TECHNICAL NEWS
from
THE OKONITE COMPANY

Engineering Information for the Professional Engineer

July, 2004 Edition: 0016

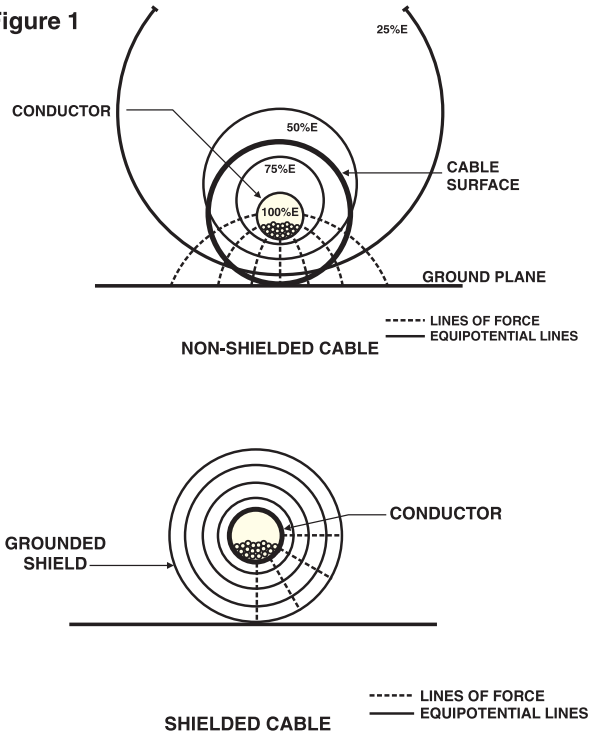
Why Are Terminations Required On Shielded Medium Voltage Cables?

Every shielded medium voltage conductor requires terminations at both ends, but why?

The purpose of a shield on a medium voltage power cable is to confine the equipotential lines within the insulation and to equally distribute voltage flux around the conductor. See Figure 1.

The insulation wall between the applied voltage (conductor) and ground (the shield) is relatively small, 175 or 220 mils for a 15kV cable. This distance is so small that a flashover would occur from the conductor to the shield if the cables shielding system was not trimmed back at the cable ends. Thus when a cable is terminated, the metallic shield component (copper tape, wires, LCS, flat straps, etc.) and the semiconducting polymer layer below it must be stepped back. If left without any additional treatment, at 5 or 15kV this "bare" termination would hold voltage, but over time would discharge at this point due to equipotential stress concentrating at the shield edge. See Figure 2.

Figure 1



Thus the stress at the shield edge must be re-directed, i.e. relieved. The various stress relief methods include:

A. Hand Wrapped Stress Cone: This is the oldest type termination. Here elastomeric tape is used to gradually build up the insulation thickness beyond the termination of the cable shield. The

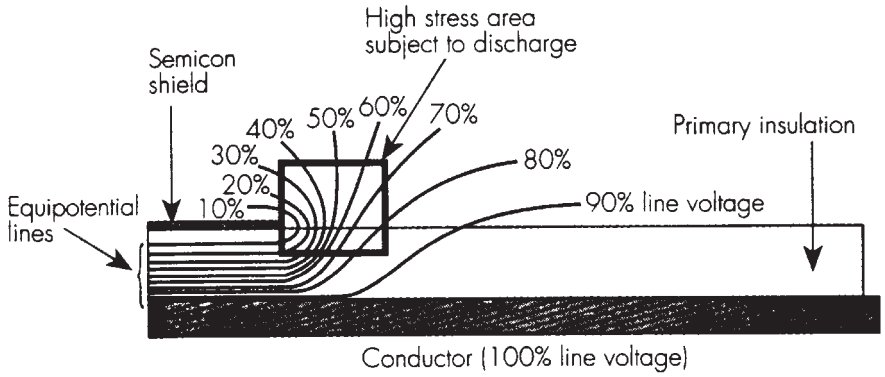


Figure 2 Configuration of equipotential lines on cable without stress relief

stress concentration is thereby reduced to an acceptable level. This is known as geometric stress grading. Hand wrapped stress cones are rarely employed today due to the skill level required and the availability of easier and more economically applied terminating alternatives.

B. Pre-molded Termination: This is another type of geometric stress graded termination that acts like a hand wrapped stress cone but is pre-molded of EPDM insulation by the termination manufacturer and factory tested. They are sized in ranges of insulation OD's and require silicone grease to assist in slipping them onto the cable end. The silicone grease also displaces any air within the termination, which can discharge. Pre-molded terminations include pre-molded stress cones (see Fig. 3) and elbows.

C. Potheads: These are basically stress cones housed in a porcelain or copolymer housing that is filled with compound to eliminate air. Potheads for 69kV and higher may also incorporate internal capacitors for additional stress grading.

