SPLICING & TERMINATING PORTABLE CABLES

prysmian

The planet's pathways

SHIELDED CABLE

GENERAL PROCEDURES & TECHNIQUES

As a general rule, the higher the system voltage rating, the lower the margin of safety. As such, higher voltage systems require more care in engineering and installation. Further, splices and terminations, a vital part of any cable system, become more susceptible to failure at higher voltages. Whether the splice or termination is accomplished using hand-applied tapes, a filled or molded device, heat-shrinkable tubing, or a prefabricated device, care should be exercised during the application. Poor workmanship or improper materials could jeopardize the reliability of the entire system.

MAJOR CAUSES OF SPLICE & TERMINATION FAILURE

- Grounding or ground-check conductor shorter than the power conductors
- Poor removal of Semi-conducting residue on the insulation surface
- Gaps, voids or soft spots in insulating tape build-up
- Improper shielding system termination, leaving inward-pointing projections
- Damage to factory insulation by improper shielding systems removal
- Excessive slack in one or more individual conductors
- Splice has low tensile strength and is easily pulled in two
- Individual wires damaged during connector application
- Splice is too bulky—will not pass through cable guides or over sheaves
- Improper outer covering application, allowing water to enter the cable interior

When using a commercially obtained splice or terminating kit, the splicer should always carefully follow the kit supplier's directions and instructions, including their dimensions and drawings. This should ensure a proper installation and use of the materials provided in the kit. Should such a kit not be at hand, but suitable materials are available, the following general procedures, techniques and design factors can be followed. Based on experience and laboratory tests, these instructions should result in satisfactory splices and terminations but are not intended to circumvent or replace approved kit suppliers' recommendations.

GENERAL PRECAUTIONS:

- Keep work clean and dry.
- Do not nick insulation.
- Do not pull semi-con away from insulation at cutoff.
- Dimensions shown for single indent crimp-type connector.
- We suggest soldering for flexibility.
- Keep all power conductors of equal length so mechanical pull is equal on each.

SUGGESTED ITEMS NEEDED FOR SPLICING & TERMINATING PORTABLE CABLES

TOOLS:

- ☐ Concave roller
- ☐ Crimping tool
- ☐ Diameter measuring tape
- ☐ Ruler
- ☐ Marking pencil
- ☐ Hose clamp and 0.010” shim stock (2 ea.)
- ☐ Knife
- ☐ Pliers
- ☐ Scissors
- ☐ Screwdriver
- ☐ Soldering iron
- ☐ Splicing separator
- ☐ Vulcanizer(s)

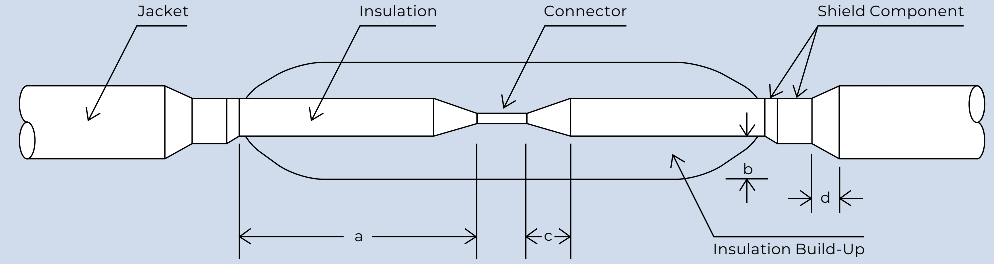
MATERIALS:

- ☐ Clean, lint-free rags
- ☐ Cleaning solvent
- ☐ Fusing semi-con tape
- ☐ Insulation putty
- ☐ Portable cable connectors
- ☐ PVC electric tape
- ☐ Shielding mesh or braid tape
- ☐ 60 grit sand cloth
- ☐ Solder and flux

VULCANIZING:

- ☐ Cement
- ☐ Cloth-backed cured rubber separator tape
- ☐ Cured insulating tape
- ☐ Neoprene, CSPE or CPE jacket tape
- ☐ Semi-con tape
- ☐ Uncured insulating tape

