ASSOCIATION OF ELECTRIC CABLE MANUFACTURERS OF SOUTH AFRICA
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The Impact of copper clad aluminium (CCA) conductors in balanced pair cables (Intended for use in structured cabling) – Advisory Note

BACKGROUND

This technical bulletin is a brief review of implications when using copper clad aluminium (CCA) conductors instead of copper, in balanced pair cables typically installed in structured cabling systems.

Balanced pair cables incorporating CCA conductors when deployed in structured cabling systems in accordance with various premises specific versions of ANSI/TIA-568.2-D, ISO/IEC 11801 or BS EN 50173 may exhibit the following:

- Poor flexibility and mechanical strength leading to failed connections;
- Fail basic transmission performance tests during commissioning acceptance tests;
- Produce higher than expected temperature rises when used to provide power using applications such as Power over Ethernet (PoE);
- Oxidation of exposed aluminium at connection points particularly when subjected to movement (e.g. vibration).

CABLING AND CABLE STANDARDS

Balanced cable “Categories” are defined in three separate sets of regional standards: North American ANSI/TIA-568.2-D, European BS EN 50173-1 and International ISO/IEC 11801. While these three standards represent the source of the specification of cable Categories, the category system is referred to by many other ANSI/TIA, ISO/IEC and European standards and those of other bodies such as IEEE.

CONDUCTOR CONSTRUCTION

All cable standards relevant to Balanced cable “Categories” require the conductors to be of solid copper (whether or not they are stranded). E.g., the standards typically states “solid conductors shall consist of commercial pure annealed, bare copper … “and that, where used “tin coated conductors shall consist of commercially pure, solid annealed copper, tin coated … “.

It is therefore obvious that a conductor that is not solid copper (whether or not tinned) cannot be used within a cable that claims to conform to standards covering Balanced cable “Categories”.

COPPER CLAD ALUMINIUM (CCA) CONDUCTORS

CCA conductors generally feature a central core of between 60 % to 80 % of the conductor diameter of aluminium with the remaining 40 % to 20 % being a copper cladding surrounding the aluminium. The aluminium reduces the weight and cost of the cable. The resistivity of annealed copper is 1.72×10^{-8} whereas the resistivity of aluminium is 2.82×10^{-8}. The resistance of an aluminium conductor is therefore 60 % above that of copper conductor of equal cross-sectional area. The production of a composite CCA conductor produces conductors that have resistance approximately 40 % above the copper equivalent.

POWER OVER ETHERNET (POE)

The latest standards for Power over Ethernet increased the current per conductor to 300 mA based upon advice from the standard bodies responsible for ANSI/TIA-568.2-D and ISO/IEC 11801. Clearly if the resistance of those conductors is increased, as is the case with CCA implementations, the thermal impact is greater. This exacerbates a concern already being expressed about the use of balanced pair cables.

CCA **will** overheat, and quite quickly. For a given applied current, initial temperature increases can be twice those seen on a solid copper conductor. When the cable does start to overheat, a vicious spiral begins and unless the current is switched off, the result may be extensive damage as even a fire can be initiated.

THE IMPACT OF FLEXING AND BENDING

Aluminium has poor malleability compared to copper; meaning it will break easily if overworked. Although cables are generally fixed in position, there are situations where they are subject to intermittent but substantial movement. Examples of such situations include where cables are fed to untethered sub-floor boxes and where cables are installed between those floor boxes and furniture-based outlets. The flexing that such cables undergo may result in broken conductors.

THE IMPACT OF OXIDATION

Aluminium starts to oxidize as soon as it is exposed to air – such as when insulation displacement connections are employed to terminate the conductor – either in plug or socket connections. The contact performance of the oxidised area will quickly deteriorate causing hot spots. The mechanical performance of oxidised areas will also be affected which can cause the CCA to snap off when subjected to vibration or minor displacement. Repair of such defects frequently requires movement of adjacent terminations resulting in further damage.

RECOMMENDATIONS

For the reasons mentioned, the Association of Electric Cable Manufacturers of South Africa caution against the use of cables incorporating CCA conductors within installations where standards-compliant cables of a specified Category is required.

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