

## SAFETYING

### 1. DESCRIPTION

This section contains information on the proper safetying techniques and procedures used when fastening hardware.

## 2. MAINTENANCE PRACTICES

### A. Safety Wiring

There are two basic forms of safety wiring. The single-wire method and the double-twist method. Safety wire comes in three types which are identified by size and color. The three types are classified by use. Inconel and Monel wire is used for general safety wiring and is identified by a natural wire color. Monel can withstand temperatures up to 800°F; Inconel can withstand temperatures up to 1500°F. Copper that is cadmium-plated and dyed yellow is used for shear and seal wiring applications. Aluminum Alloy (Alclad 5056) is dyed blue and is used exclusively for safety-wiring magnesium parts.

Size of wire is dependent on material and purpose of installation. Use a 0.020" diameter copper wire for shear and seal applications. Use a 0.020" diameter wire to safety wire parts with tie holes smaller than 0.045" or on parts with a tie hole diameter between 0.045" and 0.062" when spacing between parts is less than two inches or, when bolts and screws of 0.250" diameter or less are closely spaced. Use a 0.032" diameter wire (minimum) for general purpose safety wiring.

Shear applications are those where it is necessary to break or shear wire to permit operation or actuation of emergency devices. Seal applications are where wire is used with a lead seal to prevent tampering or use of a device without indication.

(1) Single Wire Method (See Figure 20-501)

The single wire method has a limited application. Single-wire method is used for shear and seal wiring applications. The single wire method is most commonly used on emergency equipment. The single wire method is also used when a series of three or more parts, usually small screws or bolts, are in a closely spaced geometric pattern (square, rectangle, or circle). Closely spaced is defined as the spacing of two inches or less between the centerline of parts. The wire in this application is strong enough to safety the part, but can be easily broken when use of the emergency equipment is required. A third application of the single wire method is safetying hard to reach parts which are impractical to double wire. Single-wire method is accomplished by passing a single wire through tie holes and back with the ends then twisted together. Wire twisting pliers are used to obtain a uniformly tight twist in the wire.

**Note:** When using single-wire method of safety wiring, the largest wire that will fit the tie holes should be used.

(2) Double Wire Method (See Figure 20-502)

The double-twist method is the most common method of safety wiring. When double wire safetying in a series, the direction of twist must be reversed at each unit. When safetying widely spaced series using this method, the maximum number of units is three. Safety wiring by the double-twist method is really one wire twisted on itself several times and is accomplished by inserting one end of the wire through the tie holes of the bolt head and firmly loop around the bolt head. This does not necessarily apply to castellated nuts when the slot is close to the top of the nut. The wire will be more secure if it is made to pass along side of the stud. While taut, twist the strands to within 1/8" of the next part. The twisting keeps the wires taut without overstressing and prevents the wire from becoming nicked, kinked, or mutilated. After the last tie hole, the wire is twisted three to five times to form a pigtail. Cut off any excess wire and bend the pigtail towards the part.

**Note:** Widely spaced multiple groups shall mean those in which fasteners are from four to six inches apart.

## (3) General Installation Procedures

**CAUTION:** Screws in closely spaced geometric pattern which secure hydraulic or air seals, hold hydraulic pressure, or are used in critical areas should use the double-twist method of lockwiring. Lockwiring shall not be used to secure fasteners or fittings which are spaced more than six inches apart, unless tie points are provided on adjacent parts to shorten the span of safety wire to less than six inches. When safety wiring closely spaced multiple groups, the number of units that can be safety wired by a 24-inch length of wire shall be the maximum number in a series.

**Note:** Safety wire 0.20 inch (0.5mm) in diameter shall have 10 to 13 twists per one inch (25.4 mm).

Safety wire 0.032 inch (0.8mm) in diameter shall have 6 to 12 twists per one inch (25.4 mm).

- (a) Ensure fasteners to be safetied are correctly tightened and, where specified, torqued.
- (b) Start and finish twisting the safety wire within 0.109 inch (3 mm) of the wire locking hole in either part (when using the double wire method).

**Note:** Safety wire between the parts must be tight. The safety wire at the head of the part must not be capable of being pulled over its head by using finger tension. The end of the safety-tie (pigtail) must contain a minimum of five twists, but not to exceed 0.703 inch (18 mm) in length. Twist slightly more wire than needed for the pigtail.

- (c) Cut pigtails square to prevent snagging.

**Note:** Pigtails should be made without sharp bends to prevent fractures and to prevent them from touching other components. Use new wire for each application, never re-use old wire. Parts should be safety wired so that the wire is placed in tension (pulled on) if a part attempts to loosen.

## (4) Required Installations of Safety Wire

- (a) Bolts and other fasteners securing critical parts that affect airplane safety and operation.

**Note:** In blind-tapped hole applications of bolts or castellated nuts on studs, lockwiring is installed in the same manner as described for bolt heads. Hollow head bolts are safetied in the same manner as regular bolts.

- (b) Drain plugs and cocks may be safetied to a bolt, nut, or other part having a free tie hole.
- (c) External snap rings may be locked if necessary using general locking principles as illustrated.

**Note:** Internal snap rings should not be safety wired.

- (d) When locking is required on electrical connectors which use threaded coupling rings, or on plugs which employ screws or rings to fasten individual parts of which plug together, they shall be safety wired with 0.020" diameter wire in accordance with locking principles as described and illustrated.

**Note:** It is preferable to safety wire all electrical connectors individually. Do not safety wire one connector to another unless it is necessary to do so.

