SHIELDING

Definition of Shielding - Shielding of an electric power cable is the practice of confining the dielectric field of the cable to the insulation of the conductors. It is accomplished by means of conductor and insulation shields.

Functions of Shielding - A conductor shield is employed to preclude excessive voltage stress on voids between conductor and insulation. To be effective, it must adhere to or remain in intimate contact with the insulation under all conditions.

An insulation shield has a number of functions:

(a) To confine the dielectric field within the cable.

(b) To obtain symmetrical radial distribution of voltage stress within the dielectric, thereby minimizing the possibility of surface discharges by precluding excessive tangential and longitudinal stresses.

(c) To protect cable connected to overhead lines or otherwise subject to induced potentials.

(d) To limit radio interference.

(e) To reduce the hazard of shock. This advantage is obtained only if the shield is grounded. If not grounded, the hazard of shock may be increased.

Use of Insulation Shielding - The use of shielding involves consideration of installation and operating conditions. Definite rules cannot be established on a practical basis for all cases, but the following features should be considered as a working basis for the use of shielding.

Where there is no metallic covering or shield over the insulation, the electric field will be partly in the insulation and partly in whatever lies between the insulation and the ground. The external field, if sufficiently intense in air, will generate surface discharge and convert atmospheric oxygen into ozone which may be destructive to insulations and to protective jackets. If the surface of the cable is separated from ground by a thin layer of air and the air gap is subjected to a voltage stress which exceeds the dielectric strength of air, a discharge will occur, causing ozone formation. The ground may be either a metallic conduit, a damp non-metallic conduit or a metallic binding tape or rings on an aerial cable, a loose metallic sheath, etc. Likewise, damage to non-shielded cable may result when the surface of the cable is moist, or covered with soot, soapy grease or other conducting film and the external field is partly confined by such conducting film so that the charging current is carried by the film to some spot where it can discharge to ground. The resultant intensity of discharge may be sufficient to cause burning of the insulation or jacket.

Where non-shielded cables are used in underground ducts containing several circuits which must be worked on independently, the external field if sufficiently intense can cause shocks to those who handle or contact energized cable. In cases of this kind, it may be advisable to use shielded cable. Shielding used to reduce hazards of shock should have resistance low enough to operate protective equipment in case of fault. In some cases, the efficiency of protective equipment may require proper size ground wires as a supplement to shielding. The same considerations apply to exposed installations where cables may be handled by personnel who may not be acquainted with hazards involved.

Grounding of the Insulation Shield - The insulation shield must be grounded at least at one end and preferably at two or more locations. It is recommended that the shield be grounded at cable terminations and at splices and taps. Stress cones or equivalent protection should be made at all shield terminations.

The shield should operate at or near ground potential at all times. Frequent grounding of shields reduces the possibility of open sections on nonmetallic covered cable. Multiple grounding of shields is desirable in order to improve reliability and safety of the circuit. All grounding connections should be made to the shield in such a way as to provide a permanent low resistance bond. Shielding which does not have adequate ground connection due to discontinuity of the shield or to improper termination may be more dangerous than non-shielded non-metallic cable and hazardous to life.

SHIELDING (CONT'D)

GENERAL SHIELDING RECOMMENDATIONS FOR POWER CABLE

Shielding should be considered for non-metallic covered cables operating at circuit voltages over 2000 volts where any of the following conditions exist:

(a) Connections to aerial lines.
(b) Transition from conducting to nonconducting environment.
(c) Transition from moist to dry earth.
(d) Dry soil, such as the desert.
(e) Damp conduits.
(f) Where conducting pulling compounds are used.
(g) Where the surface of cable collects conducting materials, such as soot, salt, or cement deposits.
(h) Where electrostatic discharges are of low enough intensity not to damage cable but are sufficient in magnitude to interfere with radio or television reception.
(i) Where safety to personnel is involved.

The use of non-shielded cable may be considered where shields cannot be adequately grounded.

Since the need for shielding is governed largely by local operating conditions, only general rules for shielding can be listed. Our general practice, as listed in the accompanying table conforms to the latest ICEA recommendations. It applies to power cables only, and does not include such special applications as motor leads, or transformer leads, for which shielding is seldom used. Article 310.6 "Shielding" of the 2005 National Electric Code should be considered. Cables with voltages rating greater than 2000V must be shielded except those in the listed exceptions.