diameter of the hole it will go through, 0.032-inch diameter minimum, or except as permitted by Paragraph 3.A.(3).

(3) Safety wire of 0.020-inch diameter can be used if the wire hole in the device is 0.045-inch diameter or smaller, or the distance between the parts is less than two inches and the safety wire hole diameter is 0.045-0.062 inch diameter.

(4) For multiple fastener groups:

(a) If the multiple fasteners are 4-6 inches apart, safety-wire no more than 3 in a series.

(b) If the multiple fasteners are more than 6 inches apart, do not safety-wire them in series unless there are tie points on adjacent parts that make the span of the wire shorter than 6 inches.

(c) If the multiple fasteners are less than 4 inches apart, safety-wire together no more than can be wired with a 24-inch length of wire.

(5) When safety cable is used:

(a) Safety-cable no more than 3 fasteners in a series.

(b) Fasteners must be no more than 6 inches apart.

(c) The safety cable must have no nicks, frays, kinks or other damage.

(d) The safety cable must get no other tension than that put on the cable by the swaging tool.

(e) If the overhaul instructions do not specify the size, use 0.030-0.034 - inch diameter cable in holes up to 0.047 inch diameter, and use 0.020-0.026 - inch diameter cable in holes up to 0.035 inch diameter.

B. Single-Wire Application (Figure 1)

(1) The single-wire method is acceptable for the following applications, unless the overhaul instructions are different.

(a) Small screws in a closely spaced, closed pattern, such as a square, rectangle, triangle or circle.

(b) Parts in electrical systems where access or frequent removal make the double twist method impractical.

(2) When you use the single-wire method, use the largest standard size wire that can go through the safety wire hole.

NOTE: Boeing standard sizes are as follows: Monel – 0.020, 0.032, 0.040, 0.051 and 0.091 inch. Corrosion resistant steel and aluminum alloy – 0.020, 0.032, 0.041, 0.047 and 0.091 inch.

C. Safety Wiring Bolts, Screws and Studs (Figure 1 thru Figure 3)

(1) Install the safety wire so that loop through the fastener will be put in tension if the fastener tries to loosen. Typical installations are shown of fasteners with right-hand threads. Wire left-hand-threaded fasteners in the opposite direction. But put a right-hand twist in the wire for all double-twist installations.

(2) With the wire in tension, twist the strands until the end of the twisted section is within 1/8 inch of the fastener. To get sufficient tension and not put too much stress in the wire, apply the number of twists per inch of wire per Figure 4. (One twist of a pair of wires is a 180-degree angle change in the position of one wire relative to the other, when the wires are twisted through half a revolution.)

(3) The loop of wire that does not go through the hole can go around or over the fastener, as shown. But the loop must be held down by the manner in which the wire is twisted.

(4) On castellated nuts, make the loop go along the side of the stud or around the nut, as shown in Figure 2.

CAUTION: DO NOT TIGHTEN OR LOOSEN THE NUT OUTSIDE ITS SPECIFIED TORQUE RANGE TO INSTALL SAFETY WIRE.

(5) When you safety-wire castellated nuts, tighten the nut to the minimum specified torque. If necessary, tighten more until a slot aligns with the safety-wire hole in the bolt or the stud.

