

Importance of testing transformer oil



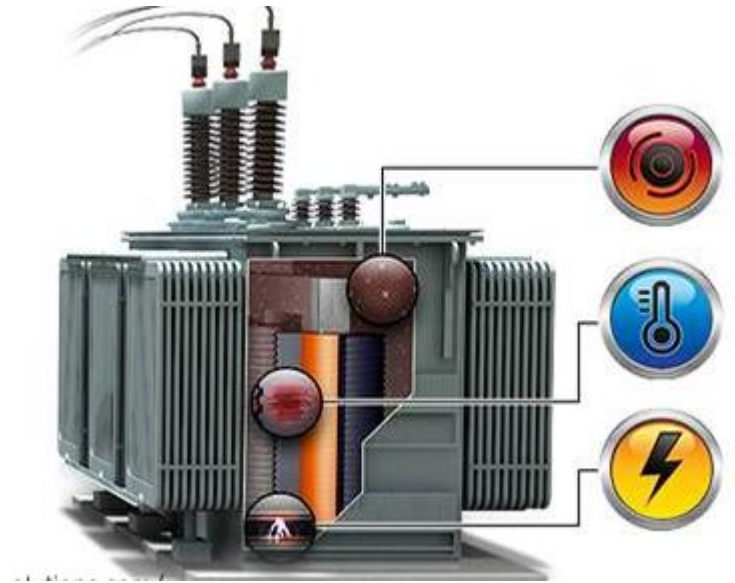
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Introduction...

Mineral Oils that combine a high flashpoint with high dielectric strength have long been used as an insulating medium in transformers, switchgear and other electrical apparatus.

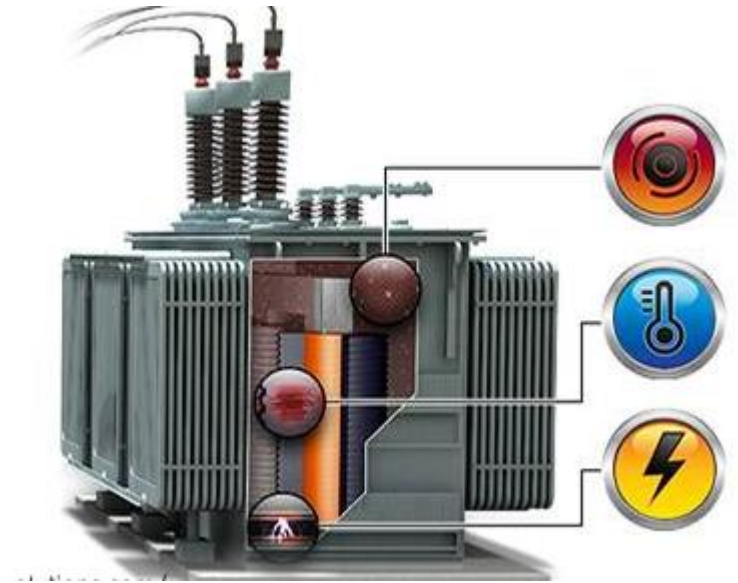
To ensure that the dielectric strength of the oil does not deteriorate however, proper maintenance is essential, and the basis of proper maintenance is testing.



