Insulating LIQUIDS TESTS

Standards, diagnostics, and practice

TRANSFORMER ACADEMY

The importance and meaning of the insulating oil test parameters to transformer owners and maintenance personnel, and the test procedures to laboratory staff.

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Ilustrations by: Tesla Institute

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The author – Marius Grisaru

is a chemist with expertise in the insulating oil domain, focusing on oil test procedures from sampling to diagnosing. Marius has vast and worldwide experience on sampling, testing, ordering, diagnosing, and debating among fellow experts around the globe.

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WHAT MAKES THIS COURSE UNIQUE

- A simple and clear understanding of the chemical principles behind insulating oil and liquid testing. Why do we carry out these chemical tests on electrical equipment? Tailor the minimum oil tests required for specific electrical equipment. How to save money on accurate and dedicated power transformer maintenance. Improve transformer sustainability and save precious resources such as metals, organic oil, liquids, and the environment.

- A basic understanding of the underlying chemical principles of insulating oil and fluid testing is essential. These tests play a vital role in ensuring the reliability of electrical equipment. They help to identify potential problems and maintain the integrity of the equipment. To optimize the efficiency of these tests, it's essential to tailor them to the specific needs of different electrical equipment. This customization ensures that the minimum required tests are performed, saving both time and resources.

- Cost-effective and accurate power transformer maintenance is achievable through smart strategies. By implementing efficient maintenance practices, you can reduce costs while extending the life of your transformers. This, in turn contributes to sustainability efforts by conserving valuable resources. It also helps protect the environment, making it a win-win solution for both your budget and the planet.

- Genuine pictures and video test descriptions by Tesla Institute

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The course is intended for:

1. Utility engineers, both junior and senior, especially those responsible for tests and diagnoses through collaboration with global or local laboratories

2. Manufacturers of transformers, transformer components, monitoring systems, sensors, oil treatment equipment, etc

3. Students and everyone who wishes to understand the scientific foundation of explanations, problematics, and benefits of insulating oil/liquid tests

4. For electricians and non-chemists to be convinced about the value of chemical tests for electrical equipment. Users who need to order oil tests, users who hold an oil lab or wish to establish one

5. Staff who are responsible for transformers and want them to be more operational and efficient in cooperation with providers of oil services such as treatments, replacement, and maintenance

COURSE DETAILS AND KEY LESSON POINTS

The intention of the course is to describe and explain the importance and meaning of oil test parameters to transformer owners and maintenance personnel and the test procedures to professionals such as laboratory staff.

The course will be held on three levels: basic, intermediate, and master's level.

Introductory/Basic level

Review of main insulating oil test procedures, based on new and old standards and chemical principles

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Intermediate level:

Diagnosing transformer condition by clarified oil testing according to current international standards and guides

Master's level:

Demystification of oil test procedures through theory and real-life oil tests, test performances, particularities and the main key point: performing them in dedicated short films and pictures

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Description of all oil tests according to IEC, IEEE, ASTM prioritise test, selecting, and laboritory performances

- **Standard oil tests**

Diagnose transformer condition by oil test according to current international standards

- **Diagnosis and health index**

Oil test - practical stage. Implement stnadard and chemical procedures in practice

- **Theory and practice oil test in a real laboratory**

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The lessons for each level are listed as follows:

BASIC LEVEL - Standards oil tests

Lesson 1: Introduction to insulating oil test

- Short history overview and short course overview
- Argumentation for transformer oil testing
- Importance of oil test qualities among all other possible tests for electrical equipment
- Brief overview of historical developments in the insulating oil test

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Lesson 2: Review of available conventional literature, guides, and standards for oil testing

- Main available standards, guides, and references for transformer oil testing
- All liquid types
- Similarities and varieties among major national & international standards and guides
- Why do we have different groups of tests and limits in the different standards?

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INTERMEDIATE LEVEL/
Part two - Diagnostics and health index

Lesson 3: Oil test priorities: specification, frequencies, limits

- Tests are recommended and required for each transformer type by each standard, with differences by transformer age
- Oil test limits according to standards
- Are they indeed critical, important, or nice to have?
- Which oil tests do I need for my transformer(s), frequencies, and limits?