Figure 1



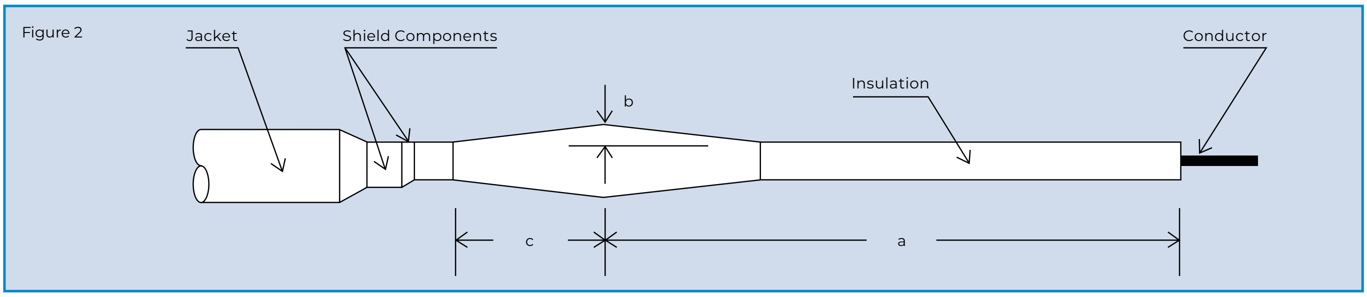
PREPARATION FOR SPLICING & TERMINATING

When preparing cable ends for splicing and terminating, follow these steps to prevent premature failure:

1. Cable ends should always be cut carefully and squarely.
2. Remove the outer jacket without damaging shield tapes or braid. To start, ring jacket circumferentially through approximately 80 percent of the jacket thickness.Holding knife at an angle, cut the jacket longitudinally in such a manner so that repeated traverses of these cuts will only have penetrated approximately 80 percent of the jacket thickness. Using pliers, grip the edge of the jacket and pull in the direction of the slant cut. If the jacket does not readily tear at the cut, a knife may be used with tension applied to the jacket, still avoiding damage to the underlying shield tapes or braid.
3. Thoroughly clean jacket on both ends of the splice to obtain good adhesion between the factory jacket and the completed splice jacket.

TAPE TIPS:

1. Remove separator backing.
2. Half-lap all tape.
3. Stretch 8 - 10" strips of insulating tape to ½ original width.
4. Overstretch ends and roll each layer to prevent voids.
5. Start tape in middle of splice.
6. Use fresh tapes only.



MAKING THE SPLICE

1. The connector is compressed on the two cable ends to be joined. Any burrs on the connectors should be removed. Any indentations existing are filled, preferably with semi-conducting tape strips.*

2. Semi-conducting material is applied over the exposed conductor and connector to produce a smooth contour. Any saw-tooth effect created by laps in the tape injects stress points in a very crucial region, which could be more detrimental to the life of the splice than omitting the operation completely.

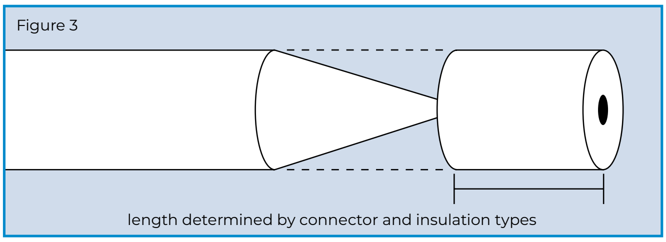
3. Pencilling of the insulation requires a 360° perpendicular cut through all but the last 1/16" of insulation, at a predetermined distance from the conductor end. This distance is directly dependent on the type of connector and type of cable insulations. Pencil and smooth the taper before removing the short section of insulation from the conductor. This buffer technique (Fig 1) protects the conductor surface against undue abrasion and scoring.

4. The splice is re-insulated with an insulating tape (Fig 2) applied half-lapped and in a smooth, rhythmical fashion, introducing uniform stretch as specified by the tape manufacturer. Frequent rolling of the work with a concave tool, screwdriver handle, or other round object helps to eliminate any entrapped air, which could otherwise ionize if sufficient voltage gradient is impressed across it. The insulating tape is wrapped to approximately ¼" from the cable semi-conducting component. This space allows for proper transition between materials in re-shielding.

5. The joint is re-shielded by using, where required, semi-conducting insulation shield tape applied half-lapped across the joint, starting by overlapping the ¼" of exposed, terminated, insulation semi-conducting layer at one end of the joint and finishing by overlapping the exposed semi-conducting layer at the other end. Roll this layer of tape as described above to eliminate any air voids. For proper metallic shielding, a tinned all-copper knit mesh or braid tape should be used for adequate conductance. This tape should be applied half-lapped across the joint and soldered to the cable shield at both ends of the splice.

6. Attempting to rebuild the cable as close to its original condition as possible includes consideration of the jacketing material. Neoprene, CSPE and CPE tapes have been used for this purpose with considerable success. Vulcanization in a mold is suggested for best results.

