

Cable Lore

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CORONA-RESISTNACE

The author of a recent article on "Breakdowns and Discharges" mentioned that Corona is a term which means different things to different people. Physicists, transmission engineers, power transformer engineers, capacitor designers, and power cable designers all see corona in a light that focuses attention on their own peculiar problems. These problems overlap and are related but cannot be covered by a blanket explanation or solution that satisfies everyone.

No attempt will be made to simplify an explanation of corona. This phenomenon is too complex for casual treatment. Much has been written on the subject and much is unknown. How to measure corona is a subject of much recent debate. A statement on the tolerance of cables to corona will get you into a lot of interesting arguments but no unanimous opinions. If all this is so, why all the fuss about corona? One major factor makes all cable manufacturers worry about corona; it is a hazard and insulation engineers are constantly searching for materials that are more resistant to corona.

A few of the generally accepted facts concerning corona - means to eliminate the causes of corona and the necessity for using materials with the highest degree of corona-resistance - will offer some feel for the subject:

- (1) Corona-resistance and ozone-resistance are not synonymous terms. Each is a separate phenomenon. Materials such as Polyethylene exhibit excellent ozone-resistance but have poor corona-resistance.
- (2) One good definition of corona is: "A discharge of electricity appearing as a glow of colored light on the surface of a conductor when the potential gradient exceeds a certain critical value. It is due to ionization of the surrounding air by high voltage."
- (3) Corona level is the voltage at which corona discharge disappears. This level is recorded after applying sufficient voltage across a cable insulation to give clear indications of corona discharge and then lowering the voltage until the discharge disappears.
- (4) Corona can occur between the surface of a conductor and insulation if a void is present, in voids within the insulation itself, or between the insulation and shield if a void is present.
- (5) Corona is accompanied by a liberation of heat, and a watt meter connected in a circuit having corona will indicate that power is being supplied to corona.

- (6) Corona causes deterioration of insulating materials by the combined action of the discharge striking the surface (ion bombardment) and the action of certain chemical compounds that are formed by the discharge. Ozone, oxides of nitrogen and (in the presence of moisture) nitric acid are formed by corona discharge in air.
- (7) The higher the voltage gradient across the insulation, the greater the probability of corona occurring.
- (8) Extruded strand shields with smooth surfaces and bonded to the insulation will make it virtually impossible for corona to occur at the interface.
- (9) Processing techniques designed to keep insulation voids to a minimum will reduce the chance of corona occurring.
- (10) Intimate contact or bonding between the outer layer of insulation and shielding system will minimize the chances of corona occurring.
- (11) Many mechanisms have been described for explaining what happens during corona, how to measure corona, and even suggested standards. All of these are useful but none absolute.

As far as insulated cables are concerned it all boils down to -

- (1) Choose an insulation with a high degree of resistance to corona
- (2) Put this insulation into a cable design that incorporates features for increasing the corona level (Uniblend concept)
- (3) Use processing techniques that will fabricate the design with a minimum of voids or areas that would encourage corona

Whitehead, in his book on the "Dielectric Breakdown of Solids", covers nicely the tolerance of cables to corona:

"In practice a great deal of insulation has given satisfactory and lengthy service in the presence of internal discharge. The inadequacy of theoretical analysis is illustrated by the fact that the prediction of what is tolerable and what is dangerous is still largely based on experience."

Corona-resistance is an important property desired by both the consumer and cable manufacturer. Much work is in process throughout the industry to measure corona and to set realistic standards for reliable cable performance.

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