

FED. SUPPLY CLASS

MATERIALS:

1. The materials for the Safety Wire shall be those materials listed on NASM20995.
2. The materials for the Safety Cable shall be those materials specified in AS4536.
3. The materials for Cotter Pins shall be those materials listed in NASM24665.

GENERAL INSTRUCTIONS FOR THE SELECTION AND APPLICATION OF SAFETY WIRE:

1. The selection of materials shall be made from NASM20995 and shall be in accordance with the service limitations outlined herein.
 - a) Nickel Alloy (uncoated), Nickel-Copper (uncoated)

This will be for all general lock wiring purposes: Lock wiring is the application of wire to prevent relative movement of structural or other critical components subjected to vibration, etc. Nickel-Copper is to be used at temperatures up to 700 °F, and Nickel Alloy is to be used at temperatures up to 1500 °F.
 - b) Copper, Cadmium Plated and Dyed Yellow in accordance with FED-STD-595, color numbers 13655 or 23655

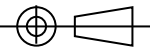
This will be for shear and seal wiring applications only. Shear applications are those where it is necessary to purposely break or shear the wire to permit operation or actuation or emergency devices. Seal applications are those where the wire is used with a lead seal to prevent tampering or use of a device without indication.
 - c) Aluminum Alloy Alclad 5056, Anodized and Dyed Blue in accordance with FED-STD-595, color numbers 15102 or 25102

This will be used exclusively for safety wiring magnesium parts.
 - d) Surface treatment which obscures visual identification is prohibited

Note: All of these wires are visually identifiable by the color of the finish for each: Nickel-Copper & Nickel Alloy (Natural), Copper (Yellow), and Aluminum Alloy (Blue).
2. The size of the wire shall be in accordance with the following minimum requirements:
 - a) Ø.032 inch minimum for general purpose lock-wiring except that Ø.020 inch wire may be used on parts having a nominal hole of less than Ø.045 inch, on parts having a nominal hole between Ø.045 and Ø.062 with a spacing between parts of less than 2 inches, or on closely spaced screws and bolts of Ø1/4 inch and smaller.
 - b) Copper (CY) Ø.020 inch shall be used for shear and seal wire applications.
 - c) When employing the single wire method of locking, the largest nominal size wire for the applicable material listed in NASM20995 that the hole will accommodate shall be used.

THIS IS A STANDARD PRACTICE. NOT TO BE USED AS A PART NUMBER

THE INITIAL RELEASE OF THIS DOCUMENT SUPERSEDES MS33540J, NOTICE 1.

THIRD ANGLE PROJECTION 	CUSTODIAN NATIONAL AEROSPACE STANDARDS COMMITTEE	REVISION 3
PROCUREMENT SPECIFICATION NONE	TITLE SAFETY WIRING, SAFETY CABLING, COTTER PINNING, GENERAL PRACTICES FOR	CLASSIFICATION STANDARD PRACTICE NASM33540 SHEET 1 OF 11

REVISION DATE: DECEMBER 18, 2015

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AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.
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FORM 12-01