7. Place all the cable components back into their original configuration as close as possible with the proper lay or twist. If the cable fillers are no longer intact or are insufficient in body to fill the interstices of the spliced conductors, use cut lengths of tape to build up the fillers to produce a round joint. Tape over all with jacketing tape (Fig 3) if a mold is to be used, extending the tape out over the cleaned areas of the original cable jacket. Build up the jacket thickness to a diameter slightly larger than the mold cavity to ensure that the cavity will be completely filled out and that the excess material will be squeezed out in the form of a flashing. The tape manufacturers' recommendations for temperature and mold pressures should be followed



*The power conductors should be staggered to reduce the overall diameter of the completed splice. Grounding and ground-check conductors should be of equal length and approximately 1/4" longer than the power conductors.

BUILDING A TERMINATION

1. Following either the supplied kit drawings or dimensions, terminate the shielding components, both metallic and semi-conducting portions, as described in the instructions. Clean the entire exposed length of insulation along the creepage path as indicated for splicing.

   The three most common types of stress cones in use for terminations are pre-molded, pennant or hand-taped. Pre-molded and pennant types are usually in kit form, and instructions for application are supplied.

   a. If a hand-taped stress cone is to be formed using materials at hand, start applying half-lapped insulating tapes at the center of the stress cone, taping to within ¼" of the terminated semi-conducting component. Tape back up across the center to the prescribed length of the stress cone and build up the cone to the proper dimensions.

2. Apply half-lapped semi-conducting tape from ⅛" below the peak of the stress cone, down the slope and over the semi-conducting layer of the cable.
3. Apply half-lapped, tinned all-copper knit mesh or braid tape from ⅛" below the edge of the semi-conducting tape, down the slope and over the shielding tapes or braid of the cable. Attach the external ground strap or pigtail at this location.
4. Re-jacket the entire termination using either uncured tape and molds where available or self-curing tapes applied half-lapped, with the last layer applied from the cable jacket upward to the lug. This last layer then provides a “shingle” type layer and reduces the amount of contaminants that would be accumulated at the edges of the tape.

OBTAINING GOOD ADHESION BETWEEN DISSIMILAR POLYMERS DURING VULCANIZATION

The following procedure has been tested and found to produce good adhesion between the uncured thermosetting tapes and the cable jacket in a standard vulcanized splice.

Preparation

1. The jacket must be thoroughly cleaned. Buff with 60 grit sand cloth until only virgin material remains. It should be free of grease, dirt, slipper coating, paraffin, etc.
2. Completely cover the freshly buffed surface of the jacket with a properly mixed adhesive.
3. Allow adhesive to dry until tacky to the touch.
4. Half-lap uncured tape over tacky surface. Exclude air voids.**
5. Apply uncured tape until dimensions are slightly larger than cavity of mold.
6. Cure according to standard procedures. A general guide which has been proven successful is:

   a. Curing temperature: 280° F.

   b. Nominal time: 1 hour (varies slightly with cable size).

   c. Mold pressure: 275 lb/in². Pressure should be sufficient to completely close both halves of the mold and to cause immediate extrusion of the uncured tape compound from the relief openings in the mold. This pressure should be maintained throughout the curing time period.

7. After removing the cable from the vulcanizing mold, allow to cool for at least one hour before bending or stressing.

** Some adhesives dry so rapidly that it is difficult to apply the tape over the entire area while still tacky. This will not reduce the degree of bonding.

SPLICING NONSHIELDED CABLE

GENERAL PROCEDURES & TECHNIQUES

Most low-voltage, nonshielded cable splices and terminations are made with “off the shelf” kits or with approved materials stocked by the user. Without shielding, less consideration needs to be given to creepage distances and other critical dimensions of shielded cable splices and terminations. In most cases the insulation is not even pencilled, though this is recommended. Thus, the splice consists of a mechanically applied connector, hand-applied insulation and jacket replacement.

Some splicing procedures require special care, however, especially in multi-conductor cables. When splicing MC cables, ensure:

1. Power conductors are staggered to reduce the overall diameter of the completed splice.
2. Both ground-check and grounding conductors are approximately ¼” longer than the power conductors. A shorter conductor will carry most of the tensile load and could fail prematurely due to connector pullout or strand breakage.
3. Adequate insulation over the exposed strand and connector. Refer to kit instructions or provide at least two (2) times the factory-applied insulation thickness.
4. The splice or termination should is properly jacketed and sealed against moisture.

Good judgement should be exercised in the type of kit used or materials chosen. The decision should be based upon the cable’s end use, its normal or possible environment, the physical requirements of the cable, and its splices and terminations.

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