
ELE-3COP-256

Title – Hand Cable Laying.

Before starting work please read this document carefully and note the guidance given.

1 Purpose and Scope

This COP describes the procedure to be used when hand laying cables. The instructions in this document take preference over IPC/WHMA requirements, as do the drawing and any customer documentation.

2 Performance Objective

This code of practice is produced to support operators already trained in the installation of heat shrinkable and harnessing products. It identifies the procedure to be used when hand laying cables.

3 Materials and Equipment:

Component wires to be laid
Fillers as required to maintain a circular cross section
Kevlar binder as required
Mylar Wrap as required
Adhesive tape (Paper)
6M Bench
Holding fixture (Small bench vice)

4 Health and Safety

Adhere to local Codes and Regulations relating to Safe Working practices. For the U.K. adhere to requirements of the Health and Safety at Work Act 1974 and subsequent amendments.
A knife should never be used for wire stripping as this can easily cause personal injury and conductor damage.

5 Terms Used

Binder

Usually Kevlar, used when required to hold layers of components together. Refer to ELE-3COP-257.

Wrap

Usually Mylar, a thin clear tape used in machine built multicore cable to hold layers together and act as a separator between component wires and screen. Not normally used in hand laid cables, if required refer to ELE-3COP-258.

Shield or Braid

Woven covering over cable bundle usually of Tinned Copper construction.

Lay

A number of components helically wound in the same direction without crossovers.

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Lay Direction

The direction of a component wire in a layer as it goes away from the observer from the top of the cable.

Left Hand Lay passes to the left as it goes from the top of cable.

Right Hand Lay passes to the right as it goes from the top of cable.

Concentric Lay

Alternative layers being left and right hand lays.

Filler

Material used to bring wires up to diameter or to fill in gaps between wires.

Standard construction

A cable with same component cable and size, no mixed component constructions.

Hybrid construction

A cable with various types and sizes in the construction.

6 Procedure

Cables and Harnesses

When hand laying a cable or harness only a concentric lay is used.

A Binder is used as and when required to hold a layer together.

Each layer of wires will have its own lay length usually between 8 and 16 times the diameter of the layer.

Fillers may be required to maintain a circular cross section.

Cut wires to length + 20% for Lay Loss and end tapes.

Ensure the correct number of wires and type for each layer.

Cable Construction

Where a cable cross section or construction is already specified, then the hand build should follow the same format as close as possible. If no construction is specified then contact TE for guidance. As a general guide, if possible when laying a hybrid, place the larger diameter wires in the outer layers of the cable. If this is not possible, the small wires may be laid together in groups to approximate the size of the larger wires and any that are left over may be lost in the interstices. Failing this, a combination of a laid core of small wires, laid units of small wires and the larger wires in combination may be laid, once again losing some of the small wires in the interstices.

Hand Laying Cables

There are two basic methods of laying cables dependant upon the length of the workbench or the length of the cable length. As a guide cables up to 12 metres should be considered for hand laying. If cables have twisted pairs in them, then extreme care must be taken to lay the components in the correct lay direction so that they remain as twisted pairs and do not become a quad.

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Method 1 - For cables up to 6 metres in length

The following example is a standard lay with 19 components.

Centre 1

1st Layer 6

2nd Layer 12

Always aim to have the outer layer as a left hand lay.

1st Layer

Take 7 wires and wrap 6 of these around the 7th.

Tape them into position in the centre of the cable and secure them in a holding fixture. Do not clamp wires directly in the holding fixture as this may cause damage to components. (See Figure 1) Working from the centre will aid the ease of cable laying. (For example a 6 metres length becomes two 3 metres).

Start laying the 6 wires around the centre wire in a right hand lay ensuring no crossovers. After approximately eight or nine turns have been wrapped around, comb out the loose wires so that no twists are present. Repeat until first length is complete securing at intervals and at the end with adhesive tape.

Reverse the cable in the holding fixture and repeat for second length.

2nd Layer

Take the remaining 12 wires, tape them into position in the centre of the cable around the 1st layer and secure them in a holding fixture. Do not clamp wires directly in the holding fixture as this may cause damage to components. (See Figure 1) Again working from the centre will aid ease of cable laying.