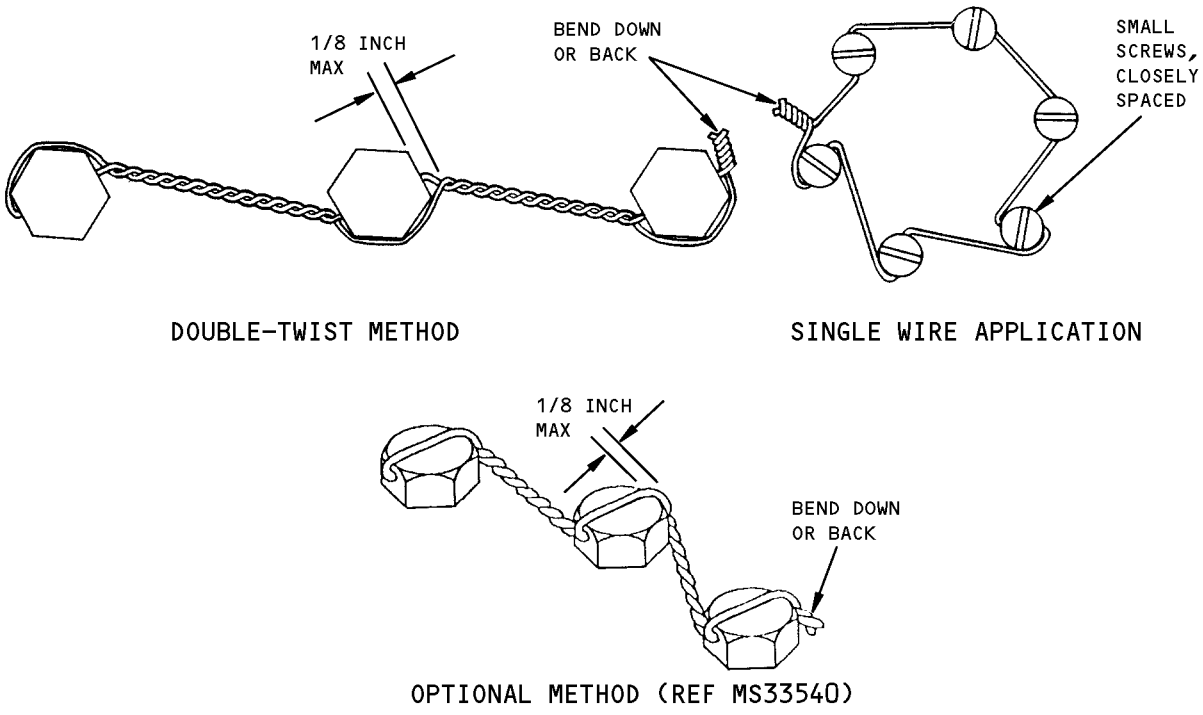
(6) If the bolts, such as NAS673-series titanium bolts, have the safety-wire hole drilled at an angle through flats of the hex head, install the safety wire as shown in Figure 3.

D. Safety cabling bolts, Screws and Studs (Figure 5)

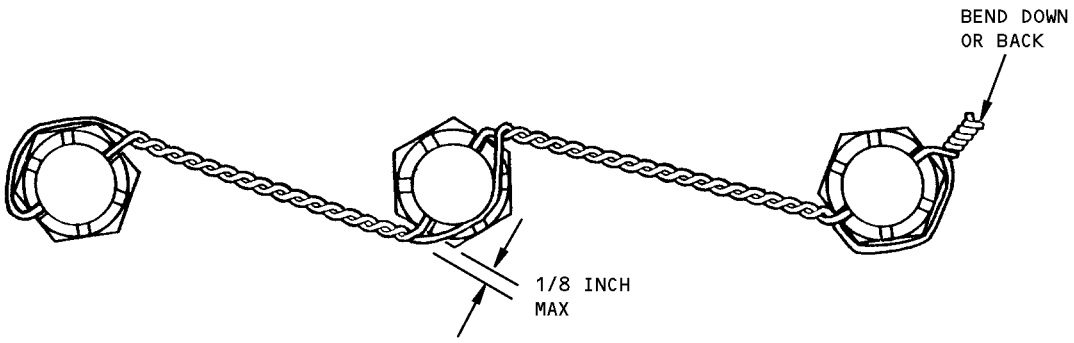
(1) Install the safety cable so the cable will be put in tension if the fastener tries to loosen. Left-hand threaded items are safety-cabled opposite of right-hand threaded items.

(2) Do not tighten or loosen the fastener outside its specified torque range to align the safety-wire holes.

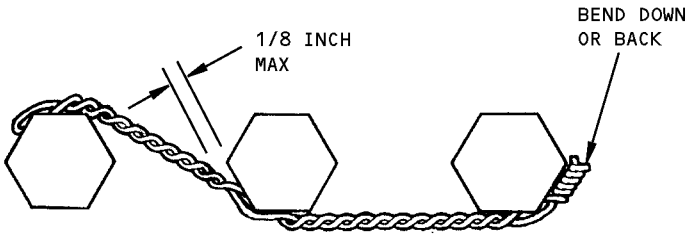
(3) Before you swage the ferrule onto the cable, pull the cable tight. Let the installation tool apply the correct tension. After the cable installation is complete, the tension is acceptable if the cable is within the flex limits shown in Figure 6.



