

Two Layers vs. One Layer of Cable Covering / Insulation for Overhead Cables

Many years ago, for underground service to street lights, a large electric utility used a cable with one layer of polyethylene insulation over the conductor (Fig. 1). (The insulation was filled with carbon black which provided sunlight resistance when the cable was stored outdoors or used for above ground applications.) The electric utility cable engineer found that this design had a high failure rate. His study concluded that the sharp pieces of coral in the soil on much of the system were cutting through the insulation and resulting in failures.

In conjunction with a major cable manufacturer of that time, it was concluded that if the wall thickness of the one layer cable was divided into two layers, fewer failures would occur. It was determined that the inner layer would maximize the electrical insulating properties, while the outer layer, insulating indeed, would be selected for maximum toughness against abrasion, cutting and impact (Fig. 2).

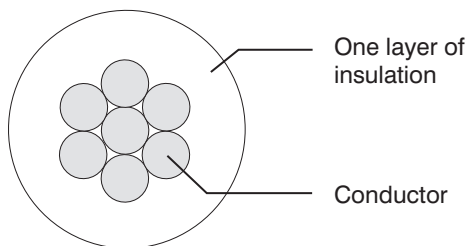


Fig. 1
One Layer Design

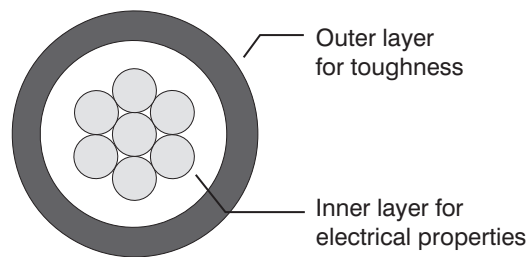


Fig. 2
Two Layer Design

Clearly, the concept worked, because the entire market for underground secondary cables has been filled with “ruggedized” two layer designs used by many utilities. The concept is the same today as it was many years ago. The inner layer is selected to maximize the desirable electrical properties, while the outer layer, also insulating, is selected to maximize cable toughness and weatherability against the elements (sunlight, etc.).

So what about spacer cable and high reliability tree wire which are used in overhead applications? When a tree branch rubs on the surface of a covered overhead cable, this presents a case similar to the “coral cutting the cable insulation.” Of course, the outer layer on spacer cable and tree wire must be very tough and sunlight resistant, but it must also be as track resistant as possible (Fig. 3). Tracking is current flow on the surface of any non-shielded cable insulation. Tracking will be the subject of another TIP.

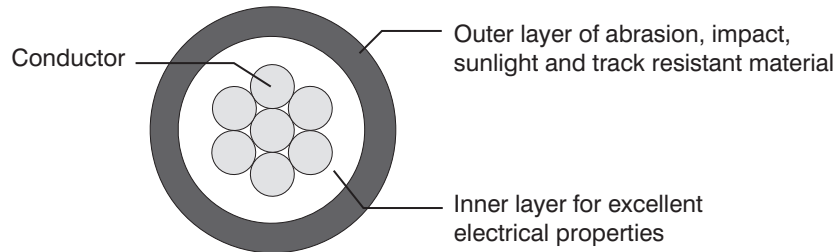


Fig. 3
Two Layer Spacer Cable or
High Reliability Tree Wire

If the outer layer has all of these desirable properties and is insulating, why not make the entire covering out of this “outer layer” material? There are three reasons: First, the inner layer is selected to provide the maximum in electrical properties. Second, the inner layer selected is a bit softer (except for the 90°C cable design) and offers somewhat easier strippability and, on smaller cable sizes, more flexibility than the outer layer material. Finally, filled materials can have an occasional pinhole which may compromise the dielectric integrity of the cable covering. Stringent testing can locate very nearly all pinholes, and they can be removed. However, there is always a concern that one pinhole could slip through the test and not be detected. With extrusion of the covering in two layers, the possibility of two pinholes at the same location is virtually non-existent (Fig. 4). To further verify that weak spots are not present, the two layer combination is spark tested using AC voltage.

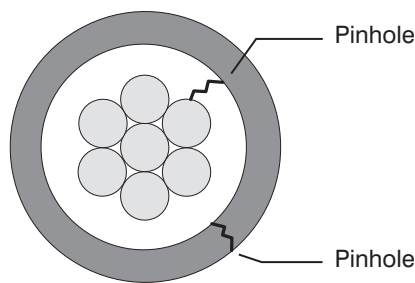


Fig. 4
Two layers provide a higher level
of assurance than one layer

As the voltage stress level increases, the need for a higher level of assurance makes sense. That is why Hendrix recommends the two layer design for spacer cable and tree wire systems rated 15kV and above. A conductor shield is also recommended, but that is the subject of TIP No. OH-3.