

Instruction
Hardware Engineering

No. LMS 13-5

Subject: Safety Wiring (Lock wiring)

APPROVED BY Manager, Hardware Engineering

STATUS Maintenance Revision

PURPOSE Defines the procedure for safety wiring (lock wiring) of nuts, bolts, screws, and electrical connectors and defines installation of cotter pins. The guidelines outlined in this instruction shall be used by all L-3 Communications Corporation, Link Simulation & Training Division (hereafter referred to as Link) personnel when installing safety wiring and cotter pins.

AFFECTED FUNCTIONS Hardware Engineering
Manufacturing

REFERENCES None

DEFINITIONS None

INSTRUCTION

1. Requirements

- 1.1 General - safety wiring installation. Installation of safety wiring shall be in accordance with the instructions contained herein.
- a. The double-twist method of lock wiring shall be used as the common method of lock wiring. 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 2 inches (5.08 cm) between centers."

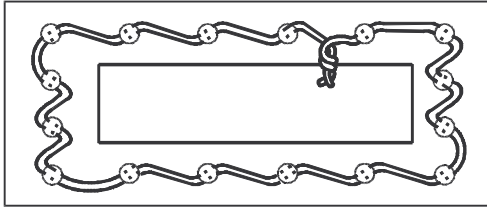
CAUTION

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 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.

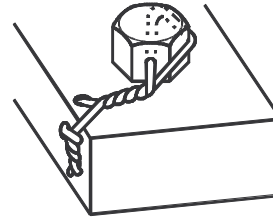
- b. Parts shall be lock wired in such a manner that the lock wire shall be put in tension when the part tends to loosen. The lock wire should always be installed and twisted so that the loop around the head stays down and does not tend to come up over the bolt-head and leave a slack loop. (This does 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 lock wire to insure that it is tight but not overstressed.
- c. In an alternate method, the safety wire shall be inserted through one lock-wire hole in thin-head bolts and plugs or through one set of diametrically opposite lock-wire 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.
- d. A pigtail of .25 inch to .50 inch (6.35 mm to 12.7 mm) (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.
- e. Safety wire shall be new upon each application.
- f. When castellated nuts are to be secured with lock wire, 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.
- g. 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.
- h. Hollow-head bolts are safetied in the manner prescribed for regular bolts.
- i. Drain plugs and cocks may be safetied to a bolt, nut, or other part having a free lock hole in accordance with the general instructions contained herein.
- j. External snap rings may be locked, if necessary, in accordance with the general locking principles contained herein. Internal snap rings shall not be lock wired.
- k. When locking is required on electrical connections which use threaded coupling rings, or on plugs which employ screws or rings to fasten the

individual parts of the plug together, it is preferable to lock wire all electrical connectors individually. Do not lock wire one connector to another unless necessary.

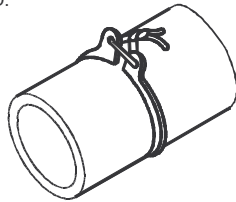
- l. Larger assemblies such as hydraulic cylinder heads, super chargers, clutch mechanisms, etc., for which lock wiring is required, but not specified, shall be lock wired in accordance with the principles outlined herein.
- m. Figure 1 illustrates correct lock wire applications.
- n. Lock wiring widely spaced multiple groups by the double-twist method.
 - (1) When the multiple fasteners are from 4 to 6 inches (10.16 cm to 15.24 cm) apart, 3 fasteners shall be the maximum number in a series that can be safety wired together.
 - (2) When the multiple fasteners are spaced more than 6 inches (15.24 cm) 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 (15.24 cm).
 - (3) 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 (61-cm) length of wire.
 - (4) One end of the safety wire shall be inserted through one set of lock-wire 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 lock-wire holes in the same unit and inserted through this set of lock-wire holes.



A. SMALL SCREWS IN CLOSELY SPACED, CLOSED GEOMETRICAL PATTERN - SINGLE - WIRE METHOD.



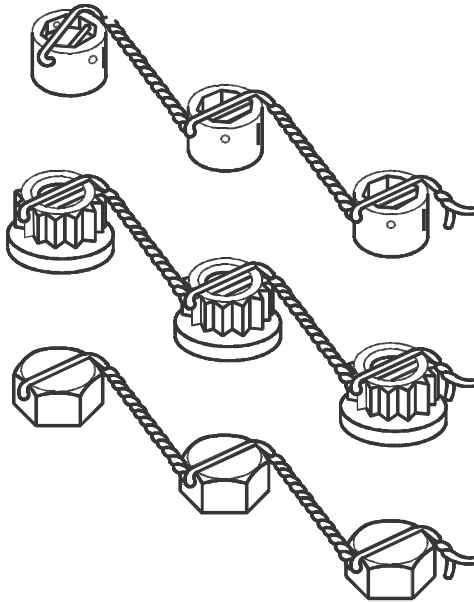
D. SINGLE FASTENER APPLICATION
- DOUBLE-TWIST METHOD.



