

# Bureau Veritas

Oil & Petrochemicals



## Transformer Oil Analysis

North-West European Capabilities



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## Transformer Oil Analysis

Transformer oil or insulating oil is an oil that is stable at high temperatures and has excellent electrical insulating properties. It is used in oil-filled transformers, some types of high-voltage capacitors, fluorescent lamp ballasts and some types of high-voltage switches and circuit breakers.

Its functions are to insulate, suppress corona discharge and arcing and to serve as a coolant. It must therefore have high dielectric strength, excellent thermal conductivity and chemical stability and must keep these properties when held at high temperatures for extended periods.

Unused insulating oils must meet the specifications according to a number of international standards.

- IEC 60296 / ASTM D3487 : Specifications for unused mineral insulating oils.
- IEC 60836 / ASTM D4652 : Specifications for unused silicone insulating oils.
- IEC 61099 : Specifications for unused synthetic esters.
- IEC 62770 / ASTM D6871 : Specifications for unused natural esters.

Bureau Veritas provides transformer oil analysis according to all these international standards and test methods.

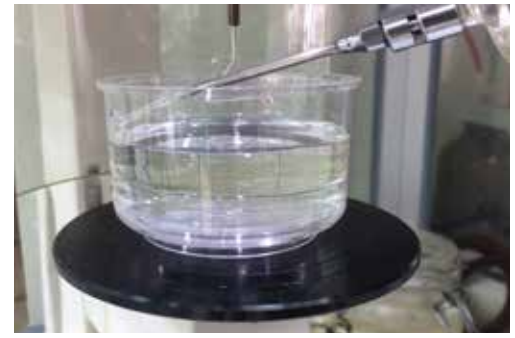
## Acceptance of Oil-Filled Transformers

A substantial proportion of electrical equipment is supplied to the final user already filled with mineral insulating oil. In such cases, as the oil has already been in contact with insulating and other materials, it can no longer be considered as "unused oil" as defined in IEC 60296. Therefore its properties shall be regarded as those applicable to oils in service even though the electrical equipment itself may not have been energized.

Supervision and maintenance guidelines can be found in:

- IEC 60422 : Mineral insulating oils in electrical equipment.
- IEC 60944 : Silicone transformer liquids.
- IEC 61203 : Synthetic organic esters for electrical purposes.

Bureau Veritas provides all the necessary analytical services for acceptance of new oil-filled transformers with confidence.



## Transformer Oil Condition Monitoring

Transformers can self-destruct if neglected over time and failure to conduct regular transformer oil testing can allow problems to go undetected. Transformers and insulating oils are subject to electrical and mechanical stresses while a transformer is in operation. As a result, the original chemical properties of transformer oil change gradually, often rendering it ineffective for its intended use after some time. Regular monitoring of the oil enables potential problems with both the transformer and the oil to be diagnosed.

### Why test transformer oils?

Bureau Veritas provides transformer oil analysis to power generating and service companies. We not only provide independent and impartial testing results but also the necessary sampling equipment according to IEC 60567. Our transformer oil analysis support to:

- Monitor health of oil and transformer.
- Take early remedial action before possibly dangerous and costly unit failure occurs.
- Control stability and insulation performance.
- Control health, safety & environmental concerns.

## Testing & Analysis

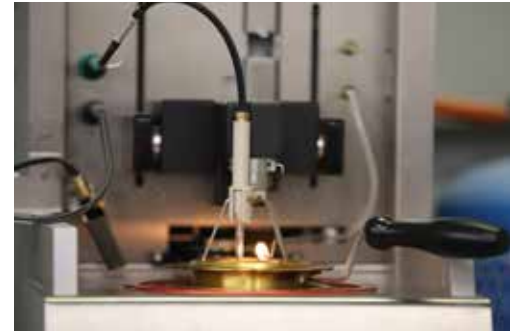
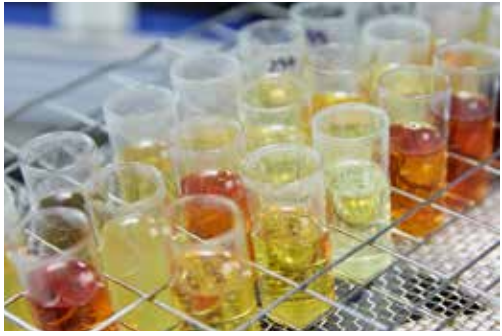
Transformer oils require a specific range of testing to determine the electrical insulation properties of the fluid. Bureau Veritas offers a number of analysis packages:

- **Routine oil quality** (colour & appearance, acidity, water content, dielectric dissipation factor, breakdown voltage).
- **Internal transformer faults & paper degradation** (dissolved gas analysis, furanic compounds).
- **Stability** (acidity, corrosive sulphur, passivator content, DBDS).

