EIU Course 103: Material Properties Laboratory - A Sampling of Test Methods

Background

The Material Properties Laboratory at ELTEK International Laboratories was developed as an answer to a need expressed by many of our clients. After materials are chosen and a system is developed, it is tested to meet the intended requirements.

First, the product must survive its own manufacture, i.e., the materials and system must still have the integrity intended after the product goes through the manufacturing process including insulating, winding, and assembly. In addition, any ***changes*** to manufacturing processes must be thoroughly evaluated to assure that the final product will meet the criteria for its intended usage.

Secondly, once the product is placed in service, the manufacturer warrants the quality and integrity of the product for its intended use. Abuse and operation beyond intended limits can cause product failures. In addition, defective materials and/or workmanship can cause product failures.

Summary

ELTEK Labs has the broad capability to assist companies in the challenge of problem solving in the science of electrical insulation. Each problem is approached in a scientific and engineering manner. Tests are performed under laboratory conditions or simulated field conditions as the case may require, using prescribed industry accepted test methods. Where the exact requirements are not fully defined within standardized test methods per se, in some situations modifications to these methods may be employed to achieve the most accurate results.

Test procedures are documented and test results are reported in a formal test report. All reports are signed by at least two qualified members of the ELTEK Labs staff and all equipment used is listed with model numbers, ranges, calibration dates, etc. ELTEK Labs is an ISO 17025 Certified Laboratory; accreditation issued by the International Accreditation Service (IAS).

Sampling of Popular Test Methods

The following is a presentation of some of the more frequently requested. This is not a complete list of tests conducted at ELTEK Labs in these categories. These and other tests are presented in additional EIU classes in more detail.

ASTM D 3638 & IEC 60112 & UL 746 A - (CTI) Comparative Tracking Index and Comparative Tracking Performance Level Categories of Electrical Insulation Materials

The test method for determining the comparative tracking index of electrical insulating materials – which is the voltage as determined under the conditions specified in the standard tests method(s) for comparative tracking index ASTM D-3638 and IEC 60112, that causes a permanent electrically conductive carbonized path within the application of 50 drops of electrolyte solution that is applied at a rate of one drop every 30 seconds to the surface of the specimen between the electrodes.

This method is used to assess the relative resistance of insulating materials to tracking.

ASTM D 495 & UL 746 A - High Voltage-Low Current-Dry Arc Resistance

Testing measures the resistance of test samples to surface tracking by a high voltage arc intermittently established between two electrodes contacting the material surface. The frequency and the current intensity of the arc are increased every 60 seconds until the arc is uninterrupted or failure occurs. The value reported is the average number of seconds required.

ASTM D 257 & UL 746 A – DC Resistance or Conductance of Insulating Materials

Testing Resistivity or Conductivity is used to indirectly predict the low-frequency dielectric breakdown and dissipation factors of insulating materials.

Volume Resistivity – Can be used in obtaining necessary preproduction characteristics of insulating materials for use in various applications.

Surface Resistivity - Surface Resistivity could be defined as the material's inherent surface resistance to current flow multiplied by that ratio of specimen surface dimensions (width of electrodes divided by the distance between electrodes). It is a measure of the material's surface inherent resistance to current flow.

ASTM D 2303 & IEC 60587 – Liquid Contaminant Inclined Plane Tracking and Erosion of Insulating Materials

The inclined plane test is a severe test to evaluate the tracking performance of insulation materials. A track is defined as an electrically conductive carbon path along the surface of insulating materials or a partially conducting path of localized deterioration on the surface of an insulating material. Tracking is initiated by surface discharges in regions of high electric field strength that is promoted by dampness and pollutants on the insulation surface. There are two methods used to evaluate a materials resistance to tracking and erosion: Time to Track and Initial Tracking Voltage.

UL 94 – Flammability of Plastic Materials for Parts in Devices and Appliances

94V-0, 94V-1, 94V-2 20 MM Vertical Burning Test

This is the test that is conducted on the vast majority of solid plastics. A set of five plastic specimens are subjected to a 20mm flame in accordance with the prescribed test procedures. After the flame is removed from the specimen, afterflame and afterglow times are measured. If flaming particles fall from the specimen to a piece of surgical cotton placed below, it is noted whether or not the cotton ignites. The material is classified into categories based upon these characteristics.

94VTM-0, 94VTM-1, 94VTM-2 Thin Material Burning Test

Like the 20mm flame test, the Thin Material Burning Test is conducted on solid plastics. The specimen is prepared in a different manner, by wrapping it around a mandrel. The same 20mm flame is used as the Vertical Burning Test, and specimens are treated and the procedures are followed in a similar manner. The times for the same criteria are recorded, and the material is classified into categories based upon these characteristics

(HB) Horizontal Burn Testing
A specimen is supported in a horizontal position and is tilted at 45°. A flame is applied to the end of the specimen for 30 seconds or until the flame reaches the one inch mark. If the specimen continues to burn after the removal of the flame, the time for the specimen to burn between the one and four inch marks are recorded. If the specimen stops burning before the flame spreads to the four inch mark, the time of combustion and damaged length between the two marks is recorded. If flaming particles fall from the specimen, it is noted whether or not the gauze ignites. The material is classified into categories based upon these characteristics*.*

Vertical Testing (5V, 5V-A, 5V-B)
Testing is done on both bar and plaque specimens. Procedure for Bars: A bar specimen is supported in a vertical position and a flame is applied to one of the lower corners of the specimen at a 20° angle. The flame is applied for five seconds and is removed for five seconds. The flame application and removal is repeated five times. After the fifth application, the afterflame and afterglow times are observed and recorded as well as if any particles dripped from the specimen that ignited the cotton indicator.

Procedure for Plaques
The procedure for plaques is the same as for bars except that the plaque specimen is mounted horizontally and a flame is applied to the center of the lower surface of the plaque. After all flaming or glowing has ceased, it is noted whether the flame burned through the plaque material. For this test, “Burn Through” is defined by any visible flame observed during the test on the surface opposite of the flame application or an opening larger than 3mm after the sample has cooled for three seconds.

94HF-1 or 94HF-2 Horizontal Burning Foamed Material Tests

Conducted on foamed plastics used in devices and appliances. This includes acoustical foams, sealing foams, and filter media. A set of five specimens, each measuring 150mm x 50mm, is prepared and subjected to a 38mm flame in accordance with the prescribed test procedures. After the flame is removed from the specimen, afterflame and afterglow times are measured. If flaming particles or drops fall from the specimen to a piece of surgical cotton placed below it, it is noted whether or not the cotton ignites. Also, the length of damaged material for each specimen is measured. The material is classified into categories based upon these characteristics.