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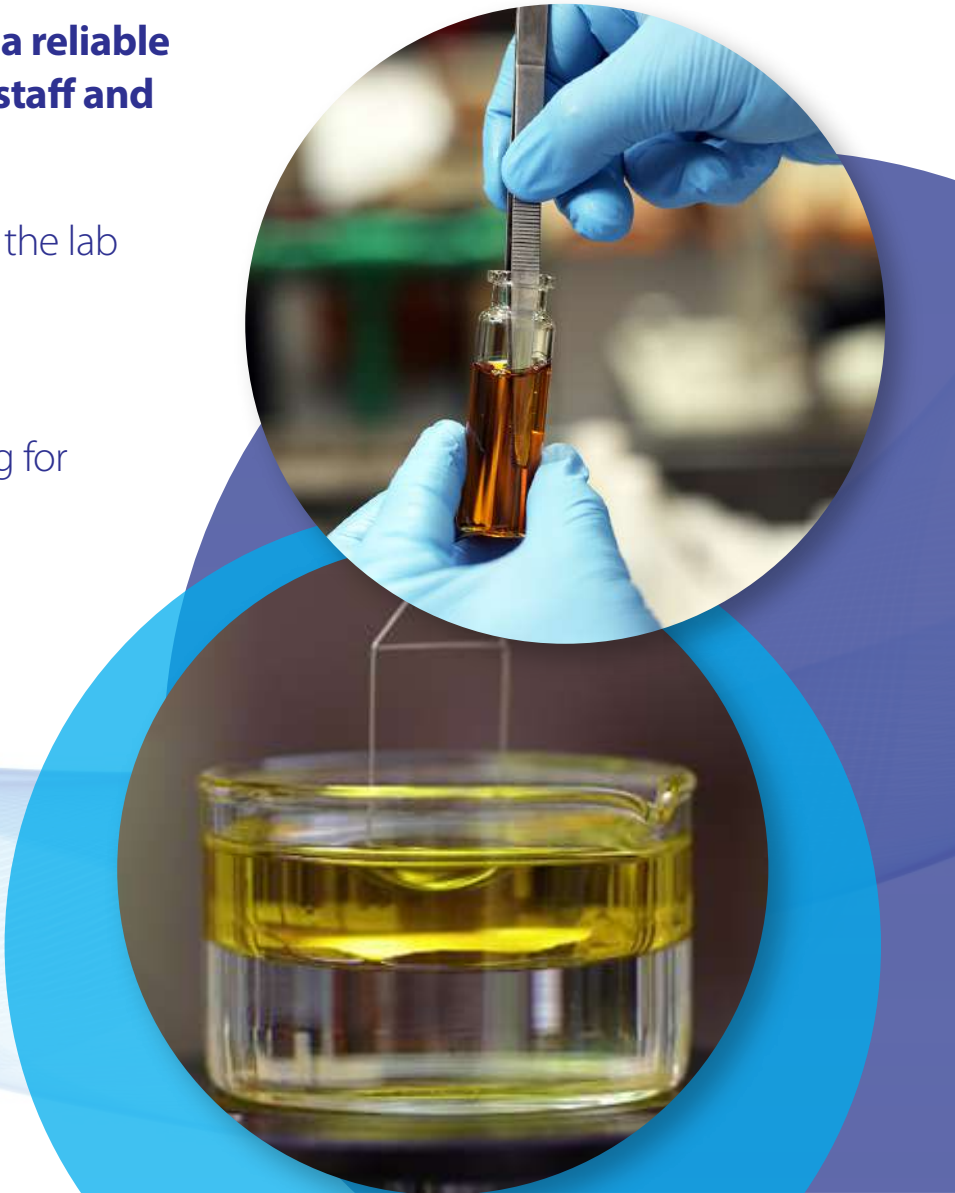
Lesson 4: Insight into transformer oil sampling, obtaining a reliable oil sample without compromising the sampling staff and transformer operation

- Sampling, registering, and transporting oil samples to the lab
- Do's and don'ts before, during, and after oil sampling
- Good practice of sampling procedure
- The correct procedures, timing, vessels, and packaging for insulating oil sampling practices

Lesson 5: Diagnostics and actions based on the results of transformer oil tests

- One or more oil tests exceed the limits, what should be my next step?
- Which maintenance actions need to be taken, and which are unnecessary or possibly harmful to transformer operation?



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- **Master's level - oil test operational description, theory, and practice**

Lesson 6: Breakdown voltage tests

- Breakdown voltage tests, history, methods, procedures, and clarifications

Lesson 7: Moisture, water, methods' significance, and compatibility

- Water in oil tests. Different approaches, various tests, diverse results, and divergent conclusions

Lesson 8: Electrical measurements for insulating oils

- Dissipation factor, tangent delta, power factor, which are all the same. Resistance and permittivity, as electrical test parameters relevant to insulating oil tests

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Lesson 9: Oil acidity measurements

- Chemical and physical significance of acidity in liquids and oil
- A concise review of measured parameters in acidity tests. Is neutralization the correct term?
- Methods to measure acid, base, pH, in organic liquids in aspects of general concepts

Lesson 10: Color and Interfacial test. IFT

- Interfacial test. IFT. Theories, principles, methods, and difficulties
- Why IFT is more important for certain oil types, and less for others?
- Oil color, its causes, and consequences

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