

Electrical Insulation Systems [EIS] Applications from General Commercial to Automotive (13 Nov, 2006)

Presented by:
Brandelyn LaBanca
Andrea Werner-Morse
Marcie Muzzey

Abstract – The electrical industry has utilized the approach to product performance as an electrical insulation system since electricity became commercially available. As the industry grew it became necessary to shift the method of evaluation from actual units to a simpler laboratory model. The focus of this paper is to present the applications of the laboratory approach to today's industrial needs.

I. NOMENCLATURE

A. Electrical Insulation System,

A-1. As defined in IEC Publication 61057, Part 1: an insulating structure containing one or more electrical insulating materials (EIM) together with associated conducting parts employed in an electrotechnical device.

A-2. As defined in UL 1446: a unique intimate combination of two or more insulating materials used in electrical equipment.

B. Application: refers to an end product such as a completed transformer, kitchen appliance, power tool, computer, finished electronic device, and items which are "ready to use".

C. Compatibility: refers to the interaction of two or more chemistries with each other. Compatible means the chemistries do not interact in a manner which results in a reduction of life or performance. Incompatibility means the chemistries do interact in a manner which does result in a reduction of life or performance.

II. INTRODUCTION

This paper covers a range of applications and presents examples of how laboratory testing can provide the technical information, or test data, needed to help evaluate possible changes. Changes range for the evaluation of a processing change, to a change of materials, to information needed to evaluate the purchase of new equipment, and/or improved performance with higher temperature EIS resulting in possible reduction of materials.

III. PRESENTATION

The presentation is separated into three parts.

Part 1 focuses on EIS testing and how it is related to specific segments of the electrical industry. The segments are:

- (1) Evaluation of a process step of wrapping end turns of large electric motors;
- (2) Evaluation of the possibility to remove a process – specifically the varnishing process
- (3) Evaluation of a change of the ground insulation from films and composite sheet insulation to an epoxy powder coating applied directly onto the core stack;
- (4) Evaluation of replacing more traditional magnet wire / winding wire with an insulated wire with a new type of coating;
- (5) Evaluation of removal of specific layers of insulation for sensor coils in transformers by using Appliance wire.
- (6) The introduction of Single and Multi-layer wire [commonly known as Triple Insulated Wire or TIW] into small transformers
- (7) Evaluation of using the encapsulation process for coils and transformers

Part 2 focuses on segments of application which cannot be presented with actual test specimens being shown due to confidentiality agreements but will be presentation of concepts. This part will be presented in a general format. The general areas covered are:

- A) Automotive
- B) Military
- C) Medium Voltage application
- D) High Voltage application

Also included will be the introduction of the approach of laboratory testing to reflect real world stresses. This can be abbreviated using the letters to spell TEAM.

T = Thermal stresses
E = Electrical stresses
A = Ambient stresses
M = Mechanical stresses

EIS testing alone cannot address all of these aspects but when combined the two areas of testing [EIS + Compatibility] can give needed performance information to the manufacturer.

Part 3 focuses on Compatibility testing. By separating the known aspects of the real world stresses into

individual stresses can be evaluated. This part of the presentation presents several different areas of compatibility testing. The presentation will cover the areas of:

- A) Oil; for applications such as oil-filled transformers or automotive. In oil-filled transformers the evaluation is of the oil and not the EIM or EIS because the oil is the main insulating material. Any contamination of the oil could result in loss of insulation characteristics. While for automotive the concern is on the influence of the oil on the EIS; the evaluation is of the EIS after exposure to the oil.
- B) Refrigerant: for applications such as cooling or air-conditioner units for automobiles or homes and offices, and/or appliances such as refrigerators. This type of compatibility testing can be of individual materials or of an EIS. Different refrigerants have different chemical compositions; EIM and EIS need to be evaluated for each application. Refrigeration units also have lubricating oil to protect moving parts. This application is concerned about compatibility with the refrigerant and the oil.
- C) Soap or detergent: applications are for dish washing machines. Incompatibility of the liner of the washing chamber with the soap or detergent can result in reduced life. This also applies to all components such as water sprayers, shelves, holders.
- D) Exposure to high levels of moisture: this is applicable to all type of out-door equipment and is beneficial for any indoor application where high levels of moisture are a concern. This could relate to laundry rooms or to swimming pools where compatibility with chlorine and possibility salts exist.
- E) Each type of EIM can be evaluated based on application. EIM include tapes, sleeveings, lead wires, layer insulation, spacers, winding wire, varnishes, and any other materials.
- F) Volatile components: evaluation to volatile components related to almost every type of application. Volatile components can be release of molding agents, flame retardants, residual solvents, or other sources.

- G) Ozone: Ozone is difficult to show in photos but it is commonly generated in the presence of high voltage arcing. Ozone compatibility refers to the resistance of the EIM or EIS to withstand the chemical interaction between Ozone and the individual materials or system. Arcing refers to the ability of the material to withstand the stress of electrical arches striking the surface.

IV. Biographies

Marcie Muzzey – Head of the Compatibility Laboratory of ELTEK International Laboratories. She joined ELTEK Labs in 1998. She is also a Certified Technician for submittals to UL for Compatibility testing. And she is a Certified Type 1 and 2 Technician recognized by the Refrigeration Service Engineers Society [USA].

Brandelyn LaBanca – Head of the Electrical Insulation Systems Laboratory of ELTEK International Laboratories.

She joined ELTEK Labs in 2000. She recently began participation on the IEEE working group for the revision of IEEE 117, IEE 275 and IEEE 429; all are IEEE Standards for EIS testing.

Andrea Werner-Morse: Special Projects manager and also Quality Manager for ELTEK International Laboratories.

She joined ELTEK Labs in 2006. She is in the process of completing the training to become an internal auditor for ISO 17025 –Laboratory Certification.

ELTEK International Laboratories is a Certificated Administrative Agent and also a Certificated Engineering Agent with UL under the Client Agent Program.

ELTEK Labs operates under the guidelines of ISO 17025 – Standard for Laboratory Certification