WIRE STRIPPABILITY

The ease with which a slug of insulation can be cleanly stripped from an insulated copper or aluminum wire is a characteristic that can impact the efficiency of the stripping process as well as the quality of the termination. Wire strippability is often taken for granted, but it quickly becomes a major concern if difficulties arise—especially with high-volume production. The characteristics of wire and automated stripping equipment interact in subtle and complex ways. As a result, troubleshooting can be difficult and time-consuming. Below is an overview of some of the key characteristics that influence wire strippability.

Strip Force

The strip force of an insulated wire is the axial force required to remove a given length of insulation from a conductor in preparation for termination. The amount of friction or adhesion between the insulation and the copper conductor must be low enough for the slug to be easily and cleanly removed, yet high enough so the remaining insulation does not slide during stripping or during subsequent processing. Industry standards provide test methods to measure this force.

A typical strip force measurement method consists of the preparation of a sample of wire with a short length of insulation removed from one end of the wire while leaving a precise length of insulation undisturbed. The end of the wire is then inserted through a hole in a metal plate that is slightly larger than the copper conductor. The remaining length of insulation is pulled from the conductor by pulling the conductor through the metal plate using a tensile testing machine pulling at a specified rate. The maximum force reached during stripping is measured and recorded.

The strip force of a wire varies with length of slug, wire size, insulation type, type of stranding and other variables, but it is typically in the range of 5 to 25 pounds (22 N to 111 N). Wire manufacturers can control strip force within reasonable limits by careful control of conditions during extrusion of the insulation including conductor surface cleanliness and texture, conductor preheat, extrusion temperature, extrusion pressure, extrusion tooling and cooling rate.

Cut-Through Resistance

The cut-through resistance of wire insulation must be high enough to withstand the mechanical forces of installation and usage and to comply with industry standards. At the same time, it must be low enough to permit the knives of a stripping machine to reliably cut the material. PE (polyethylene) and XLPE (cross-linked polyethylene) are common materials with relatively high cut-through resistance, while EPR (ethylene propylene rubber), silicone and polyurethane have relatively low cut-through resistance. PVC (polyvinyl chloride) typically has a cut-through resistance somewhere between these two extremes. The knives of the stripping equipment must, of course, be sharp enough to cut cleanly through the insulation or jacket and must also be properly adjusted so the insulation is cut all the way through without nicking the copper or aluminum conductor.

Crush Resistance

As with cut-through resistance, the crush resistance of wire insulation must be high enough to withstand installation and in-service mechanical forces and to comply with industry standards. The crush resistance of a wire must also be high enough to withstand the force applied by the grip of automated stripping equipment. This force is often adjustable and must be set high enough to prevent slippage as the insulation slug is pulled from the conductor, but it must be low enough to not damage the wire insulation. The crush resistance of a wire depends primarily on the type of insulation, but conductor material and stranding also has an effect. Wires with finely stranded conductors typically have better crush resistance than solid or coarsely stranded conductors because the conductor strands will compress.

Insulation Hardness

Insulation hardness can also affect strippability. Soft, rubbery insulations such as EPR, silicone or CSPE (chlorosulfonated polyethylene) can buckle and thus bind as they are being pulled from the conductor if adhesion to the conductor is too high, especially if the strip length is long. This phenomenon is seldom an issue with harder polymers such as PE, XLPE and FEP (fluorinated ethylene propylene). Polymer hardness is often measured and reported using a method called durometer hardness testing.

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