Start laying the 12 wires around the 1st layer in a left hand lay ensuring no crossovers. After approximately eight or nine turns have been wrapped around, comb out the loose wires so that no twists are present. Repeat until first length is complete securing at intervals and at the end with adhesive tape.

Reverse the cable in the holding fixture and repeat until the cable is complete.

Method 2 - For cables greater than 6 metres in length

Again using the example with 19 components.

Centre 1

1st Layer 6

2nd Layer 12

Always aim to have the outer layer as a left hand lay.

All wires must be on individual reels, preferably small reels that are easy to handle.

Take 7 reels of wire, tape the ends of the wires together and secure in a holding fixture. Do not clamp wires directly in the holding fixture as this may cause damage to components.

Unwind the central wire from its reel for the full length of the bench. Then, taking the other size reels, one at a time, wind them round the central wire. Ensuring that the same number of turns has been put on with each reel. Also, when winding the wire on from the reel, it must be held in the same plane at all times so as not to impart a twist to the component wire.

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Working from the holding fixture, tighten up the lay ensuring that no wires cross over and that the core does not jump out. This layer of wires should be in a right hand lay. Continue this procedure until the core has been built for the full length of the bench. Remove clamped end of core from the holding fixture and coil up laid cable. Transfer coiled cable and unlaied reels to the end of the bench and secure in holding fixture.

Repeat the above procedure as many times as required until the first layer of the cable is complete.

Using the end which has just been finished as the start for the second layer, secure the end of the cable in the holding fixture and run out the coiled cable for the length of the bench. Take twelve reels of wire and tape the ends of the wires together and position around the central cable core ensuring that the paper tape holds the ends of the wires onto the cable close to the holding fixture. Taking the twelve reels at one time, wind them round the cable, again ensuring that the same number of turns has been put on with each reel and that the reels have been held in the same plane at all times. Working from the holding fixture, tighten up the lay ensuring that no wires cross over. This layer should be a left hand lay. (See Figure 2)

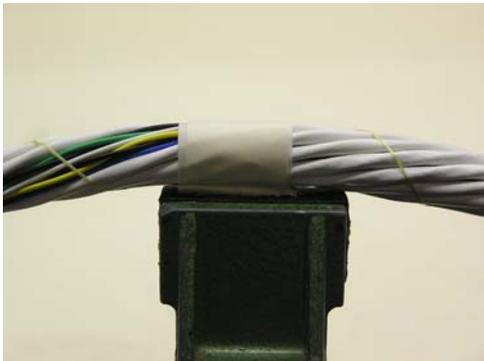


FIGURE 1



FIGURE 2

Hand Laying Harnesses

Each type of harness assembly needs to be evaluated for the best method of laying. Some harnesses may be suitable to be split down into sub sections. As a general guide it is suggested that each harness branch is laid starting from centre sections or transitions working to branch ends. Plan ahead and ensure that the lay direction for the outer layer is the same for all branches.

7 Binder

For cables starting from the holding fixture, tie the binder onto the cable and tape the end in position using adhesive tape. Bind all the components of the outer layer in position ensuring that the binder is even and the opposite direction to the cable lay.

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For harnesses start at centre section or transition, tie the binder onto the cable and tape the end in position using adhesive tape. Bind all the components of the outer layer in position ensuring that the binder is even and the opposite direction to the cable lay. (See Figure 3)

For cables with multiple layers, binder may be required on each layer to secure during hand build.



FIGURE 3

8 Inspection Requirements

Adhesive tapes to be removed from cables sections except for the holding tape at the free end. Correct type and number of component wires are in the cable run. That the lay is even with good lay length and that no "flip over's" have occurred. Each layer goes the opposite direction. (This is also applies to any Binder and Wrap). Ensure component wires are not scraped, nicked, severed or otherwise damaged.

9 Visual Standards



ACCEPTABLE



NOT ACCEPTABLE
Wire crossing over

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NOT ACCEPTABLE
Lay length too short
(Cable over twisted)



NOT ACCEPTABLE
Lay length too long
(Cable under twisted)

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4	CR06-DM-071	07/04/06	John Cronin	Ken Wallington
5	CR09-DM-018	27/01/09	Paul Newman	Neil Dorricott
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