Insulation Oil Testing
Oil Dielectric Strength Testing

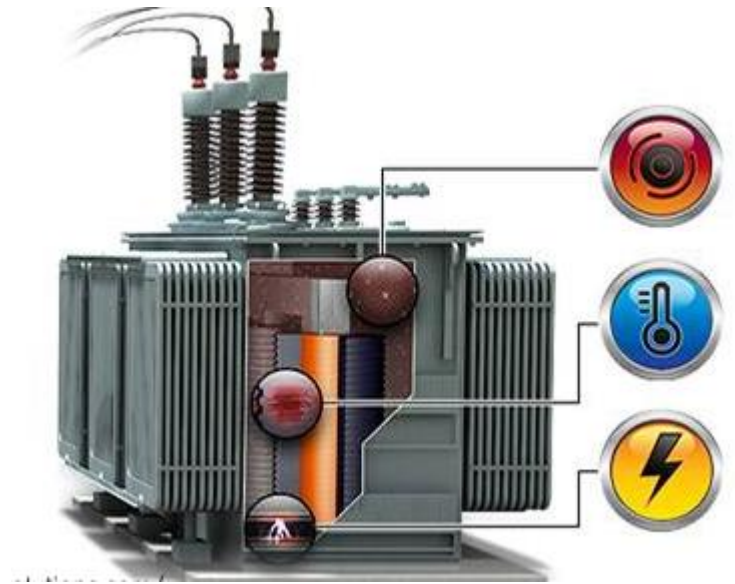
...Introduction

- Mineral Oil is an efficient **coolant** with a high flash point and a high dielectric strength
- The insulation properties can (will) **change** due to oxidation, acids, sludge, gas and water absorption.
- These changes may eventually lead to unexpected, catastrophic transformer **failure**.



Insulation Oil Testing
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- Research has long concluded that the greatest risk to a transformer's reliability and even its end of life lies more with the presence of moisture and particles in the oil (causing reduction in dielectric strength) than it is from paper aging.
- Thus it is vital to manage the oil on an on going basis to carry out dielectric tests on the oil to verify the continued integrity of the transformer.

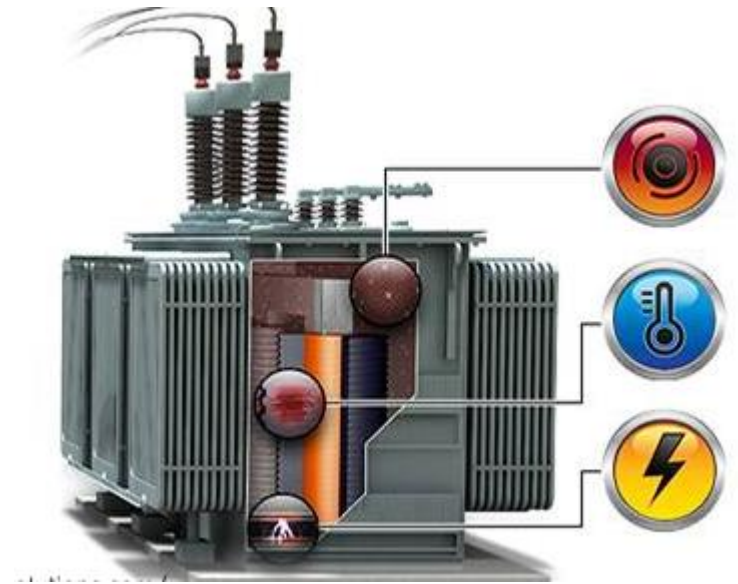


Insulation Oil Testing **Oil Dielectric Strength Testing**

What are the methods testing oil?

For in-service equipment in particular, there are many test techniques for evaluating the condition of the insulating oil.

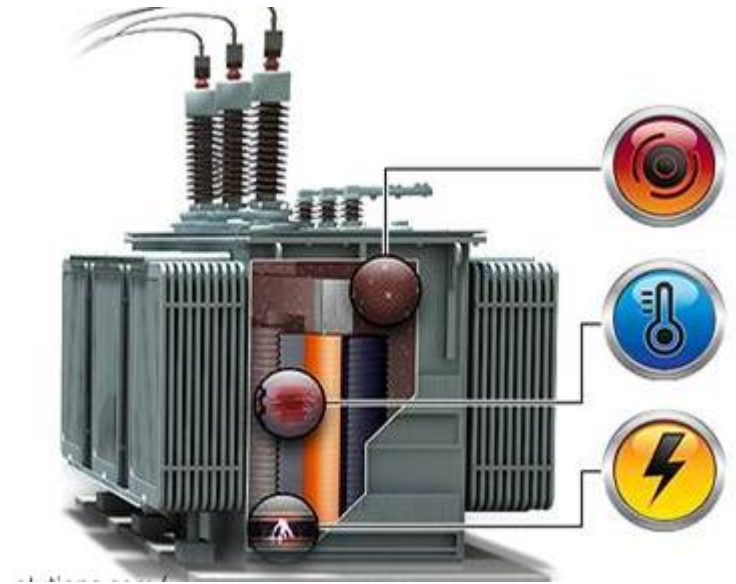
If the technique of dissolved gas analysis is excluded, oil tests can be divided into **two basic groups...**