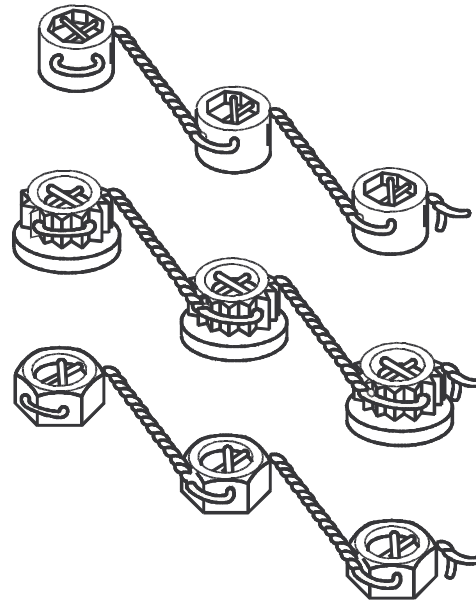
B. EXTERNAL SNAP RING -
SINGLE-WIRE METHOD.



E. CASTELLATED NUTS ON UNDRILLED STUDS
- DOUBLE-TWISTED METHOD.



C. MULTIPLE FASTENER APPLICATION ALTERNATE
DOUBLE-TWIST METHOD - SINGLE HOLE.



F. MULTIPLE FASTENER APPLICATION
DOUBLE-TWIST METHOD - MULTIPLE HOLE.

NOTE: THE FIGURES SHOWN IN THIS INSTRUCTION ARE RIGHT-HAND THREAD APPLICATION.
LOCKING FOR LEFT-HAND THREADS WILL BE OPPOSITE.

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Figure 1 Lock Wiring

- (5) The strands, while taut, shall be twisted until the twisted part is just short of the nearest lock-wire hole in the next unit. The twisted portion shall be within .125 inch (3.175 mm) 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.
 - (6) 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.
- o. Safety wire shall not come into contact with adjacent parts or assemblies when such contact can cause damage or operation malfunction to adjacent parts, assemblies, or safety wire.
- 1.2 Cotter Pins. Cotter pin installation shall be in accordance with the instructions contained herein.
- a. When nuts are to be secured to the fastener with cotter pins, tighten the nut to the low side (minimum) of the applicable specified, or selected, torque range, unless otherwise specified, and, if necessary, continue tightening until the slot aligns with the hole, but do not exceed the high-side (maximum) torque range.
 - b. Castellated nuts mounted on bolts may be safetied with cotter pins or lock wire. The preferred method is illustrated in Figure 2. An alternate method where the cotter pin is mounted normal to the axis of the bolt may be used where the cotter pin in the preferred method is apt to become a snag.
 - c. Install the cotter pin with the head firmly in the slot of the nut with the axis of the eye at right angles to the bolt shank. Bend prongs so that the head and upper prong are firmly seated against the bolt.

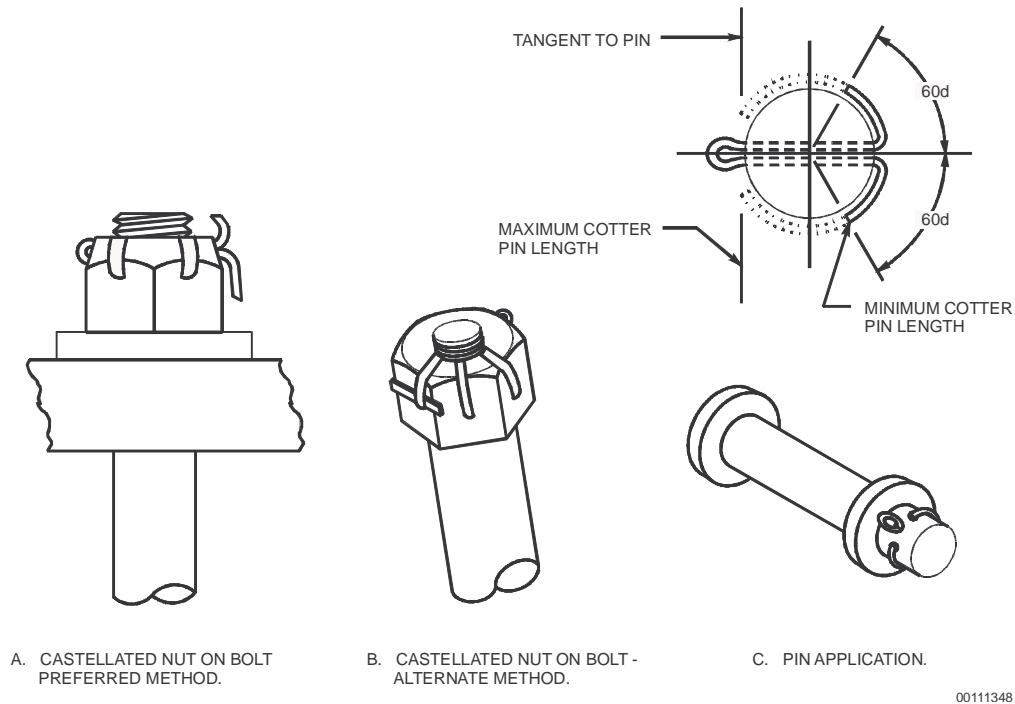


Figure 2 Cotter Pins

- d. In pin applications, install the cotter pin with the axis of the eye parallel to the shank of the clevis pin or rod end. Bend the prongs around the shank of the pin or rod end.
2. Quality Assurance Provisions
 - 2.1 The Quality Assurance Organization shall be responsible for assuring the requirements of this instruction are met.
 3. Preparation For Delivery (Not Applicable)