AmerCable INCORPORATED

Tiger Tips

Why you should shield high voltage trailing cables

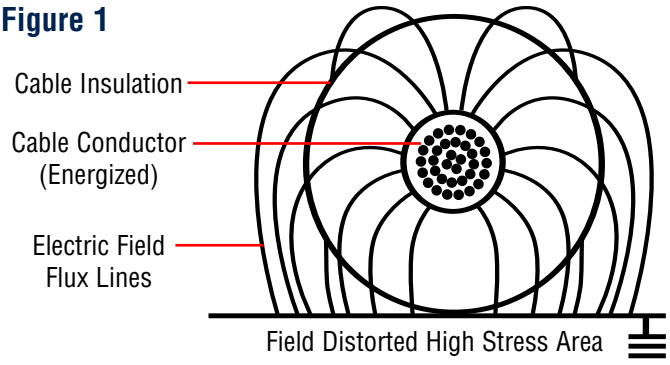
The decision to select non-shielded or shielded cable for high voltage trailing cable applications requires extensive discussion. You should first understand the operational principles of a non-shielded cable in comparison to a shielded cable, and the types of operating problems that may occur.

The primary function of an electrical conductor is to conduct voltage and current. The primary function of an insulation is to contain the voltage within the conductor. No insulation does this perfectly. All insulations build up charges on the surface.

Electrostatic energy or stresses cross the insulation and gather on the outer surface of the insulation trying to find a path to ground. These electrostatic charges emanate from the conductor and are called radial stresses. Visualize lines like spokes of a wheel. Ideally the lines of force are uniformly distributed.

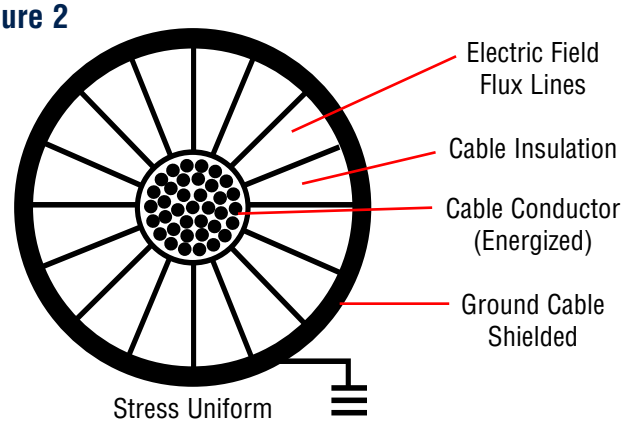
A high voltage non-shielded cable's electrostatic stress lines become distorted when the cable is placed in the vicinity of a grounded surface. (Figure 1) This results in varying voltage stresses around the cable's insulation surface. If the operating voltage of the cable is high enough, for example 2400 volts, and if the cable is in damp locations or where the cable surface is exposed to dirt, carbon, moisture or other contaminates, surface tracking (discharging to ground) can cause cable failures.

Figure 1



A grounded shield on the cable distributes stresses uniformly around the insulation circumference, eliminating stress concentration and the occurrence of surface voltages. (Figure 2) Because discharges, tracking, corona and ozone cannot occur, shielded cable is an inherently reliable cable design that will work in all applications.

Figure 2



To shield, or not to shield, is a highly charged topic among cable designers, engineers and users. There are many conflicting opinions on the necessity of shielding for different voltage classifications and operational conditions. The following facts (see back page) about non-shielded and shielded cables are universally accepted by cable engineers and AmerCable.

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Non-Shielded vs Shielded

There is a greater probability that the electrostatic stress path escaping the surface of the insulation will be distorted in the effort to find a path to ground at a point. This results in a non-uniform stress distribution.

Non-uniform stress distribution reduces the efficiency of the insulation.

If the cable comes into contact with ground, electrostatic stresses at the point of contact will result in a tangential stress.

Tangential stresses can result in electrical discharge, ozone formation, become an ignition source for explosive gas mixtures, localized heating, and general insulation deterioration.

Non-shielded cables, traveling through sections of wet and dry conditions, will witness varying capacitance to ground. This in turn may result in breakdown of the insulation.

Non-shielded cable connected to overhead lines can be subject to traveling waves due to lightning or induction from charged clouds or fog drifts. This can result in surge voltage buildup and insulation breakdown.

When the outer surface of the insulation or covering of insulated cables is not in contact with ground throughout the entire length of cable (non-shielded cable), a considerable potential difference may exit between the covering and ground.

This potential difference may create a hazard and could be lethal to anyone coming in contact with the cable and could also result in sparking which could be an ignition source for explosive gas mixtures.

Shielding of an electrical power cable is the practice of confining its dielectric field to the inside of the cable insulation by surrounding the insulation with a grounded conducting medium called a shield.

Some conducting mediums suitable for shielding purposes are: metal tapes, metal braids, metal tubes, semi-conducting tapes, extruded semi-conducting layers, and extruded semi-conducting layers with drain wires.

A shield acts as a barrier to electrostatic stresses and confines them with in the insulation.

Shielding properly applied and grounded will enhance insulation efficiency.

Shielding properly applied and grounded will keep radial stresses uniformly distributed within the insulation.

Shielding properly applied and grounded will eliminate tangential stress.

Shielding properly applied and grounded will eliminate longitudinal stresses by bringing the entire insulation surface to ground potential.

Shielding properly applied and grounded reduces surge potential on cables connected to overhead lines.

Shielding properly applied and grounded will provide personnel safety.

Shielding properly applied and grounded will help eliminate ignition sources due to spark discharges.

AmerCable engineers recommend that all cables over 4160 volts be shielded and, depending on the operational environment, strongly consider shielding trailing cable at circuit voltages over 2000 volts.