

CABLE TESTING



WE KNOW POLYMERS - WE KNOW TESTING

Insulated electrical cables are widely used for industry and commercial power transmission. The quality of the cable is a function of the effectiveness and durability of the polymer insulation surrounding the copper cores.

Cable Condition Monitoring to Improve Reliability

The higher demands by the electricity industry have created an increased focus on the need to limit installation and service costs and obtain higher performance, reliability, and asset life from electrical cables. The traditional and more conservative approach to circuit loadings and emergency ratings has given way to the demands for the maximum use and efficiency of a cable asset without any deterioration or reduction in the long term performance. Conditions that cause the degradation of the cable include the mechanical damage that may occur prior to the energising of the circuit, the overheating of the cable with resultant ageing and deterioration, and the electrical deterioration of the insulating components.

Power cables can fail for a number of reasons, the most common causes being external interference or damage, overheating, moisture ingress, poor installation, cable or accessory defects, all of which will result in electrical failure or breakdown of the primary insulation.

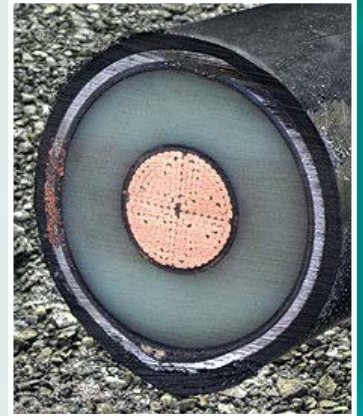
ExcelPlas can determine the cause/s of electrical cable failure (e.g. damage, ageing, and electrical deterioration) and reduced cable life with the analytical tools to predict and analyse such failures as part of a continuous process of monitoring the condition of the asset.

Mechanical damage is usually attributed to activities during or after installation, when the cable is most exposed to the possible damage, however experience shows that damage during manufacture, transport, and handling is also possible.

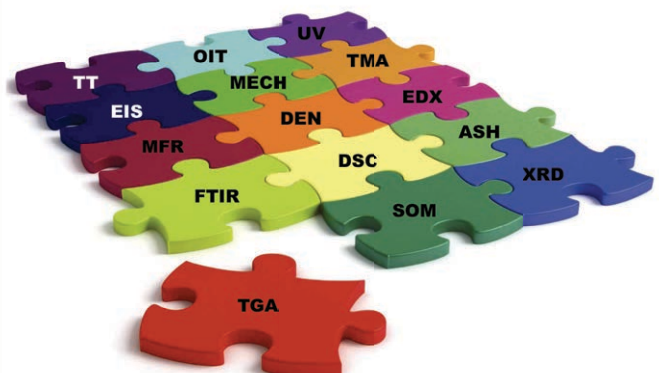
Ageing and overheating is a direct result of incorrect system design, inappropriate installation, or abuse of the cable by overloading.

Overheating of cables accelerates the ageing process and can lead to cable or core movement (due to thermal expansion) that was never designed or catered for in the system arrangement. If such movement is concentrated at one point (as is often the case, for example, at the accessory) damage and/or failure at that point (the accessory) will certainly result.

As polymer-insulated cables age due to overheating, they become quite fragile, and mechanical impact, or an attempted movement, may be sufficient to crack the increasingly delicate paper insulation layers and cause failure.



Polymer Problem Solving



25+

Years in Operation

15+

Qualified Staff

500+

Return Customers

1000+

Failure Analyses

8000+

Laboratory Jobs

The newer XLPE insulated cables also suffer problems when overheated, initially seen as deformation of the insulation layer, but eventually resulting in a breakdown of the polymer chains, baking and carbonising of the insulation. With the insulation at any one of these stages of deterioration, any additional stresses imposed by voltage peaks, impulses, and spikes will initiate the breakdown of the entire thickness of insulation.

Deterioration of the primary insulation is the most severe type of ageing damage, but the most common ageing damage occurs to the outer parts of the cable, as they are in contact with the external environment. For the polymeric sheathing materials, such factors as UV radiation and chemical reactions, are the most significant, while for the metallic layers, corrosion and electrolytic action are a danger. The breakdown of the external cable protection then leads to damaging effects onto the primary insulation and cable eventual failure.

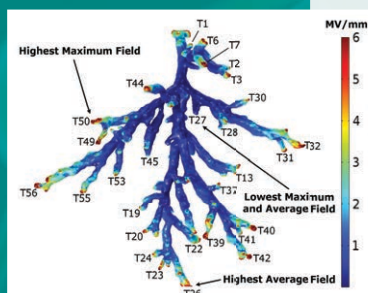
An example is the problem commonly seen with oil filled cables where either fatigued or corroded metallic sheaths release oil pressure, and result in primary insulation failure. In very many cases it is not the cable that initiates the failure, but the accessory, by allowing the ingress of water at an aged or poorly installed interface or at a broken interface due to movement.