3. 3 The double-twist method of lock-wiring shall be used as the common method of lock-wiring, where one twist is defined as being produced by twisting two strands of wire through an arc of 180 degrees and is equivalent to half a complete turn. The single wire method of safety wiring may be used in a closely spaced, closed geometrical pattern (triangle, square, rectangle, circle, etc.), on parts in electrical systems and in places that would make the single-method more advisable. Closely spaced shall be considered a maximum of two inches between centers. Caution: Screws in closely spaced geometric patterns which secure hydraulic or air seals, hold hydraulic pressure, or are used in critical areas of clutch mechanisms and superchargers should use the double-twist method of lock-wiring. Use the single wire method for shear and seal wiring applications. Make sure that the wire is so installed that it can easily be broken when required in an emergency situation. For securing emergency devices where it is necessary to break the wire quickly, use copper (CY) only.
4. a) Parts shall be lockwired in such a manner that the lockwire shall be put in tension when the part tends to loosen. The lockwire should always be installed and twisted so that the loop around the head stays down and does not tend to come up over the bolt head and leave a slack loop. (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 the side of the stud.) Care shall be exercised when installing lockwire to ensure that it is tight but not over stressed.
- b) In an alternate method, the safety wire shall be inserted through one lockwire hole in thin-head bolts and plugs or through one set of diametrical opposite lockwire holes in internal wrenching bolts. The loop of the double wire shall be taut but not over stressed and pass over the top of the head.
5. A pigtail of 1/4 to 1/2 inch (3 to 5 twists) shall be made at the end of the wiring. This pigtail shall be bent back or under to prevent it from becoming a snag.
6. Safety wire shall be new upon each application.
7. When castellated nuts are to be secured with lockwire, tighten the nut to the low side of the selected torque range, unless otherwise specified, and, if necessary, continue tightening until a slot aligns with the hole.
8. In blind tapped hole applications of bolts or castellated nuts on studs, the lock-wiring shall be in accordance with the general instructions contained herein.
9. Hollow head bolts are safe-tied in the manner prescribed for regular bolts.
10. Drain plugs and cocks may be safe-tied to a bolt, nut, or other part having a free lock hole in accordance with the general instructions contained herein.
11. External snap rings may be locked if necessary in accordance with the general locking principals contained herein. Internal snap rings shall not be lockwired.
12. When locking is required on electrical connectors which use threaded coupling rings, or on plugs which employ screws or rings to fasten the individual parts of the plug together, they shall be lockwired with Ø.020 inch wire in accordance with the locking principles outlined herein. It is preferred to lockwire all electrical connectors individually. Do not lockwire one connector to another unless necessary.
13. Larger assemblies such as hydraulic cylinder heads, super chargers, clutch mechanisms, etc. for which lock-wiring is required, but not specified, shall be lockwired in accordance with the principles outlined herein.
14. Drilled head bolts and screws need not be lockwired if installed into self locking nuts in accordance with NASM33588 or installed with lock washers in accordance with AND10476. Castellated nuts with cotter pins or lockwire are preferred on bolts or studs with drilled shanks, but self locking nuts are permissible within the limitations of NASM33588.

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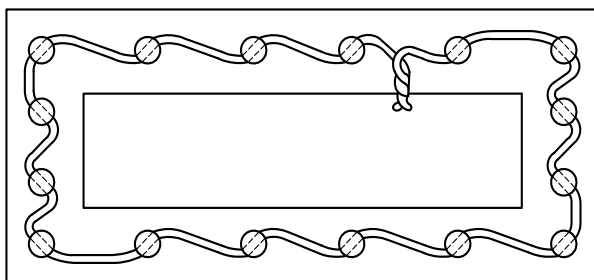
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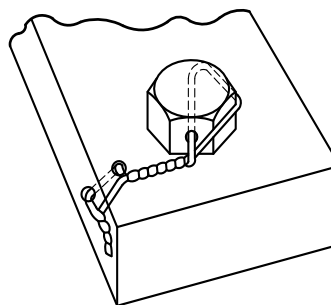
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15. For new designs, lockwire shall not be used to secure, nor shall it be dependent upon fracture as the basis for operation of emergency devices such as handles, switches, guards, covering handles, etc. that operate emergency mechanisms such as emergency exits, fire extinguishers, ejection seats, emergency cabin pressure releases, emergency bomb releases, emergency landing gear releases, and the like. However, where existing structural equipment or safety-of-flight emergency devices require shear wire to secure equipment while not in use, but which are dependent upon shearing or breaking of the lockwire for successful emergency operation of equipment, particular care shall be exercised to ensure that wiring under these circumstances shall not prevent emergency operation of these devices.
16. The following illustrations are typical of correct lockwire applications. Lock wiring of turnbuckles in accordance with MS33591 has been superseded by MS33736 clip locking turnbuckles.