Insulation Oil Testing
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The first group includes tests that are concerned with the **immediate condition** and acceptability of the insulation in an item of electrical equipment.

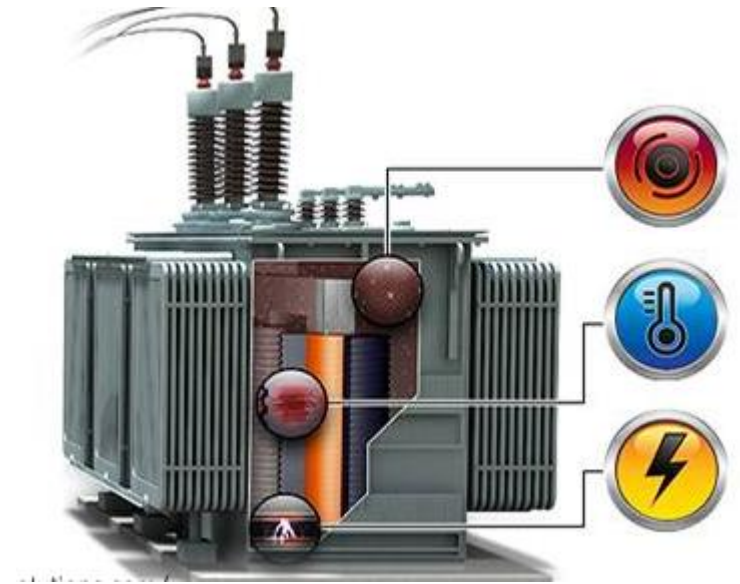
- This group includes:
 - Dielectric breakdown voltage testing
 - Moisture measurement by the Karl Fischer (KF) method
 - Determination of insulation condition by measuring the dielectric dissipation factor



Insulation Oil Testing
Oil Dielectric Strength Testing

The second group includes tests that look at the **longer term aging** of the oils degree of degradation and aging of the equipment's insulation system.

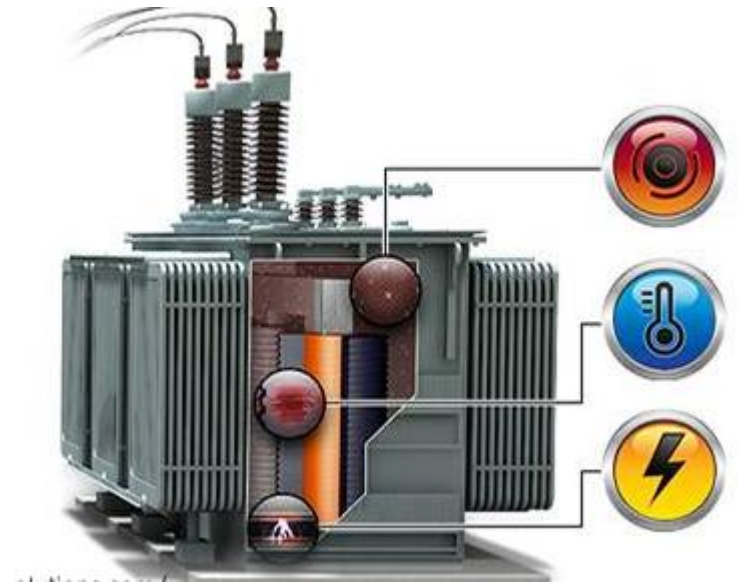
- These tests include:
 - Interfacial tension,
 - Acidity (neutralisation value),
 - Resistivity
 - Visual determination of colour and appearance of the insulating oil.



