

Technical Bulletin # 210

OIL INTEGRITY TESTING

The following ASTM tests should be routinely performed on the dielectric fluid samples taken from your power system.

1. **Neutralization Number D664** - The neutralization number for service-aged transformers is, in general, a measure of the acidic constituents of the oil. It may be pertinent, if compared to the value of the new product, in detecting contamination of the oil from substances which have come in contact with the oil. It may also be important in revealing a tendency toward chemical change or deterioration of the oil and its additives. It may be used as a general guide for determining when oil should be replaced or reclaimed, provided suitable rejection limits have been established and confirmation is received from other tests.
2. **Dielectric Breakdown Voltage D877** - The dielectric breakdown voltage of an insulating liquid is of importance as a measure of its ability to withstand electric stress without failure. It is the voltage at which breakdown occurs between two electrodes under prescribed test conditions. It serves primarily to indicate the presence of contaminating agents such as water, dirt, or conducting particles in the liquid, one or more of which may be present when low dielectric values are found by test. However, a high dielectric breakdown voltage does not indicate the absence of all contaminants.
3. **Interfacial Tension D971** - The interfacial tension between an electrical insulating oil and water is a measure of the molecular attractive force between their unlike molecules at the interface. It is expressed in dynes per centimeter (mnewtons per meter). This test provides a means of detecting soluble polar contaminants and products of deterioration. Soluble contamination or oil-deterioration products generally decrease the interfacial tension.
4. **Power Factor D924** - Power factor is the ratio of the power dissipated in the oil in watts to the product of the effective voltage and current in voltamperes, when tested with a sinusoidal field under prescribed conditions. A high value is an indication of the presence of contaminants or deterioration products such as oxidation products, metal soaps, charged colloids, etc.

5. **Color D1500** - The color of an insulating oil is determined by means of transmitted light and is expressed by a numerical value based on comparison with a series of color standards. A rapidly increasing or high color number is an indication of oil deterioration or contamination or both.

6. **Water in Insulating Oil, Karl Fisher Method D1533** - Water may be present in insulating oil in several forms. The presence of free water may be disclosed by visual examination in the form of separated droplets or as a cloud dispersed throughout the oil. This type of water invariably results in decreased dielectric strength, which may be restored by filtration or other suitable means. Water in solution cannot be detected visually and is normally determined by either physical or chemical means. The ASTM method cited is suitable for the determination of water in insulating oil and, depending upon conditions of sample handling and method of analysis, can be used to estimate total water as well as soluble water content of oil. The unit of measure of the water is in parts per million. These tests are significant in that they will show the presence of water which may not be evident from electrical tests.

When evaluating the conditions of dielectric fluid, the following control limits for oil can be used as reference levels of acceptability:

Parameter	Recommended Value
Dielectric Breakdown ASTM D 877	25 KV minimum
Color ASTM D1500	4.0 maximum
Neutralization Number ASTM D864	.4 mg XOH/gram maximum
Interfacial Tension ASTM D971	18 dynes/DM minimum
Power Factor ASTM D924	1.0% Dissipation factor
Moisture Content ASTM D1533	55 ppm maximum

If any of these measurements fall outside the recommended values, the tank dielectric fluid should be filtered or replaced as soon as possible.