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INSULATION – PHYSICAL TOUGHNESS

An electrical insulation must remain electrically stable to adequately perform its intended function. The primary emphasis during the development of insulating compounds is placed on electrical properties. Physical properties play a secondary role and in general are controlled by materials that have been chosen to maximize electrical properties. Traditionally protective sheaths or jackets are provided for physical protection.

Recent trends in cable design and a review of the prevalent causes for cable failures point clearly to the need for a special emphasis on the physical toughness of insulations. Following are a few examples:

- (1) Trend to unipass or single-shot constructions, 600-volt and 5Kv unshielded
- (2) Reduced insulation walls
- (3) Over 90% of cable complaints investigated indicate that failure was due to physical damage of the cable during handling, installation, or in service

It is fairly obvious that any covering in a single-shot or unipass construction must function as a combination insulation and jacket. Cable users must exercise good judgement in cable application and choose a cable design consistent with the physical environment and potential for physical damage. In many applications a traditional cable with a special protective sheath offers the greatest reliability.

A review of the various types of physical damage to which a cable is exposed during handling, installation, and application will emphasize the necessity for insulation toughness and for discretion in cable choice.

- (1) Compression-Cut: A condition under which a crushing load physically ruptures the insulation. In a cable the metal conductor functions as a cutting tool when a crushing load is placed on the cable exterior. Leakage paths to ground result in cable failure.
- (2) Impact Damage: Similar to compression-cut but damage occurs immediately upon impingement. The degree of damage is dependent upon the foot pounds of force and the area contacted at point of impingement. A good example would be trying to drive the blunt end of a pencil into a cable and then the sharp end. With the same total energy the pointed end will penetrate; the blunt end will not.

- (3) Tearing: Cables pulled over industrial ill, uncleared terrain and other obstructions can initiate cuts or gouges that can develop into full scale tearing or ripping of a cable covering.
- (4) Abrasion: Rare in other than portable cables but can occur when pulling cable through a conduit that has not been de-burred or where cables rub against other objects or each other.
- (5) Deformation: When subjected to sufficient shearing stress any body will deform. This deformation can be accelerated at elevated temperatures. Cables covered with fill containing large rocks will, through natural earth movement, be subjected to shearing stress by these rocks and vulnerable to damage.

Laboratory tests simulate the above types of damage and provide a good screening method for selection of most suitable materials. Since different degrees of physical protection are required for the multitude of cable application involved, good judgement consistent with the ability of various cable designs to withstand physical damage must be exercised in cable choice for reliability and safety.

Steve Bunish