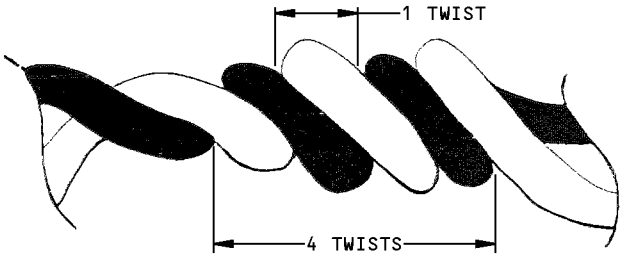
Typical Safety Wire Installation - Right Hand Threaded
Figure 1



Safety Wire Installation - Castellated Nuts
Figure 2



Safety Wire Installation for Bolts with Wire Holes Near Bolthead Corners
Figure 3



WIRE DIAMETER (INCH)	LESS THAN 0.019	0.019-0.026	0.027-0.042	0.043-0.065	MORE THAN 0.065
TWISTS PER INCH	11-14	9-12	7-10	5-8	4-7

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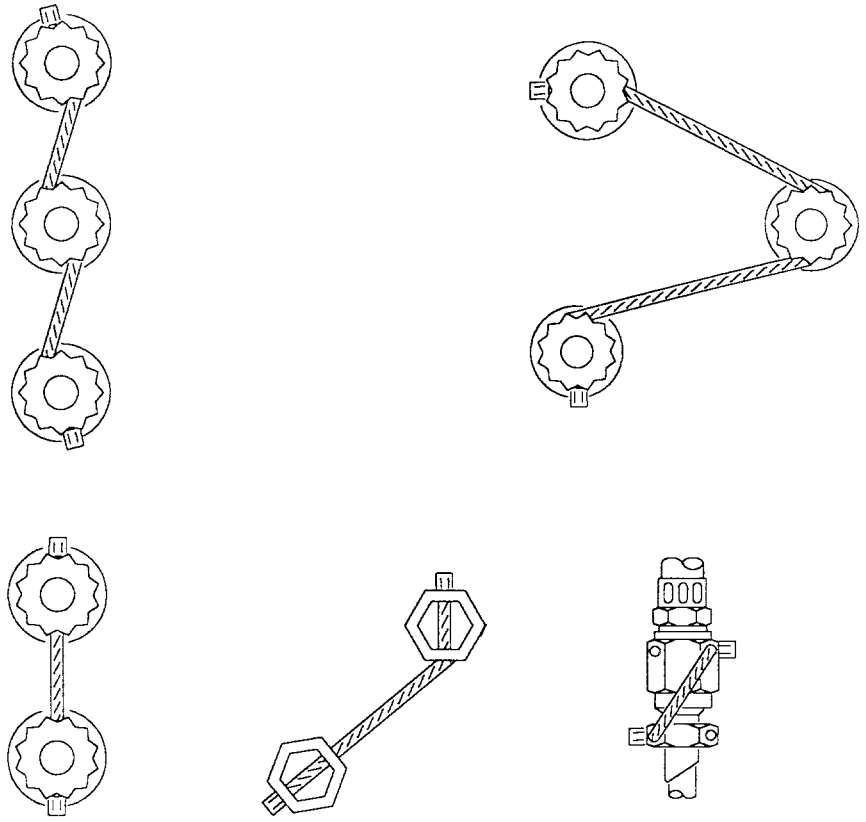
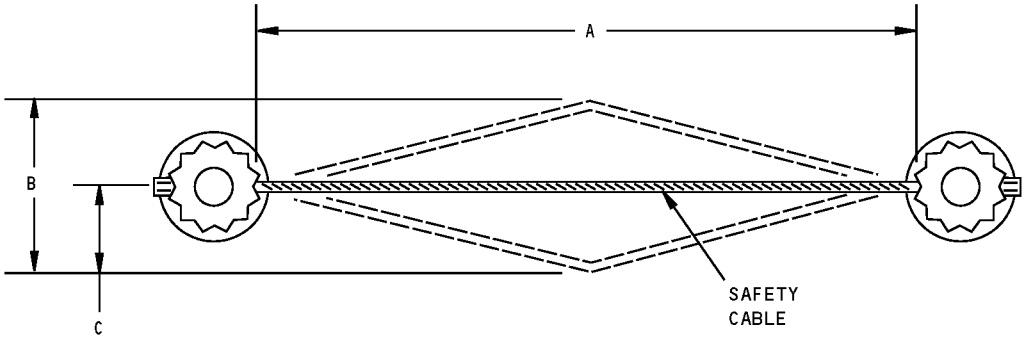
Safety Wire Twisted Details
Figure 4