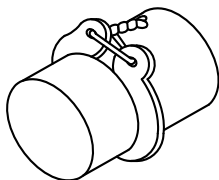
Small screws in closely spaced, closed geometrical pattern

Single Wire Method



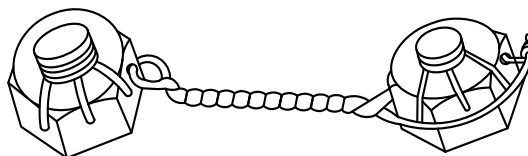
Single Fastener Application

Double Twist Method



External Snap Ring

Single Wire Method



Castellated Nuts on Undrilled Studs

Double Twist Method

FIGURE 1- LOCKWIRE APPLICATIONS

Notes:

- (a) The figures shown on this standard are for right-handed thread application. Locking for left-handed threads will be opposite.

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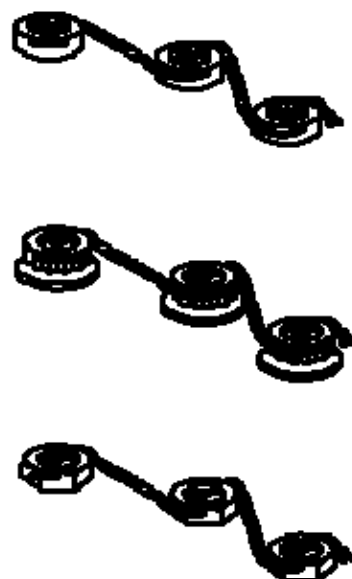
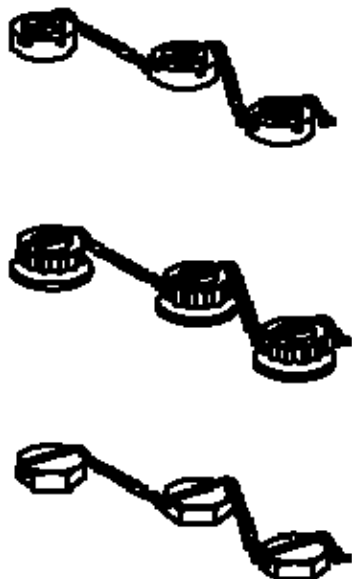
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FIGURE 1 (cont)

Multiple Fastener Application
Alternate Double Twist Method Single Hole

Multiple Fastener Application
Double Twist Method Multiple Hole

17. Lock-Wiring Widely Spaced Multiple Groups by the Double-Twist Method.

- a) When the multiple fasteners are from 4 to 6 inches apart, three fasteners shall be the maximum number in a series that can be safety wired together.
- b) When the multiple fasteners are spaced more than 6 inches apart, the multiple fastener application specified in Figure 1 shall not be used unless tie points are provided on adjacent parts to shorten the span of the wire to less than 6 inches.
- c) When the multiple fasteners are closely spaced, the maximum number of fasteners that can be safety-wired together shall be the number of fasteners that can be wired with a 24 inch length of wire.
- d) One end of the safety wire shall be inserted through one set of lockwire holes in the head of each unit. The other end of the safety wire shall be looped around the head to the next set of lockwire holes in the same unit and inserted through this set of lockwire holes.
- e) The strands, while taut, shall be twisted until the twisted part is just short of the nearest lockwire hole in the next unit. The twisted portion shall be within 1/8 inch of the holes in each unit as shown in Figure 1. Caution shall be exercised during the twisting operation to keep the wire tight without overstressing it or allowing it to become nicked, kinked, or otherwise mutilated. Abrasions normally caused by commercially available wire-twisting pliers shall be acceptable.
- f) After wiring the last unit, the wire shall be twisted to form a pigtail of three to five twists. The excess wire shall be cut off. The pigtail shall be bent in towards the part to prevent it from becoming a snag.

18. Safety wire or safety cable shall not come into contact with adjacent parts or assemblies when such contact can cause damage or operational malfunction to adjacent parts, assemblies, or safety wire. Avoid routing safety wire or safety cable where the safety wire or safety cable contacts parts, electrical wiring, sealing components or other surfaces. Where these installations can not be avoided, use of a protective material over the safety wire or safety cable is recommended.

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