D. Impedance Graded Terminations: These type of terminations use Hi-K polymer materials (a.k.a. stress control layer) to electrically grade termination

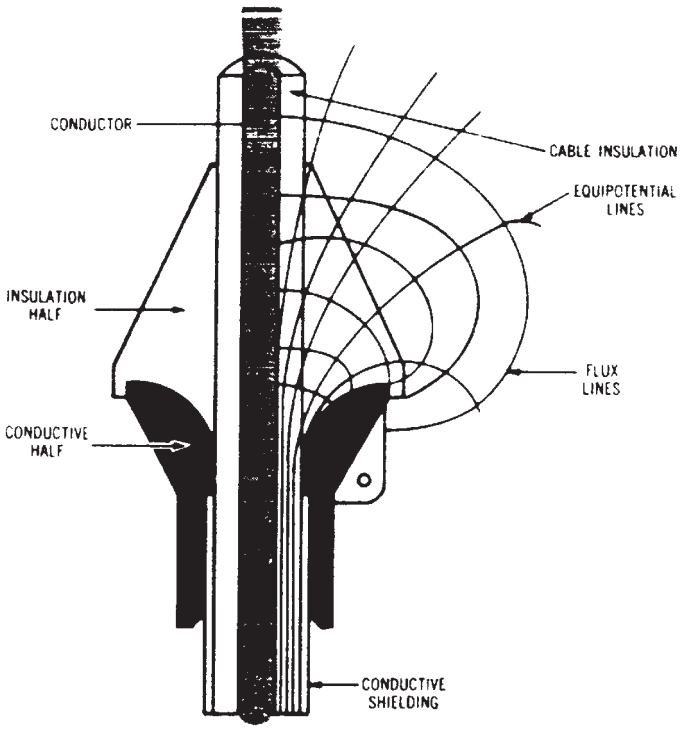


Figure 3 Pre-molded stress cone employing geometric stress grading

tions that use a wraparound stress later with an overall slip on covering.

Terminations are not addressed by UL or NEC. Standards that address terminations include:

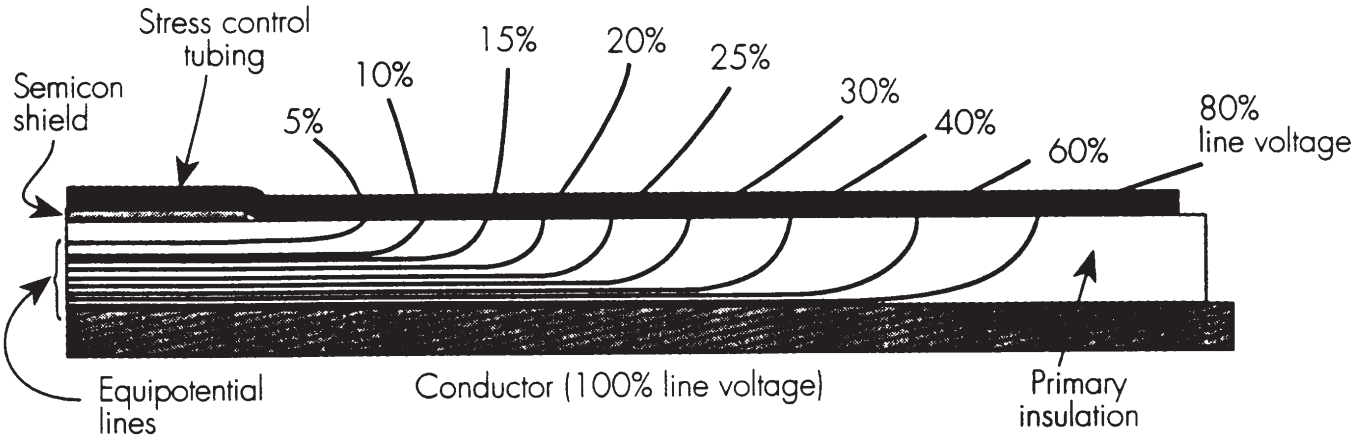


Figure 4 Impedance graded termination - heat shrink, cold shrink, wraparound, etc...

stresses the same way a stress cone geometrically grades the stress. See Figure 4. The advantage of impedance graded terminations is a thinner profile, bend flexibility, and ease of installation. Impedance graded type terminations include heat shrink, cold shrink, hand wrapped terminations (that use a stress control tape as the very first layer) and other varia-

IEEE 48 - Standard Test Procedures and Requirements for Alternating Current Cable Terminations 2.5kV though 765kV

IEEE 386 -Standard for Separable Connector Systems for Power Distribution Systems Above 600V.