Safety Cable Installation Examples
Figure 5



ASSEMBLY LENGTH, A	MAXIMUM FLEX AT CENTER	
	SIDE-TO-SIDE TOTAL, B	ONE-SIDED DIRECTION, C
0.5	0.125	0.062
1.0	0.250	0.125
2.0	0.375	0.188
3.0	0.375	0.188
4.0	0.500	0.250
5.0	0.500	0.250
6.0	0.625	0.312

ALL DIMENSIONS ARE IN INCHES

Safety Cable Flex Limits
Figure 6

4. INSTALLATION OF COTTER PINS

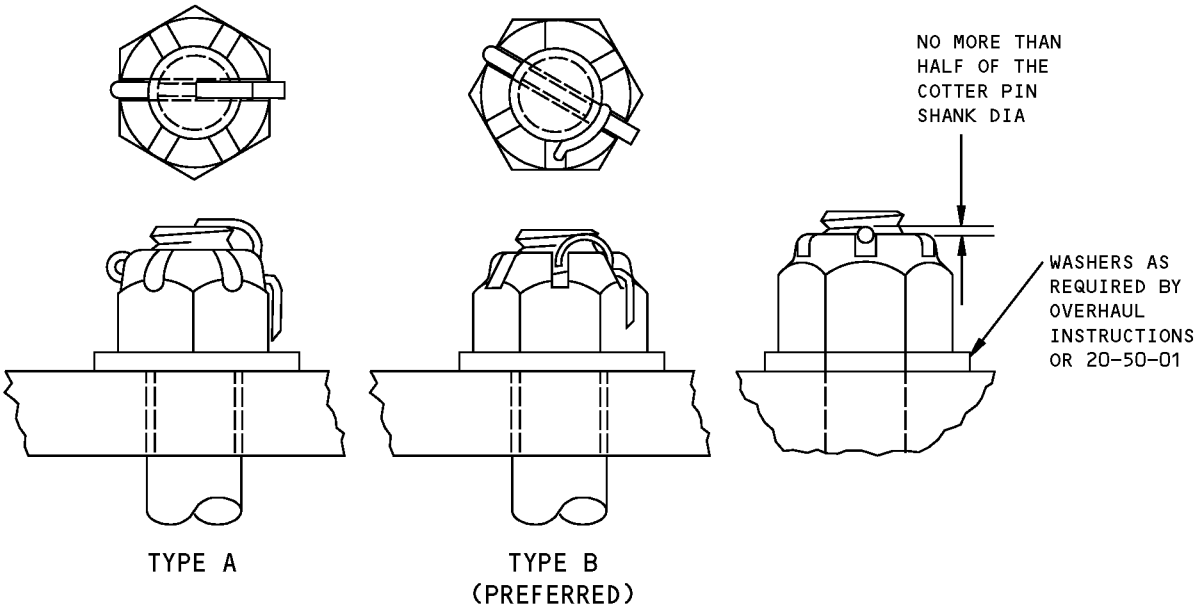
A. Install cotter pins in castellated nuts to agree with the methods shown in Figure 7. Make sure you install the pin with its head parallel to the slot in the nut. Make sure the eye of the pin is firmly against the nut for minimum axial movement of the pin after installation. Use the Type B method whenever you can, unless the access is too tight to help prevent snags and decrease safety hazards. Do not use cotter pins again after they are removed.