Insulation Oil Testing Oil Dielectric Strength Testing

The next few slides will focus on what you can achieve within your own resources without undue complexity, training burden and excessive investment.

Given the earlier points the most important of these tests is an oil dielectric strength test and the presentation will now focus on how to do this effectively

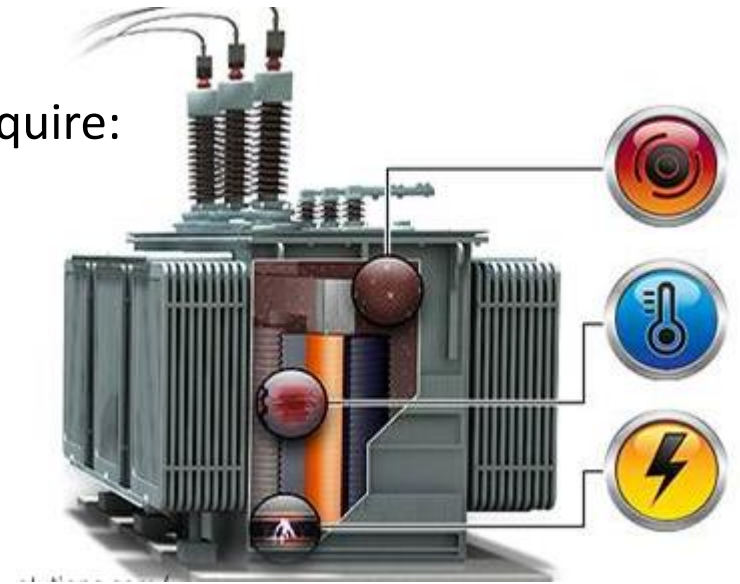


Insulation Oil Testing Oil Dielectric Strength Testing

Some comments on preparing the test

For oil samples from transformers, this is the information that oil test laboratories generally require:

- Description of the sample
- List of tests to be performed
- Transformer name plate information
- Type of transformer
- Type of insulating fluid
- Any leaks noted
- Insulating fluid service history (has it been dried, etc)
- Transformer service history (has it been rewound, etc)
- Type of breather
- Type of insulation, including temperature rise rating
- Details of cooling equipment (fans, radiators, etc)
- Temperature of top of fluid, from gauge
- Actual fluid temperature measured
- Fluid level
- Vacuum and pressure gauge readings

