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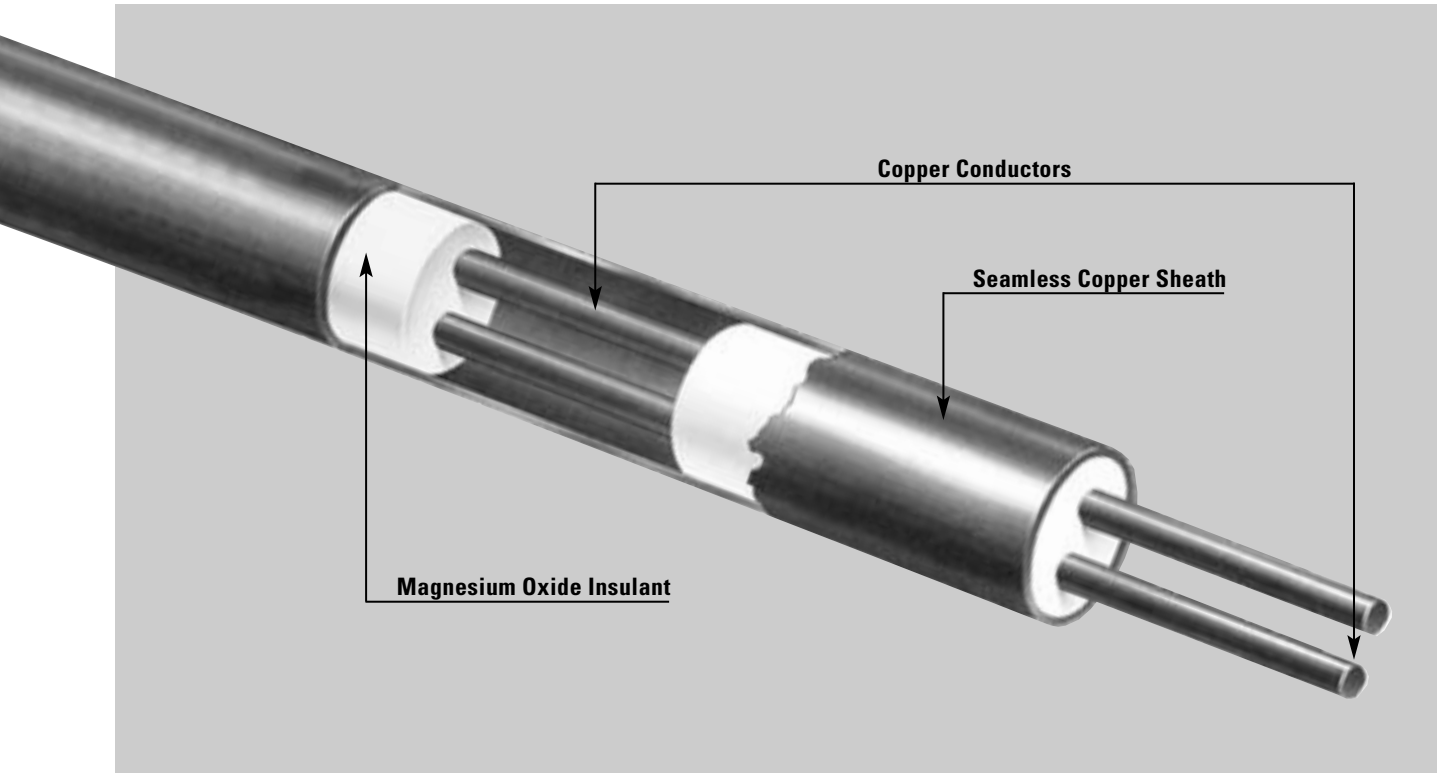
Information Sheet
The Case for Pyro E Bare Copper MI Wiring Cables



Copper sheathed mineral insulated cable does not normally require a plastic outer covering , or any other form of additional protection because of the exceptionally high resistance of copper to atmospheric corrosion. Unlike steel and aluminium, copper has been used for over 5,000 years and the British Museum possesses objects dated to approximately 3200 BC[(1)].

Quantitive data on the atmospheric corrosion of copper have been given in a paper by Scholes and Jacob[(2)]. This describes tests in which panels of copper and copper alloys were exposed to an industrial environment in Birmingham and to a marine environment in Scotland for a period of 20 years. Panels were mounted horizontally, vertically and at 45^{o} with the vertical and sloping panels facing south. The tests were started in 1948, some panels being withdrawn for examination after five years and the remainder after 20 years. Assessment was by visual appearance, weight loss, intensity of localised attack and loss of mechanical properties.

The 20 year examination showed that very little corrosion had occurred to any of the material at either site in any position and that unalloyed copper was in general, superior to any of the alloys. Maximum depth of attack on deoxidised non-arsenical copper after 20 years was 0.019mm at the industrial site and 0.025mm at the marine site. The five year examination had shown greater attack, 0.058mm and 0.035mm respectively. Average depth of attack, calculated from weight loss measurements, was about 0.002mm per year at both sites after 5 years but reduced after 20 years to just under .002mm per year at the industrial site and about .001 per year at the marine site. The greatest loss of strength after 20 years was about 3% reduction in UTS at the marine site.

Some information about longer term resistance of copper to less polluted atmospheres has been obtained by the examination of copper roofs. In 1928 Vernon and Whitby examined a portion of the roof covering from the Bodleian Library in Oxford which was laid in 1830[3]. The covering was originally specified as 28oz (per sq. ft.) copper (0.038") and the thickness measured nearly 100 years later was still 0.038". The same authors also analysed the surface patina from the roof of the Chapel Royal in St. James's Palace, London which was believed to have been installed in 1540. They were not able to measure its thickness although it was evidently still in good condition.

These tests and observations confirm what is commonly accepted about copper, that it is exceptionally durable even when exposed to polluted or marine atmospheres. When first exposed to the atmosphere, copper gradually blackens but after some years acquires a green or blue green patina which tends to stifle further corrosion. Scholes and Jacob found that this patina contained basic copper, copper sulphate at the industrial site and basic copper chloride with cuprous oxide at the marine site. U. R. Evans[4] has found that after about 70 years this patina becomes largely brochantite ($CuSO_4.3\ Cu\ (OH)_2$) with a little malachite ($CuCO_3Cu\ (OH)_2$) and, at this stage, it is likely that corrosion is entirely suppressed.

Our own experience with service failure investigations bears out the fact that copper cables sheaths should survive indefinitely in all normal environments, regardless of the presence of damp or chlorides. The one possible exception, where severe corrosion has been found, is in the presence of substantial quantities of ammonia or related compounds. In practice these conditions are only likely to arise in the presence of animal excreta, decomposing protein or nitrogenous soil. Genuinely corrosive environments with ammonia or strong acids present can of course exist in industrial situations and these are the only applications for which there is a real need for cables with an outer plastic covering.

REFERENCES

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