B. Cotter pins in castellated nuts must not extend more than one-half of the cotter pin diameter above the top of the slot, as shown in Figure 7. If necessary, adjust the cotter pin hole location with a different bolt grip length or more washers per SOPM 20-50-01.

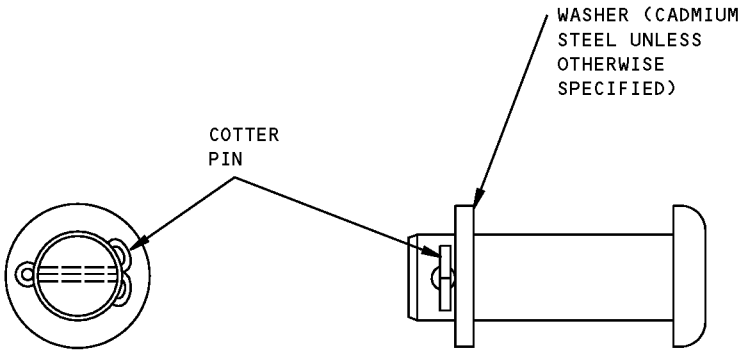
C. Use the largest nominal diameter cotter pin which can go through the hole or in the slots. Use of a smaller pin for a nut, bolt, or screw is limited as follows:

Thread Size	Minimum Pin Size, Inch
No. 6	0.028
No. 8, 10; 1/4, 5/16 inch	0.044
3/8 thru 1/2 inch	0.072
9/16 thru 1 inch	0.086
1 1/8 thru 1 1/2 inches	0.116