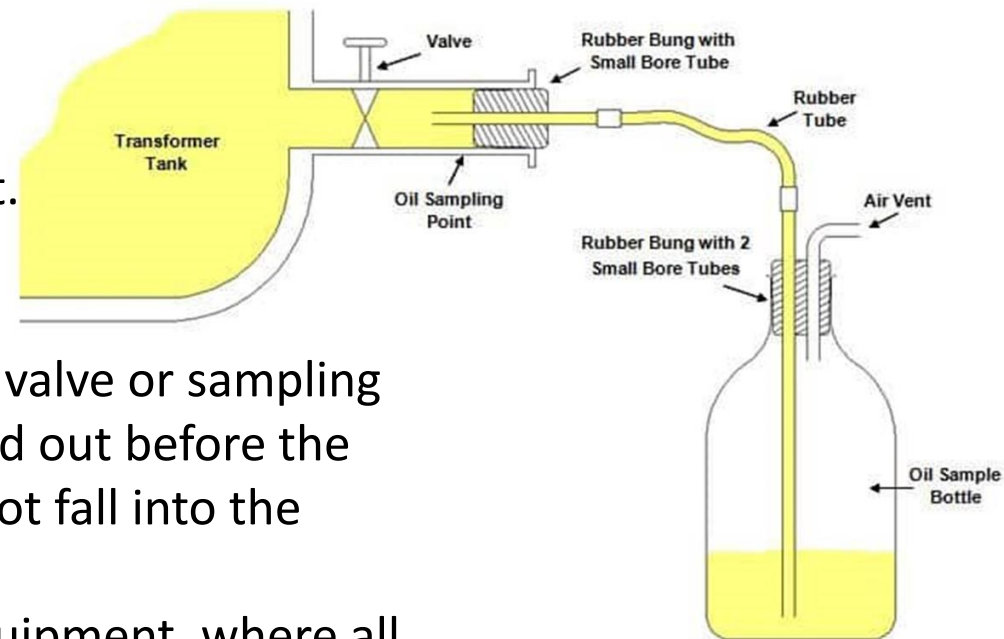


Insulation Oil Testing
Oil Dielectric Strength Testing

Internationally, there is a sampling standard - IEC 60475 Ed. 2.0 – Method of Sampling Insulating Liquids...

Hints and tips for taking oil samples

- For a sample to be truly useful, it must be representative of the oil in the equipment. This means that cleanliness is extremely important.
- Samples are normally drawn from a drain valve or sampling cock. This must be cleaned both inside and out before the sample is taken to ensure that dirt does not fall into the sampling container.
- The drain valve is at the bottom of the equipment, where all of the sludge, water and contaminant particles collect. It is important therefore, to flush the system thoroughly to ensure that the sample is drawn from the main bulk of the oil. This may involve removing two litres of oil, and even more if the equipment has been out of service for some time.

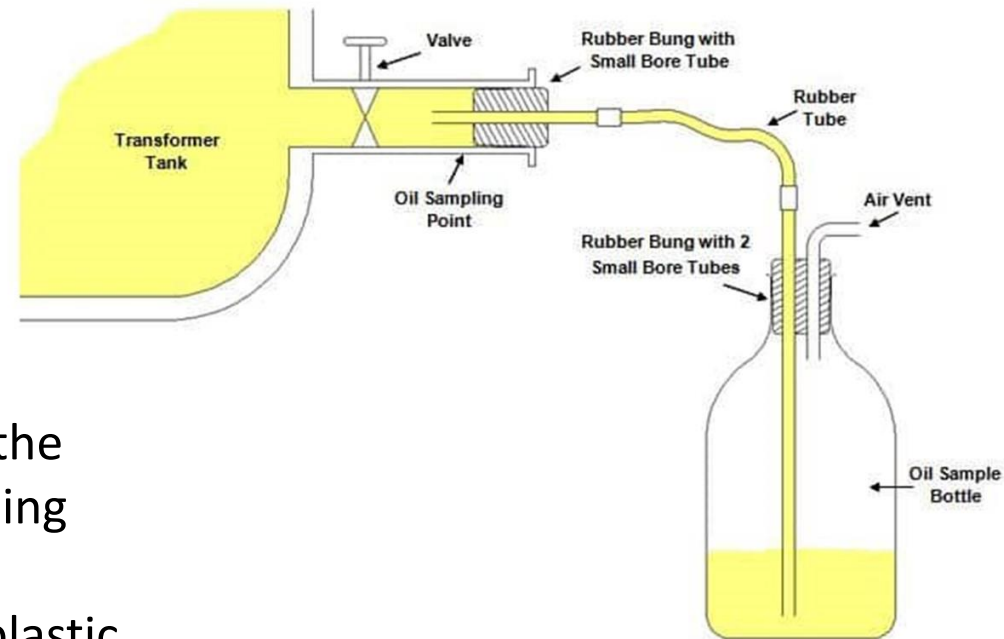


Insulation Oil Testing
Oil Dielectric Strength Testing

...Internationally, there is a sampling standard - IEC 60475 Ed. 2.0 – Method of Sampling Insulating Liquids

Hints and tips for taking oil samples

- **Do not** be tempted to use old engine oil bottles, even for a few P.P.M. of engine oil will cause the sample to fail a breakdown test.
- **Do** let the oil flow down the side of the sample bottle, or use a clean tube run to the bottom of the bottle; it will prevent air being mixed with the oil.
- **Do** store the oil samples in glass or clear plastic bottles in the dark, mineral oil will deteriorate if exposed to UV light.



