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ALUMINUM CONDUCTORS

In spite of the fact that aluminum conductors must be used two gauge sizes larger than copper to achieve equal ampacity, aluminum conductors cost less than copper and are, therefore, being specified with increasing frequency for feeders and branch circuits.

The major factor which precludes the interchangeability of aluminum and copper in wiring circuits is their differing coefficients of expansion and contraction. When subjected to heat generated by flowing current, aluminum expands 36% more than copper for a given temperature decrease. Thus, aluminum wire inside a copper-bodied connector will expand at a faster rate than the copper, causing pressure at the interface which forces the wire out of the connector. The continued excessive expansion and contraction eventually causes the aluminum wire to become loose. This results in arcing, a fire hazard; and complete circuit failure. When an aluminum connector is used with copper wire, the expansion is on the outside because the aluminum connector has the higher rate of expansion. In this case, the pressure at the point of contact does not exceed the elastic limits of either metal, and permanent stress does not occur. Consequently, only aluminum connectors need be used to accommodate both copper and aluminum conductors when both types of wire are being installed.

Design of aluminum connectors must take into consideration another important characteristic of aluminum — surface oxidation which quickly forms when the metal is exposed to oxygen in the atmosphere. All wire oxidizes when its exposed surface comes in contact with air. But whereas copper oxide does not interfere with electrical conductivity, layers of aluminum oxide form a resistance barrier which reduces current flow and increases heat buildup at the contact point. Therefore, both ends of aluminum connections must be in intimate contact — bare metal to bare metal. The brittle oxide layer must be penetrated and the bared metal must not be permitted to reoxidize.

Some manufacturers are marketing UL-listed aluminum connectors for use with aluminum wire. These connectors are available in both compression and screw or bolted types. All are designed to apply sufficient pressure to shatter the brittle aluminum oxide and provide a durable metal contact. Underwriters' Laboratories has formulated test procedures for aluminum wire terminations under binding head screws. Devices meeting these UL tests are marked CO/ALR (copper or aluminum revised) and are the only such devices officially listed for direct connection to aluminum wire.

Because aluminum conductors have certain physical characteristics different from copper, greater care must be taken to install them. The aluminum conductor must be carefully prepared. After gently stripping the insulation — taking care not to nick the wire strands — the bare conductor should be wire brushed to remove the oxide, and a joint compound applied if it is not supplied in the connector. (Most aluminum-bodied connectors are plated and these should not be brushed, to avoid scratches). For screw-type connectors, the screws or bolts should be tightened to the manufacturer's recommended torque. Compression connectors also require a certain amount of extra care in their installation. The size of the connector and the conductor must be matched. And the tool and its die must be correct for the size and type of connector.

This information is excerpted from "Deviceline", published by Slater Electric, Inc.