D. Install cotter pins and washers in clevis pins as shown in Figure 8.



Installation of Cotter Pins on Castellated Nuts
Figure 7

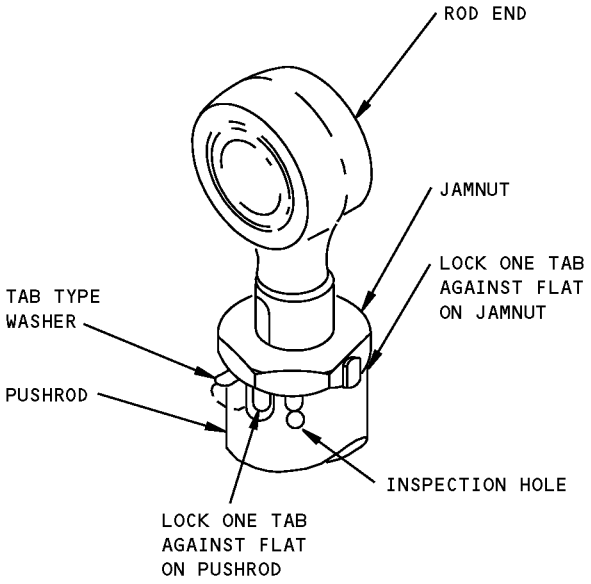


Installation of Cotter Pins on Clevis Pins
Figure 8

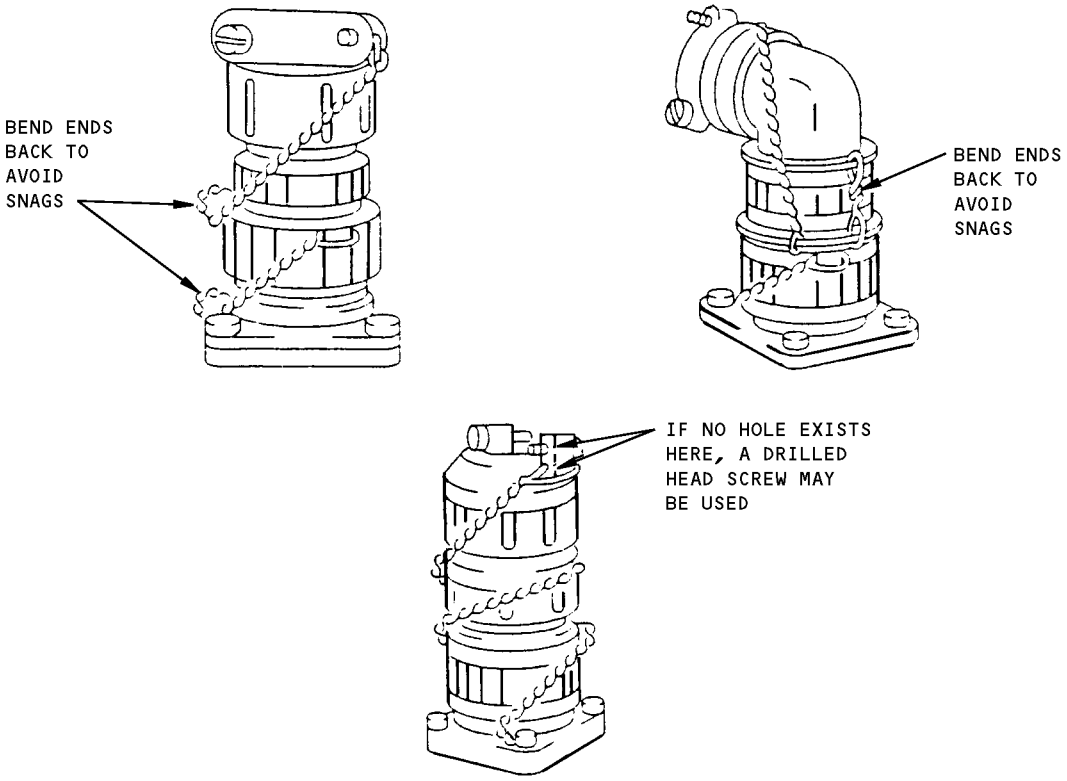
5. SAFETYING TERMINALS AND ROD END FITTINGS

A. Before you lock the tab-type washers (NAS 460 or equivalent) used on rod assemblies, see if the rod end threads are positively engaged. Try to push a probe through the inspection hole at the end of the rod. The threads are engaged if the probe cannot go through the hole. After the threads are engaged, lock one washer tab against the flat on the pushrod and one tab against the flat on the jamnut as shown in Figure 9.

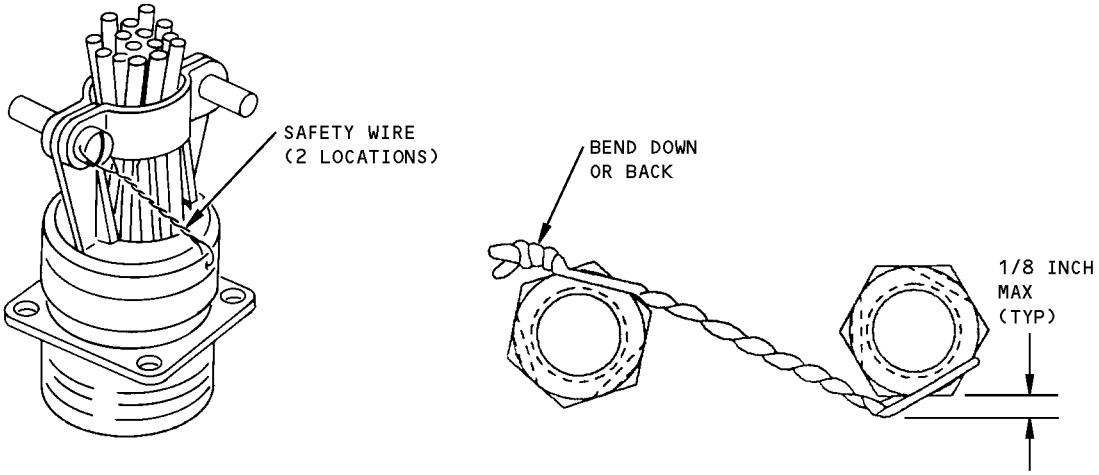
B. To safety wire terminals and rod end fittings that have safety wire holes, put the wire through the hole, not around the eye or through the fork. Then wrap the wire ends 4 turns around the shaft, to hold the ends down.



