

Data Journal

**Electrical
Insulation
Systems**

Tests run in the EIS Lab

IEEE 99
IEEE 117
IEEE 259
IEEE 275/429
IEC 61857
IEC 61857
IEC 61857
IEC 61858
UL 1446

A Commitment to the Industry

Shaping test methods used around the world through involvement in the following Technical Panels and Working Groups:

IEC
TC -112 Working Group 6
IEEE
275/429

What is Electrical Insulation Systems?

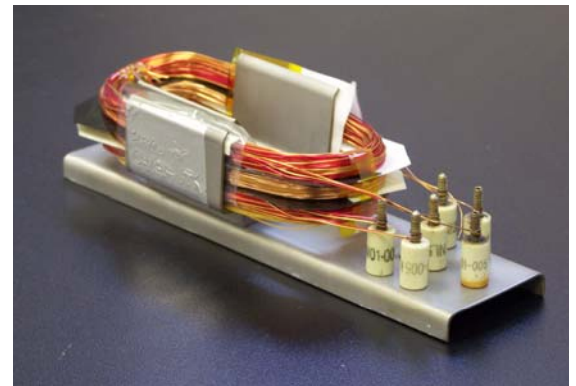
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The International Electrotechnical Commission (IEC or CEI) document 61857 offers the following definitions; “Electrical Insulation Systems (EIS) – An insulating structure containing one or more electrical insulating materials (EIM) together with associated conducting parts employed in an electrotechnical device”.

The important aspect of this definition is that an EIS evaluates a total of two or more materials (at least one EIM with at least one conductive part) in a single combined test object. The inclusion of materials into a single test object will allow for the evaluation of interactions that may occur between the materials that cannot be evaluated when traditional EIM level of testing is conducted.

The type of interaction could be chemically related – as one material decomposes, the “by-products” may cause other components to decompose more rapidly. There could be physical stress caused by different rates of thermal expansions and contractions. There could be problems related to adhesion, impregnating or encapsulating resins. EIS testing is intended to help identify potential problems, which may lead to a constructive solution.

Another important benefit of EIS testing is that since each type of EIM has different criteria used to establish a thermal class rating, trying to select EIM can become confusing and may lead to problems. By placing EIM and conductive parts into a single combined test object a more accurate evaluation of the system (group) of materials can be established.



General Purpose Model

It is also important to keep in mind that an EIS test will evaluate the thermal life of the electrical insulating portion of the system, and does no evaluation of the conductive parts, mechanical stresses or some of the other stresses which could occur in application. This is the reason the test results are identified as Electrical Insulation Systems.

In summary, an EIS is a group of EIM's combined and evaluated as a collective set. When it comes to the testing and evaluation of such systems, ELTEK Labs has more experience than all other labs and is well suited to handle your systems testing programs.

Brief History of Electrical Insulation Systems

Naval Research Report; Reliability Prediction Study on Electrical Insulation: Navy Summary Report Document

Between the 1890's and 1950's, electrical insulation testing was only performed on actual units straight out of production. As you learn about EIS testing, you will see that this is costly and time consuming.

In 1952, a program was initiated at the Naval Research Laboratory to do a major study on the aging properties of electrical insulating materials and systems. This program was initiated because of the fact that equipment in Naval vessels needed to be reduced in weight and size, yet maintain or even improve reliability. This involved the development of evaluation techniques for comparing the expected lives of new insulation systems.

While the test program started in the 1950's and completed in the early 1960's, it was not until July of 1977 that the Reliability Prediction Studies on electrical insulation was issued by the Naval Research Laboratory in Washington, D.C. This document provided much of the long-term temperature-life data needed for establishing the standards of today.

Do I Need Systems Testing?

A few of the most essential aspects of EIS testing are:

- EIS testing rates a group of Electrical Insulation Materials as a single set (system).
- No individual material (EIM) is rated by EIS testing.
- The performance of an EIS is not directly related to the ratings of the EIM's selected to be in the EIS.
- Only electrical properties are evaluated.
- EIS testing can evaluate interactions between EIM's.
- EIS testing addresses one very simple and direct question.



Electrical Insulation Systems Laboratory

So do you need EIS testing? The most important question to ask is this; "Do I need to know the maximum thermal class application rating for this system (Group of EIM's)?"

Electrical Insulation System Testing

Stresses for EIS testing GPM Specimens IEEE 117

<p>Turn-to-Turn At 120 volts</p> <p>ELECTRICAL TEST</p>	<p>A test voltage (electrical stress) is applied by energizing one strand of a bifilar winding at 120 volts and grounding the other strand in the same winding. This applies a 120 V differential throughout the entire length of the winding.</p> <p>Discussion: It is essential to understand that the value of 120 volts must not be confused with line voltage in the United States which happens to be between 110-120 VAC. This test voltage refers to a differential between the turns within a winding.</p>
<p>Coil-to-Coil Or Winding-to- Winding At 600 Volts</p> <p>ELECTRICAL TEST</p>	<p>A test voltage (electrical stress) is applied by energizing the top coil, or winding, and grounding the bottom coil, or winding. This applies a 600 volt differential across the wire insulation and ground insulation between the windings. The 600 volts is used because of the 600 volt classification used by E/E industry worldwide.</p>
<p>Coil-to-Coil Or Winding- to-Ground At 600 Volts</p> <p>ELECTRICAL TEST</p>	<p>A test voltage (electrical stress) is applied by energizing all windings and grounding the metal frame. The 600 volts is used because of the volt classification used by E/E industry worldwide.</p>

Electrical stresses for EIS testing covered by IEEE 275 and IEEE 259 will follow the same test pattern, only the test voltages would be different from the values listed above.

To help understand EIS testing, a basic definition of an EIS is needed.

EIS – from the IEC text

EIS is a product manufactured from one or more EIM's. It is employed in a particular electrical apparatus together with electrically conductive parts at different voltages.

EIS – from UL 1446: Systems of Insulating Materials – General Insulation Systems –

An intimate combination of insulating materials used in electrical equipment. For example, the combination of a coil form, separators, magnet-wire coating, varnish, lead-wire insulations, and outer wrapping of a relay coil.

In each definition the common terminology is that an EIS contains two or more interactive materials in an electrical device.

The specimens are tested as a single entity. When a specimen passes a specific test cycle, the cause of the retained electrical insulation is due to the total insulation capability of the group. It is impossible to assign a level of retained insulation to any one item or any portion of the group. Because of this simple fact, the group of materials is evaluated as a system.

The system is a unique set of materials and the results of the testing relate only to the specific group under test.

Summary of the Electrical Insulation Systems Lab

The Electrical Insulation Systems Lab offers clients the ability to evaluate two or more materials (a minimum of one EIM and one conductor) in a single test specimen. The inclusion of materials into a single test specimen, or General Purpose Model, allows for the evaluation of interactions that may occur between the materials that cannot be evaluated when traditional EIM level testing is conducted. In the EIS Lab we routinely run systems programs using

- IEEE-117 (low voltage)
- IEEE-275 (high voltage)
- IEEE-429 (high voltage / submersible)
- IEEE-259 (low voltage / transformers)
- IEEE-C series (high voltage / transformers)