Wiring and Cabling

From OP 2230, *"Workmanship and Design Practices for Electronic Equipment"*, published by the direction of the chief of the *Bureau of Naval Weapons*, 1 December, 1962. pp. 7-9 --- 7-14.

Scanned by Gary Allsebrook.

Transcribed to HTML by Jeff Dairiki.

How To Lace Cable Harnesses

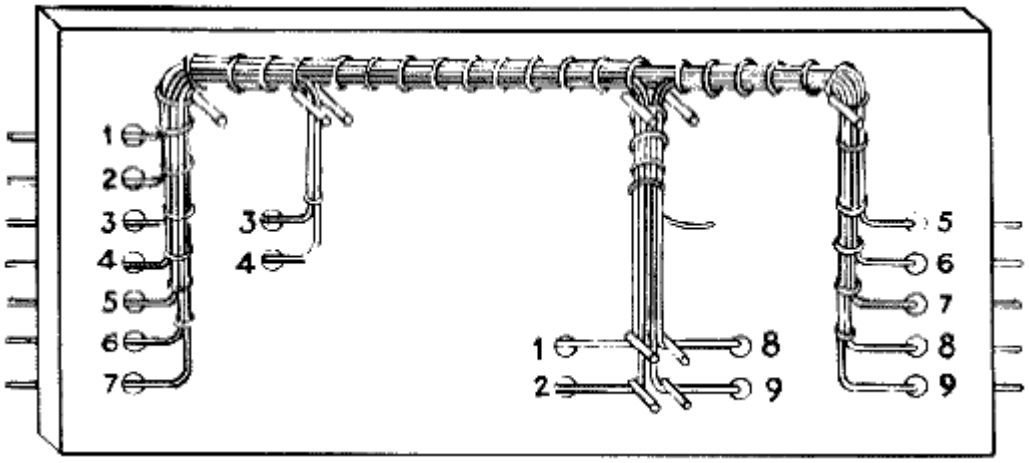
Harnesses should be located so that circuit tracing can be readily accomplished, and accessibility to parts or components which may require replacement is not limited.

Individual wires of a harness should be arranged to run parallel or at right angles to each other wherever possible. Sharp bends which may damage conductors or insulation are to be avoided.

Harnesses are usually fabricated on a *harness jig* or *forming board*. The board may be marked with numbers and symbols to indicate wire sizes, color coding, routing, terminations, and wiring sequence. Pegs or nails, placed in a pattern which follows a pictorial wiring diagram, serve to locate wire runs.

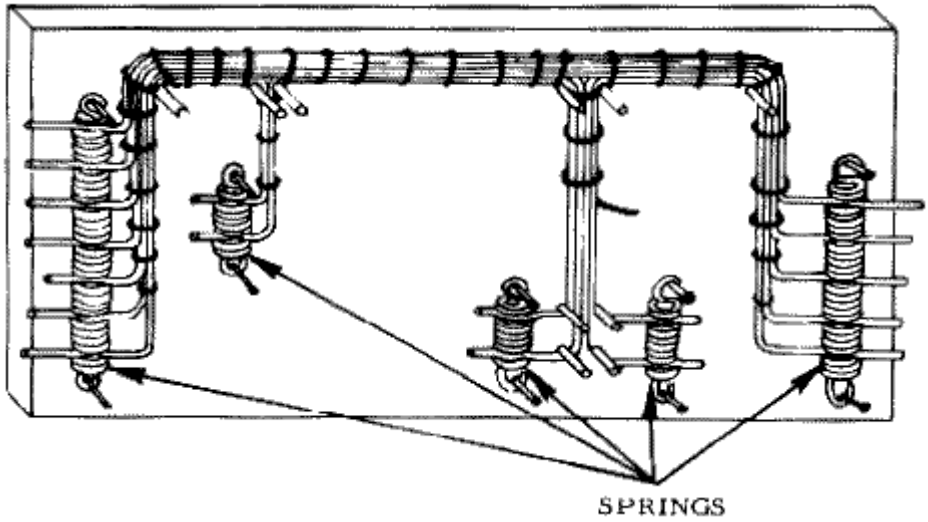
Conductor ends may be anchored to the board by wrapping them about nails or pegs, or may be fanned out for easier dressing if holes to accommodate wire ends are provided.