Safetying of Rod End Bearing
Figure 9



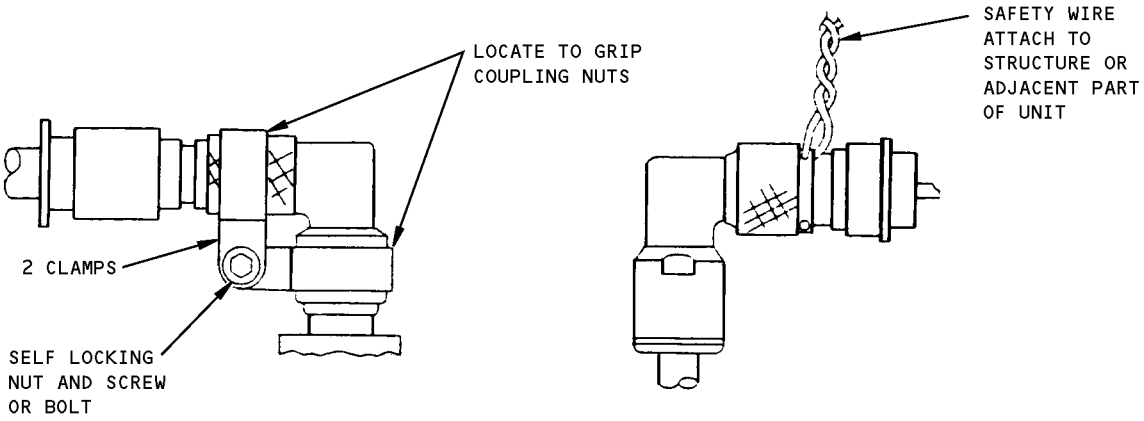
TYPICAL SAFETY WIRING SITUATIONS (NON-SELF LOCKING)



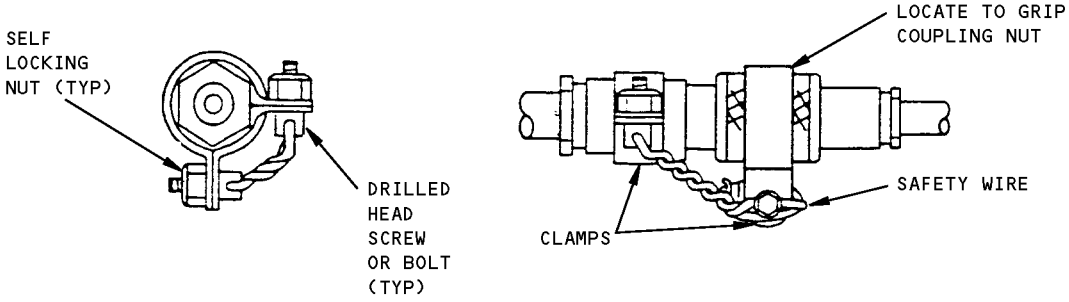
SELF-LOCKING CONNECTORS

SAFETY WIRE INSTALLATION FOR CONNECTOR JAMNUTS

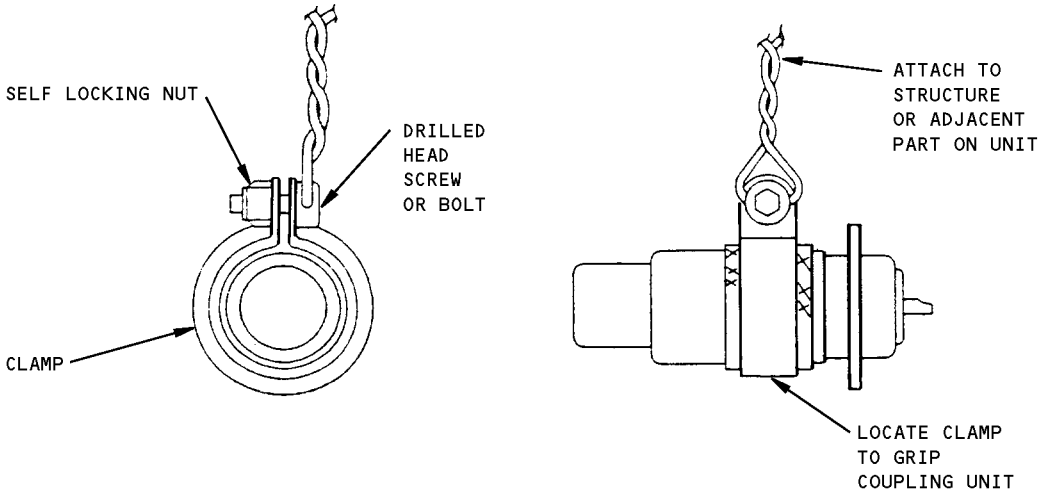
Safety Wire Installation - Electrical Connectors
Figure 10 (Sheet 1 of 2)