Observe best practise by wearing gloves and avoid environmental damage by accidental spillage

Insulation Oil Testing
Oil Dielectric Strength Testing

Having taken an oil sample, the colour contains vital information on the oil degradation itself and is simply assessed by comparing the sample bottle colour to a colour chart.

Below is a typical showing of the difference between good and bad oil

Color comparator number	Color	Oil condition
< 7	Pale yellow	Good oil
7 - 10	Yellow	Proposition A oil
10 - 11	Bright Yellow	Service-aged oil
11 - 14	Amber	Marginal condition
14 - 15	Brown	Bad condition
16 - 18	Dark brown	Severe condition (reclaimed oil)
> 18	Black	Extreme condition (scrap oil)

Typical oil colour specimens

The darker the colour the more contaminants present

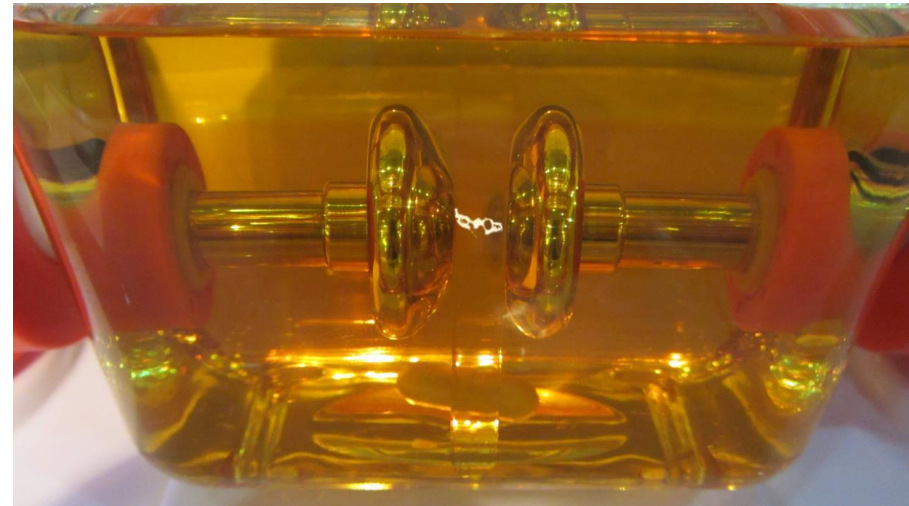
Good Fair Bad



Insulation Oil Testing Oil Dielectric Strength Testing

How is the test carried out?

- Typically a 600ml oil **sample** is taken
- Two special **electrodes** are placed in the oil at a pre-set gap of 2.5mm, typically they are a defined shape (either 13mm diameter spheres or a mushroom style)
- An AC test voltage of typically 0-60kV is applied in a **ramped** fashion at 2kV/second.
- When the oil flashes over the **breakdown voltage** is captured and recorded.
- The oil stands for 2 minutes then the test is **repeated**.
- 6 tests are performed, and an **average** taken
- The most common **standard** is IEC 60156
- Don't worry...today's testers allow standard selection and **automatic testing sequences**.



Insulation Oil Testing
Oil Dielectric Strength Testing

Selecting the right set?