A typical application for a forming board is shown below.



Harness Forming Board

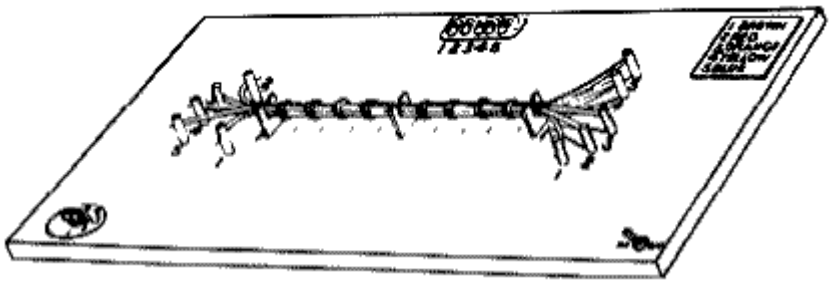
Another method of anchoring conductor ends on a harness jig is to attach springs on the board near the termination point of the wire. The pitch of the spring should be determined by the size of the wires to be held in place. The wire may be pushed into the spring, where it will be held firmly. This method is rapid and minimizes drilling of holes and placing of pegs or nails in the board. Harness jigs may thus be reused many times. A typical application of a forming board utilizing springs is shown below.



Harness Forming Board with Springs

Harnesses may be laid out on a jig bottom-side-up for ease of lacing. When this is done and the harness is installed in a given unit, the lacing knots and splices will not be visible from above and the harness will have a neat, workmanlike appearance.

Forming boards are sometimes equipped with electrical checking devices to speed harness testing, as show below.



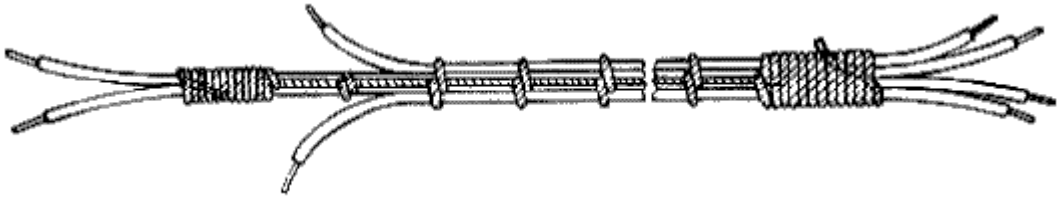
Harness Forming Board with Electrical Checking Devices

Ribbon-type lacing cord should be used in preference to round cord to reduce the possibility of cutting into wire insulation. One-eighth inch nylon or similar ribbon is best suited for this purpose.

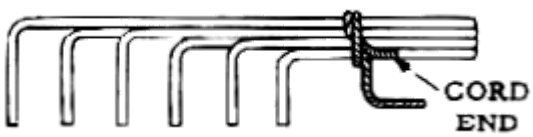
If round cord is used, sizes should be as follows:

Principal Cable Diameter	**Cord Size**
Up do 3/8"	# 4
5/16" to 3/4"	# 6
5/8" to 1"	# 9
7/8" and over	# 12

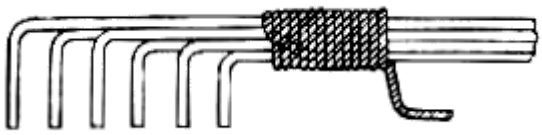
The harness is laced after all wires have been cut to length, stripped, tinned, and placed in position.



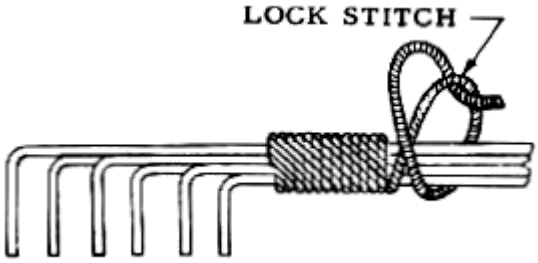
A Finished Harness



The process of lacing or binding a harness can be started at one end with a *starting tie*. Alternatively, lacing can be started at the center with a *lock stitch*, and a terminating wrap can be used at each end.