## Summary of Analysis & Test Objectives

### Dissolved Gas Analysis (DGA) – IEC 60567 – ASTM D3612

DGA is the most important tool in determining the condition of a transformer. It is the first indicator of a problem and can identify deteriorating insulation oil, overheating, hot spots, partial discharge and arcing. The health of the oil is reflective of the health of the transformer



### **Breakdown Voltage – IEC 60156 – ASTM D1816**

The dielectric breakdown voltage of insulating oil is a measure of its ability to withstand voltage stress without failure. It is the voltage at which breakdown occurs between two electrodes under prescribed test conditions. The test serves primarily to indicate the presence of electrically conductive contaminants in the oil such as water, dirt, moist cellulosic fibers or particulate matter. A high dielectric breakdown voltage does not indicate the absence of all contaminants, however.

### **Water content – IEC 60814 – ASTM D1533**

The water content in the oil and solid insulation has a significant impact on the actual operating conditions and the lifetime of the transformer. Water can originate from two sources.

- Ingress of moisture from the atmosphere
- Degradation of the insulation

### **Furanics – IEC 61198 – ASTM D5837**

Furans are a family of organic compounds which are formed by degradation of paper insulation. Overheating, oxidation, acids and decay caused by high moisture with oxygen accelerate the destruction of insulation and form furanic compounds.

### **PCB – IEC 61619 – ASTM D4059**

Polychlorinated biphenyls (PCB) are a family of synthetic chlorinated aromatic hydrocarbons which have thermal and electrical properties. These properties combined with excellent chemical stability make them useful in numerous commercial applications. However, their chemical stability and resistance to biodegradation has given cause for concern in terms of environmental pollution. This increasing concern over the environmental impact of PCB has progressively restricted their use since the early 1970s and their use in new plant and equipment was banned by international agreement in 1986. The PCB content of oil in new equipment should be measured to confirm that the oil is PCB free.

### **Corrosive Sulphur – IEC 62535 – ASTM D1275**

The amount of sulphur in oil depends on the oil refining process, degree of refining and crude oil type. It is normally present as organo-sulphur but elemental sulphur can also occur. The presence of reactive compounds causing corrosion at normal operating temperatures is due to poor refining or contamination. Some sulphur containing molecules may also cause the formation of copper sulphide deposition in the paper insulation of electrical equipment. This phenomenon leads to a reduction of the electrical insulation properties and can result to equipment failures in service.



## Summary of Analysis & Test Objectives Cont'd

### Acidity – IEC 62021 – ASTM D974

The acid neutralisation number is a measure of the amount of acid materials present in the oil. As the transformer ages, the oil will oxidize and increase in acidity. The acid value can also increase from contamination of other foreign material such as paint or varnish.

### Interfacial Tension – ASTM D971

The interfacial tension test measures the presence of soluble contaminants and oxidation products. A decreasing value indicates an increase in contaminants and/or oxidation products in the oil.

### Stray Gassing – ASTM 7150 – CIGRE 296

### Determination of dissolved metals in insulating oil – ASTM D7151

## Additional Capabilities

- Dissipation Factor – IEC 60247 – ASTM D924
- Colour & Appearance – ISO 2049 – ASTM D1500 – ASTM D1524
- Particle Count – IEC 60970 – ASTM D6786
- DBDS – IEC 62697
- Inhibitor Content – IEC 60666 – ASTM D4768
- Metal Passivator – IEC 60666
- Copper Corrosion – ASTM D1275
- Gassing Tendency – IEC 60628 – ASTM D2300
- Conductivity – IEC 61620 – ASTM D2717
- Oxidation Stability – IEC 61125 – ASTM D2440
- Aromatics – IEC 60590

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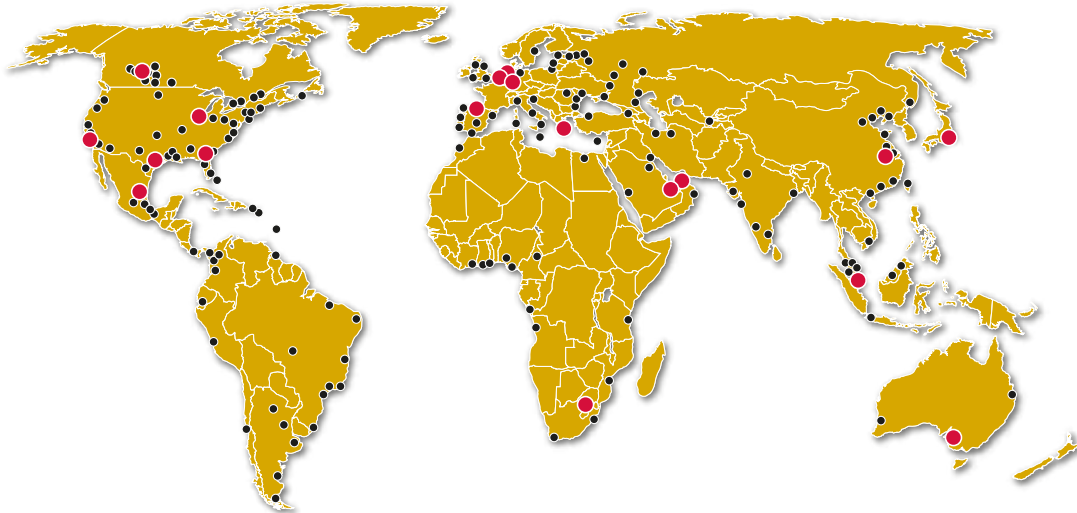
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