



DOBLE LABORATORY SERVICES

Complete laboratory analysis & support

DOBLE ENGINEERING COMPANY



DOBLE INSULATING MATERIALS LABORATORIES

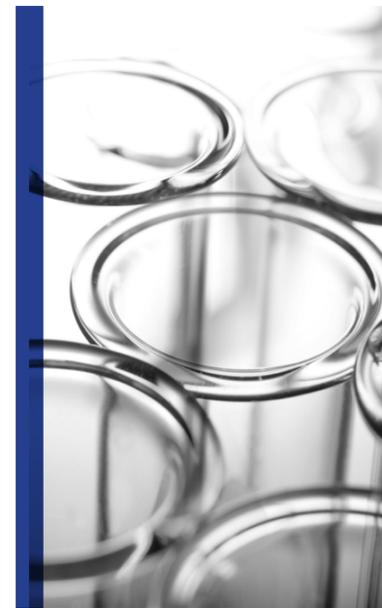
LABORATORY ANALYSIS & ENGINEERING GUIDANCE TO HELP MANAGE CRITICAL ASSET RISK

Oil testing is the best, most cost-effective means to determine the health of your generation, transmission and distribution transformers and other oil-filled assets. Developing problems can be detected at an early stage and then managed with further monitoring to detect serious deterioration or conditions that might result in failure. These tests can also be used to detect deterioration of the insulating oil that can result in formation of sludge and other by-products that can affect the quality of the electrical insulating materials and the cooling ability of the transformer.

With over 200 different tests available, let Doble's experienced laboratory team support your solid and liquid materials testing. Assisting customers since 1933, rely on our expertise for quality data and independent knowledgeable interpretation of results. Let us help you develop a test program fit for your needs. Doble offers routine and emergency testing as well as development of routine or comprehensive testing programs. We have five laboratories, located in: Massachusetts, Indiana, North Carolina, Texas, and our Morgan Schaffer laboratory in Montreal, Canada.

KNOWLEDGE COMMUNITY

Doble has published hundreds of papers on testing and diagnostics associated with electrical insulating liquids and insulating paper. Doble has performed leading edge studies on static electrification, stray gassing and corrosive sulfur problems in transformers. In addition, Doble is a leader in the evaluation of new electrical insulating oils.



OIL COMMITTEE

Join the Doble Oil Committee members who have a common interest in the quality of new oils and verification that products meet specifications. This group also explores new methods and technologies for assessment of dielectric oils. The group discusses problems and decides which areas require research. Oil Committee members have a direct interest in and often primary responsibility for procuring and maintaining mineral oil in their organizations.

ANNUAL OIL SURVEY

Be in the know about available transformer oils and their quality. The Doble Annual Oil Survey publishes data and analysis of commercially available transformer mineral oils. Issued since 1953, the report compares current data with historical reports to evaluate product consistency. This survey provides the test data and information you need to evaluate transformer oils refined worldwide.

TRANSFORMER OIL PURCHASE SPECIFICATION

Many companies use the Doble Transformer Oil Purchase Specification (TOPS) and the Annual Oil Survey to qualify oil suppliers, using these materials as independent assessments of commercially available oils. TOPS is a set of specifications developed and maintained by the Doble Oil Committee and is the basis for the Annual Oil Survey testing.

KEY DIAGNOSTIC & OIL QUALITY TESTS

Dissolved Gas-in-oil Analysis (ASTM D3612/IEC 60567)

The most important test for oil-filled equipment. Amounts, relative composition and rates of generation of key gases are used to detect and monitor developing faults in electric apparatus. Detects and distinguishes between thermal and electrical problems before failure occurs.

Furanic Compounds-in-oil Analysis (ASTM D5837/IEC 61198)

Paper is the most important electrical insulating material in transformers. When the paper breaks down, furanic compounds are generated. The amount and rate of generation of these compounds are used to assess the condition of the paper insulation. Furanic compounds are soluble in oil and therefore easy to sample.

Oil Quality & Water Content

Oil quality should be determined and periodically verified that it will perform its functions as a coolant and dielectric. Doble offers a variety of oil quality screen test packages for new and service-aged insulating liquids which can include:

Color (ASTM D1500) | Dielectric Breakdown Voltage (ASTM 1816) | **Interfacial Tension (ASTM D971)** |

Neutralization Number (ASTM D974/IEC 62021) | **Visual (ASTM D1524)** | Water Content (ASTM D1533/IEC 60814) and Relative Saturation |

Power Factor @ 25°C & 100°C (ASTM D924/IEC 60247) | Specific Gravity (ASTM D1298)

Corrosive Sulfur

Doble has been at the forefront of corrosive sulfur research and the significant effect it can have on large power transformer systems. Doble offers more than 15 laboratory tests to assess and mitigate corrosive sulfur risk.