Lacing is started by cutting a length of cord two and one-half times the length of the proposed harness. One end of the cord is laid alongside the principal cable pointing into the harness. The cord end is secured as approximately four turns of cord are wound over it, and wrapping is continued until a total of twelve turns is wound about the principal cable.



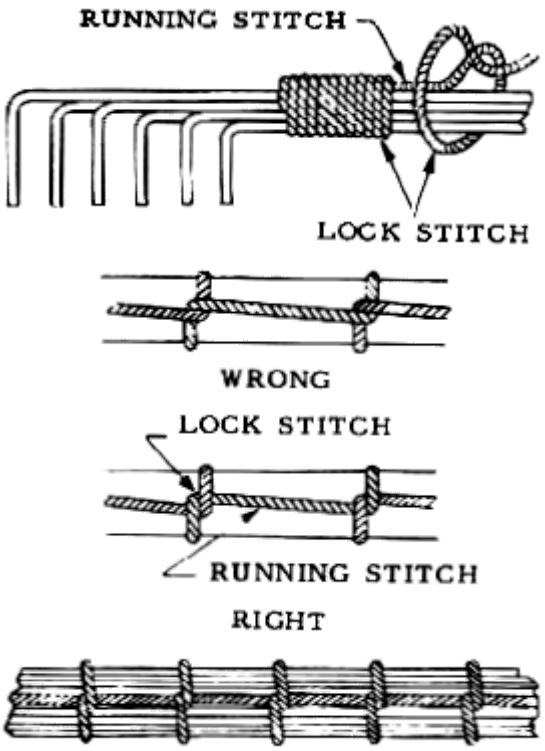
The wrap is secured by a lock stitch. This is made by forming a loop, passing the cord over the loop, then through the loop, and finally pulling the cord tight.

Secure stitches can be formed only by lacing the cord over the loop, never under, to form the so-called *lock stitch*. The cord is thus locked under each loop.

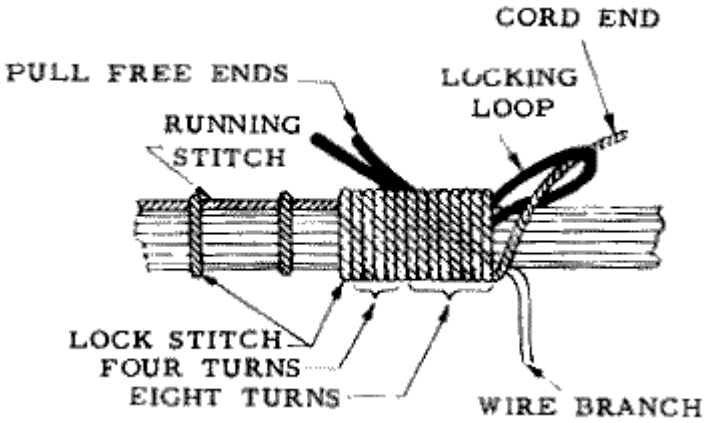
Lock stitches at approximately 1/2-inch intervals thereafter secure other loops in the same fashion.

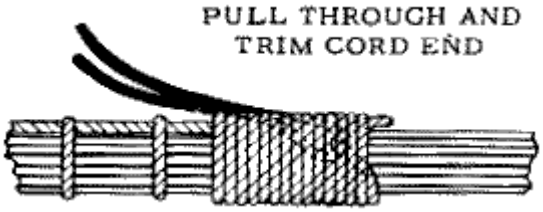
The foregoing describes the *regulation cableman's knot*, which is self locking.

As lacing is advanced, the wires should be re-formed to insure a neat and firmly bound cable; conductors should be arranged to lie parallel without crossovers except when twisting is required.