ANGLE ADAPTERS AND PLUGS



LINE DISCONNECTS



CONNECTORS ON UNIT OR STRUCTURE

Safety Wire Installation - Electrical Connectors
Figure 10 (Sheet 2 of 2)

6. SAFETY WIRING ELECTRICAL EQUIPMENT

A. When the overhaul instructions require connectors to be safety-wired, use this data.

B. Before you install the safety wire, make sure the coupling nut is tightened. Use the overhaul instructions or the information in procedure securing connector parts, SOPM 20-11-02, Par. 12.

C. Safety wire all threaded parts if they have the holes or where a screw with drilled head can be added. Threaded cable clamps and grommet compression nuts can be safety wired to coupling nuts. A coupling nut can be safety wired to a drilled-head screw on adjacent structure, as shown in Figure 10.

D. Safety wire connector assembly nuts to a hole in the endbell or backshell integral clamp or adapter, as shown in Figure 10.

E. Do not safety wire to each other the screws or bolts that attach electrical connectors to structure, unless the overhaul instructions are different.

F. If 3 or more fasteners (wing nuts, knurled nuts or snap-slides) are used on each unit, only alternate fasteners have to be safety wired. If there are only three fasteners on the unit, safety wire two of them. If the knurled nuts are self locking, they will not have holes for safety wire. Such nuts do not require safety wire.

G. Do not safety wire the electrical connectors to fuel, oil, hydraulic or oxygen lines, or to other connectors.

H. Connector jamnuts with holes on every other point can be safety-wired across the top surface of the jamnut, as shown in Figure 10, instead of around the jamnut, if this will not interfere with the mating connector.

I. When self-locking connectors are used, safety wire the backshell coupling nut to the drilled-head screws of the saddle clamp, as shown in Figure 10.

J. When you safety wire a coupling nut and an assembly nut on the same connector, use a separate piece of wire for each.

7. SAFETY CABLING ELECTRICAL EQUIPMENT

A. When safety cable is used as an alternative to safety wire per Paragraph 6., use this data.

B. Do not use safety cable on connector jam nuts which have the holes drilled through the corners.

C. When you safety cable a coupling nut and assembly nut on the same connector, use a separate piece of cable for each, as shown in Figure 5.

D. Install the safety cable so it will be put in tension if the fastener tries to loosen. Left-hand threaded items are safety cabled opposite of right-hand threaded items.

E. Use only AS3510-0118L safety cable, which is 0.020-0.026 inch diameter, on electrical connectors and their hardware.

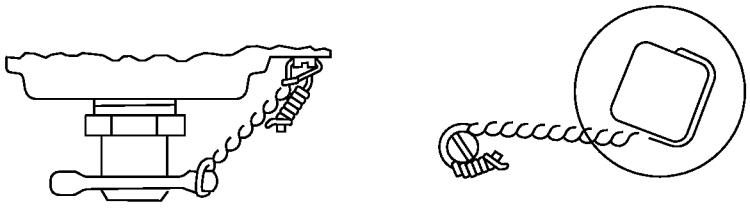
F. Do not tighten or loosen the fastener outside its specified torque range to align the safety-wire holes.

G. Before you swage the ferrule onto the cable, pull the cable tight. Let the installation tool apply the correct tension. After the cable installation is complete, the tension is acceptable if the cable is within the flex limits shown in Figure 6.

8. SAFETY WIRING HYDRAULIC FITTINGS

A. Safety wire hydraulic fittings only when required by the overhaul instructions.

B. All fittings which require safety wiring must be safety wired to the mating part or to an adjacent member, as shown in Figure 11.



Safety Wire Installation - Hydraulic Fittings
Figure 11