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Comparative study of circuit integrity cable designs and materials for Australian / New Zealand market

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Cables designed to provide circuit integrity during fire must be qualified to national and international standards. Common examples are IEC60331 and BS6387, both of which include a burner as a source of fire, with additional provision for application of mechanical shock and water spray. In addition to an IEC derived burner test (AS/NZS 1660.5.6), fire-performance cables in Australia have to pass the more severe furnace and water spray AS/NZS 3013 test for Electrical installations – wiring systems. Hence the qualification such as WS52W, where WS means wiring system, numeral 5 stands for highest level of fire protection (2 hours in a furnace following ISO 834 curve), numeral 2 for moderate level of mechanical protection and W for water spray protection (3 minutes).

The most common technology that provides circuit integrity has been the application of glass-mica tape (GMT) for over 40 years. In the last couple of decades, new insulation materials that transform into ceramic during fire were developed. These ceramifying compounds bring the advantage of easier manufacturing and installation. Nevertheless, the old GMT technology is still commonly used. It is worth noting that many importers struggle to obtain AS/NZS 3013 qualification for their products, which were designed to pass other circuit integrity standards. We have decided to systematically study the factors that contributed to such failures, with the objective to simplify the choice of designs and materials.

Materials properties examined were such as GMT composition (type of glass and its content, type of mica, i.e. muscovite, phlogopite or synthetic), type and composition of insulation and sheathing materials. Design factors considered were size, direction, orientation and overlap of GMT (for mica-taped cables) and types of layers of ceramifying compounds. Descriptive analysis will be presented, based on numerous fire tests conducted at Exova laboratories in Dandenong, Australia over the years.


AS/NZS 3013 test conclusion (left); cable residues after the water spray application (right)

Furthermore, we attempted to simulate firing conditions in the lab and develop a testing method that can predict cable's fire performance. The measurements of insulation resistance between two cores of a 2C 1.5mm^2 cable in a tube furnace were found to be a useful tool for distinguishing between ceramifying compounds. It was found that ceramifying compounds can provide higher insulation resistance between cores than mica tapes during critical stages of the firing sequence. SEM-EDX analysis of GMT and ceramified residues was conducted as well, providing data that helped understanding the observed behaviour.