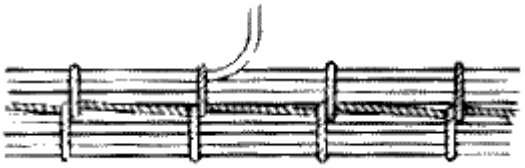
Lacing is terminated by the following procedure. Four turns of cord are wrapped adjacent to the last lock stitch. A separate piece of cord is formed into a 2-inch loop and laid alongside the cable as show. Eight turns of lacing are wrapped about the loop and the end of the lacing cord is then drawn through the loop.



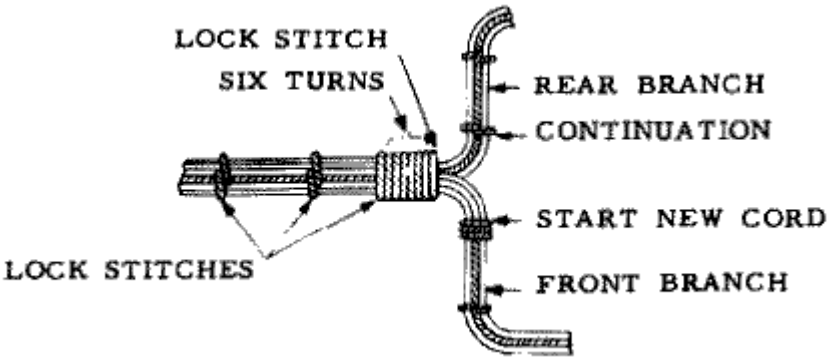


Both ends of the loop are then pulled to carefully draw the cord end underneath and out of the wrap. The cord end is then pulled tight, locking the wrap, and finally the end is cut to approximately 1/8 or 1/4 inch.

Branches and sub-branches, including single leads, are usually referred to as *breakouts*. Single-lead breakouts should be preceded by a lock stitch without variation in the distance between stitches.

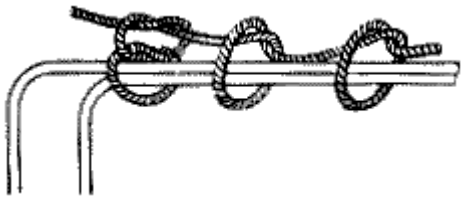


Any breakout of two or more wires should be laced. When a group of wires is branched from a cable, a lock stitch is made; six turns are wrapped firmly about the principle cable adjacent to the new stitch, and finally, another lock stitch is made adjacent to the new turns. After a branch is thus secured, the running stitches are continued along the main cable.



All lacing should follow the top of the harness. All knots, splices, or other irregularities should be hidden from view when the cable is installed in the equipment.

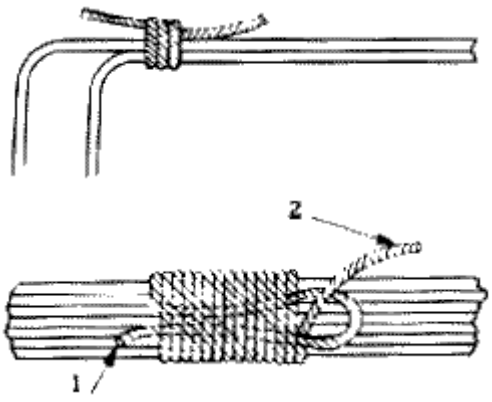
When laced, the cord should be sufficiently tight to minimize slippage but should not cut into the insulation.



Lacing may also be started with a square knot, followed by two lock stitches.

Lacing is performed as previously described, and terminated by a lock stitch and a square knot.

Another procedure for lacing consists of making a series of individually bound wraps at equidistant points along the cable, as required.



Lacing cord, 2 inches longer than the length required to make twelve turns about the harness, is cut. One end of the cord is formed into a 1-inch loop which is placed flat on the harness, parallel to the wiring.

Twelve turns are wound tightly over this loop and, at the last turn, the cord end is pushed through the loop which extends from under the wrap.

This page uses CSS2, and as such will look best when viewed using a recent browser.