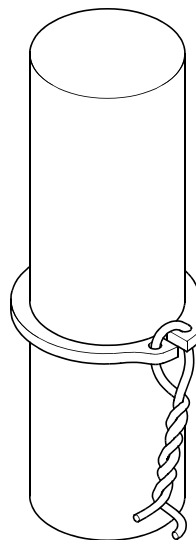
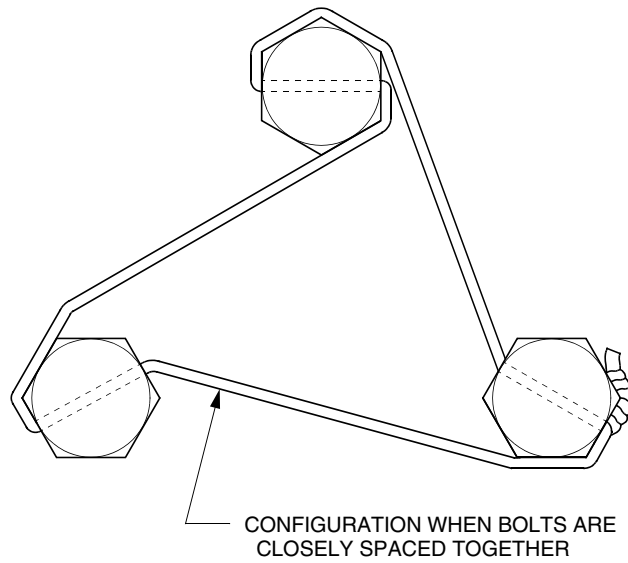
- (e) Drilled head bolts and screws need not be safety wired if installed into self-locking nuts or installed with lockwashers. Castellated nuts with cotter pins or safety wire are preferred on bolts or studs with drilled shanks.

**WARNING:** Safety wire shall not be used to secure nor shall safety wire be dependent upon fracture as basis for operation of emergency devices such as handles, switches, and guard-covering handles that operate emergency mechanisms such as fire extinguishers and the like. However, where existing structural equipment or safety of flight emergency devices requires shear wire to secure equipment while not in use, but which are dependent upon shearing or breaking of safety wire for successful emergency operation of equipment. Particular care must be exercised to assure that wiring under these circumstances will not prevent emergency operations of these devices.

Care must be used to assure that safety wire doesn't interfere with any controls, structures, wires or any other objects.

**SINGLE WIRE SAFETYING METHOD**

**NOTE** RIGHT-HAND THREADED PARTS SHOWN. REVERSE FOR LEFT-HAND THREADED PARTS.



**EXTERNAL SNAP RING**

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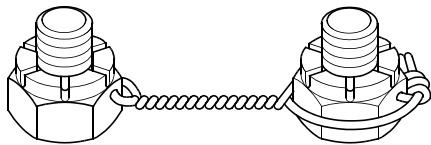
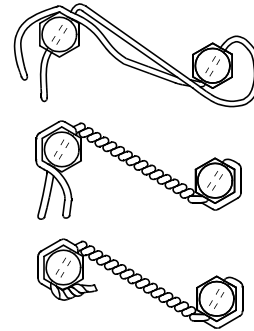
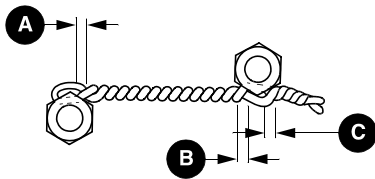
**Figure 20-501**  
**Single Twist Safety Wiring**

EFFECTIVITY:  
All

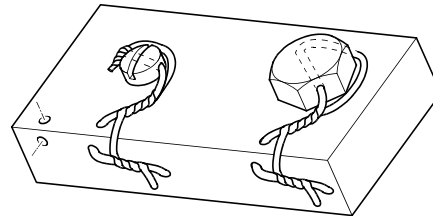
**DOUBLE TWIST SAFETYING**

**NOTE** RIGHT-HAND THREADED PARTS SHOWN. REVERSE DIRECTION FOR LEFT-HANDED THREADS.

- A** TWISTING MUST START WITHIN 0.109 INCH (3MM) OF THE LOCKING WIRE HOLE.
- B** TWISTING MUST END WITHIN 0.109 INCH (3MM) OF THE LOCKING WIRE HOLE.
- C** TWISTING OF THE PIGTAIL MUST START WITHIN 0.109 INCH (3 MM) OF THE LOCKING WIRE HOLE.



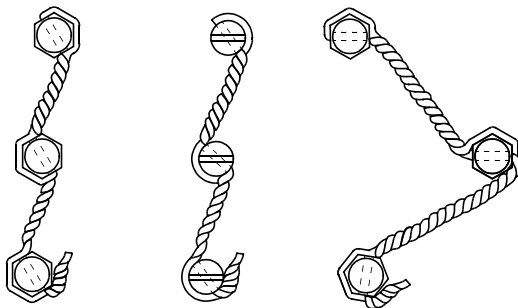
**CASTELLATED NUTS ON DRILLED STUDS**



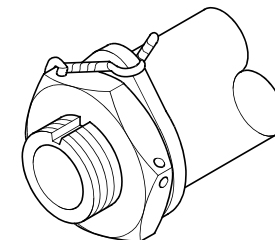
**FILLISTER-HEAD SCREW**

**SINGLE HEX HEAD FASTENER APPLICATION**

**MULTIPLE FASTENER APPLICATION**



**NOTE** AS A GENERAL RULE, NO MORE THAN THREE BOLTS SHOULD BE SAFETY WIRED TOGETHER.



**SAFETY LOCK WASHER**

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**Figure 20-502  
Double Twist Safety Wiring**

EFFECTIVITY:  
All