Degree of Polymerization of Paper (ASTM D4243/IEC 60450)

This test requires a sample of the paper and is a direct measure of paper aging which correlates with important physical properties such as resistance to tearing and bursting.

Wear Metals In Oil (Doble Test Method)

Pumped cooling systems are susceptible to bearing wear which can create metal particles. Oil is analyzed for particulate metals such as copper, iron, zinc, and lead.

Dissolved Metals in Oil (ASTM D7151)

High temperature fault conditions can create dissolved metals. High concentrations of certain metals can help locate fault sources.

Load Tap Changer Program

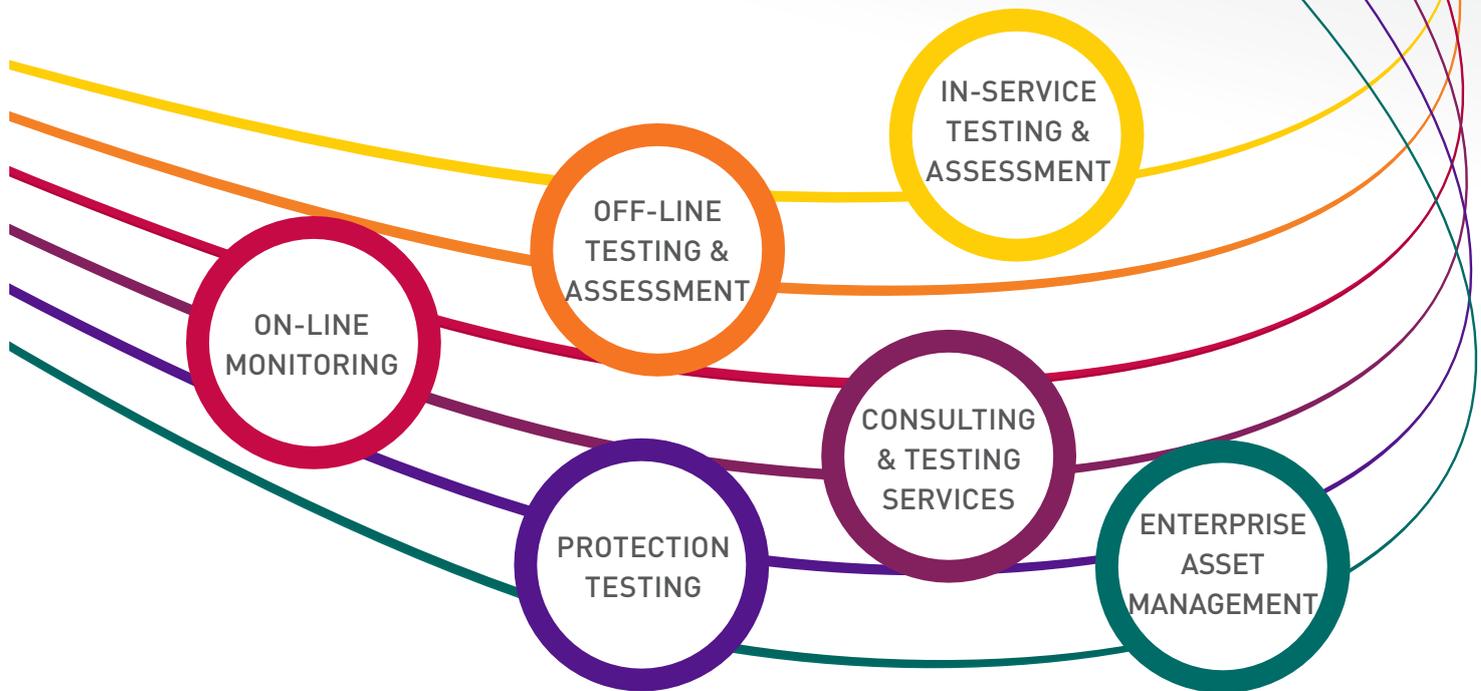
Load tap changers can fail mechanically and electrically from various wear and deterioration conditions. Doble's LTCare program includes dissolved gas-in-oil analysis (DGA), particle count, microscopic particle examination, Doble Carbon Code, several oil quality tests and dissolved metals-in-oil.

Breaker Analysis Program

Bulk oil circuit breakers can also fail mechanically and electrically from various deterioration mechanism. Our DBA program also includes DGA, particle count, microscopic particle examination, Doble Carbon Code, several oil quality tests and dissolved metals-in-oil.



OPTIMIZE OPERATIONS WITH DOBLE'S RANGE OF DIAGNOSTIC SOLUTIONS



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