- Select the **maximum test voltage**. In most distribution transformers **60kV** is fine but in transmission transformers you may select **80** or **100 kV**
 - **Mains** powered for lab or **battery** powered for field testing.
 - That is about it!
 - These units are **simple** to use but we offer web support and training on the oil sampling and operation of the sets.
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- **Frequency:** We recommend you plan to test at least annually and keep the test records to compare earlier tests



Insulation Oil Testing Oil Dielectric Strength Testing

Summary

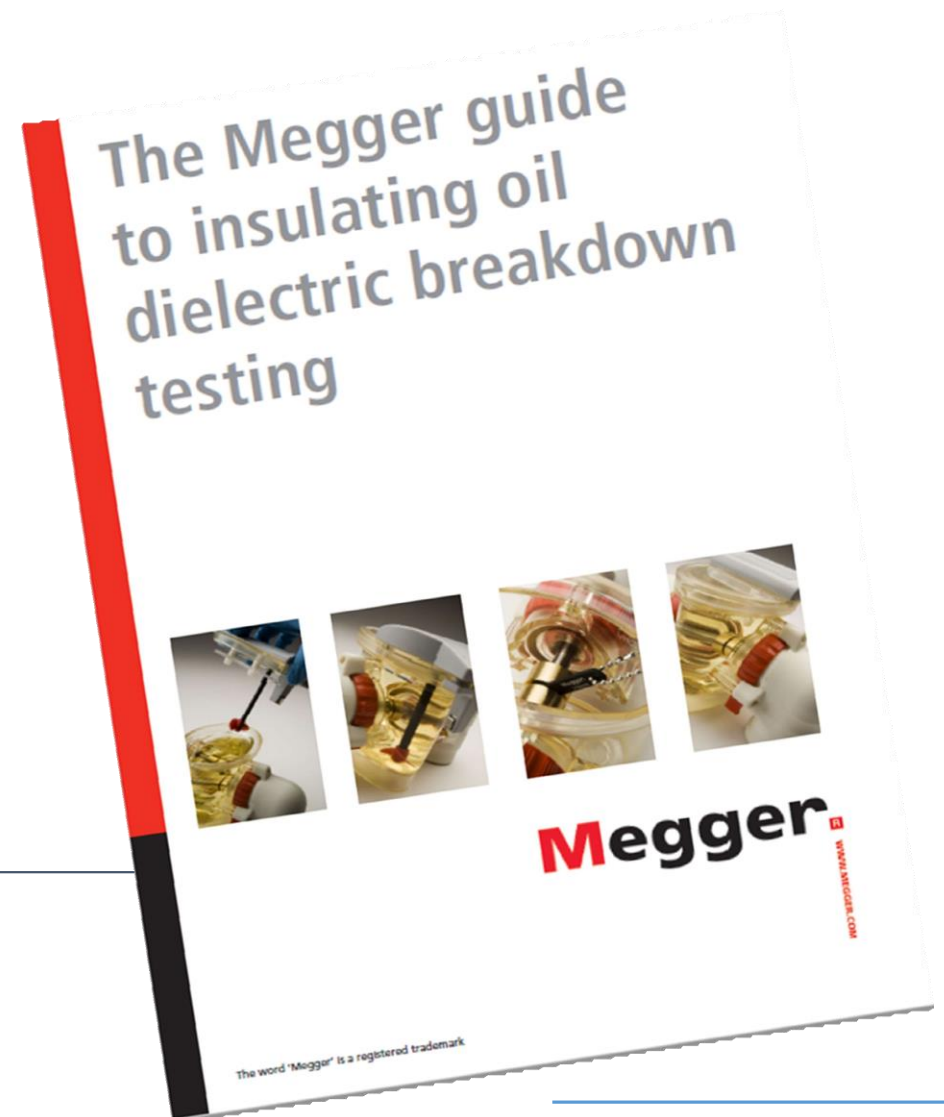
Testing transformer oil therefore is;

- Essential,
- Easy,
- Affordable.
- AND NECESSARY!!

For more information,
ask about our oil testing guide.

Available to PPA members.

Insulation Oil Testing
Oil Dielectric Strength Testing





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