ExcelPlas Cable Insulation Testing Laboratory Capabilities:

- DSC Thermal Analysis to identify Melting point, Glass transition (Tg) and Thermal Stability (OIT)
- FTIR Infra-red Analysis for compositional analysis of polymers and additives
- TGA Thermogravimetric Analysis for weight loss with loss of additives, oils, polymer decomposition, filler levels
- X-Ray Analysis (EDS/XRD) to identify the crystalline phase and composition of inorganic additives
- Carbon Black Content (ASTM D1603, AS/NZS 2904 Clause 7.4.5 which uses AS 1463 Appendix B)
- Carbon Black Dispersion CBD)
- Oxidative Induction Temperature (OITemp)
- Melt Flow Index (MFR)
- Stress Cracking Resistance Testing (ESCR testing)
- Failure Analysis (processing, water treeing, contamination ID, etc)

Examples of Polymer Materials Excelplas Can Test:

- XLPE and HDPE Cable Insulation Testing (QA, QC, incoming raw materials)
- * PVC (V-90) (Soft (plasticised) Polyvinyl Chloride compound)
- * XLPE (X-90, X-HF-110) (Crosslinked Polyethylene)
- * Rubber (R-EP-90, R-HF-90, R-HF-110) (Ethylene Propylene Rubber)
- * Testing of Cross-linked Polyethylene (XLPE) as specified in AS3808 and Low Smoke Halogen-Free (LSHF)



ExcelPlas
MATERIALS TESTING

ExcelPlas Undertakes the Following Cable Testing as per AS/NZS 5000 and AS/NZS 3808:

- * Measurement of thickness of insulation and sheath (sample test)
- * Tensile strength and elongation of insulation and sheath material – before ageing (type test)
- * Tensile strength and elongation of insulation and sheath material – after ageing (type test)
- * Loss of mass of insulation and sheath (thermoplastic materials only) (type test)
- * Pressure test at high temperature of insulation and sheath (thermoplastic materials only) (type test)
- * Heat shock (thermoplastic materials only) (sample test)
- * Hot set test (cross linked materials only) (type test)
- * Exudation of plasticizer (thermoplastic materials only) (type test)
- * Compatibility test of cables materials (type test)

Other Cable and Insulation Testing Offered by ExcelPlas NATA Lab:

- Shore A/D Hardness
- Density Determination
- Accelerated Weathering testing
- Charpy and Izod Impact Tester
- Laboratory press for preparing samples
- Plasticizer extraction analysis apparatus
- Loss in Mass (volatility) analysis
- Limiting Oxygen Index (LOI) Analysis of Cables
- Wire Insulation Abrasion
- Testing Composition of Low Smoke Zero Halogen Cables
- Testing of %Crosslinking of XLPE Cables
- Testing of Flame Retardant XLPE Cables
- Identification of Contamination/Foreign Matter
- Determination of % Carbon Black in Cable Sheathing
- Determination of Filler Content/Composition in Cable Insulation
- Limiting Oxygen Index of Flame Retardant Cables
- Plasticizer Level and Content of PVC Insulated Cables
- Compliance Testing of Imported Cable to Ensure it is Compliant with Australian Standards

ExcelPlas also has considerable experience in Water Tree Defects in Cable Insulation and provides the following services:

- Optical Microscopy (1000X mag) with dye penetrant to highlight Water Treeing
- Microtoming and Contrast Enhancement followed by Transmission Polarized Microscopy to highlight Water Treeing
- Fluorescence microscopy with rhodamine staining to highlight Water Treeing
- SEM Microscopy for void analysis in XLPE
- Elemental analysis for ions in XLPE to characterise impurities/catalyst residues
- Elemental analysis on ash residue of XLPE to characterise impurities/catalyst residues

Major Clients:

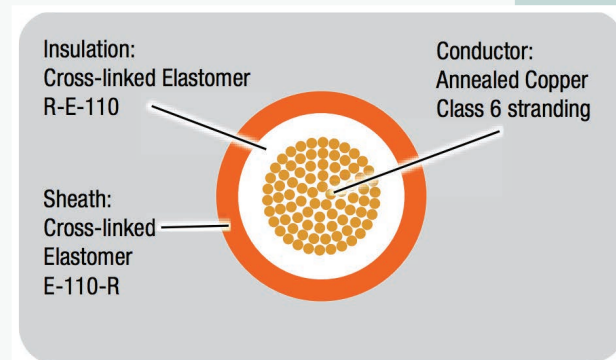
Prysmian Group

Olex Cables

Delta Cable

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