

## DIELECTRIC / TRANSFORMER / INSULATING OILS

In oil terminology the above terms are synonymous. At times they may be used together, but most often are used separately. Separately, or together, they are used as a description for an oil to be used in electric apparatus.

Dielectric is a term used to describe, or define, an electric insulating material. In effect, a dielectric is an insulating material that opposes a flow of current through it.

In the case of dielectric or transformer or insulating oil, the ability of the oil (acting as a dielectric) to oppose the flow of-a current is determined by tests which show its dielectric strength.

There are two properties that contribute to the characteristic of an oil's ability to oppose a flow of current. One is its resistivity-the specific resistance that a dielectric offers under moderate conditions of voltage. The other is dielectric strength-the ability to prevent arcing between two electrodes at high electric potentials, or to prevent arcing between the electric source and ground.

Though the two properties are not directly related, it so happens that commercial insulating materials of high dielectric strength also possess adequate resistivity. In the insulation of high voltage electric conductors, therefore, it is ordinary dielectric strength that is of the greater concern.

Petroleum oil is an excellent dielectric and it is used extensively as a hydraulic medium for equipment used around electrical apparatus, such as in servicing high voltage electric equipment, lines, or transmission media. Oil is also used in switchgears, transformers and other such electrical equipment designed to be insulated with a liquid.

Among the advantages that petroleum oil offers over solid insulation is the ability to cool by circulation and to prevent corona. Corona is the result of ionization of air in the tiny voids that exist between a conductor and a solid insulation wrapper. Corona is destructive to certain types of solid insulation. By filling all of the space around a conductor, insulating oil (or dielectric oil-or transformer oil) eliminates the source of corona. Oil also has the high dielectric strength that good insulation requires.

The minimum voltage required for arcing is the breakdown voltage of the dielectric (in this case, the oil) incurred under the circumstances involved. When the dielectric (the oil) breaks down, it undergoes a change in composition that permits it, temporarily at least, to conduct electricity.

In accordance with the ASTM Standards test method D-877, the dielectric strength of an insulating-dielectric-transformer oil is evaluated in terms of its breakdown voltage under a standard set of conditions. Because of the marked effect of contamination (by environmental and/or oxidation materials, moisture, etc.) on test results, as well as while in use, special care must be exercised in obtaining and handling such oil.

Oils that are specifically sold as dielectric-transformer-insulating oils (bought under any of the three names, together or separately) are generally thoroughly dried at the processing plant by filtration, heat, etc., and pack-aged in containers that are then sealed by a "vacuum" process where all of the air and humidity are pulled out of the container (similar to hermetic sealing) as it is sealed.

Generally all top quality R&O, turbine grade circulating oils (hydraulic oil, turbine oils, etc.) are produced and packaged under the driest conditions possible. All of LE's top quality MONOLEC circulating/industrial oils are made under such dry conditions and are packaged in dry drums.

All such oils packaged and sold by LE are shipped in drums that are closed with a tight fitting bung, plus a plastic protective "seal". LE's hydraulic and turbine oils are not shipped in "sealed" (meaning hermetically sealed) drums, but they are as dry as any oil can possibly be when shipped.

LE recommends its MONOLEC Hydraulic Oils or MONOLEC R&O Compressor/Turbine Oils for those equipment applications with hydraulic systems where a dielectric or transformer oil may be suggested by the OEM or user. They are not sold as being dielectric-transformer-insulating oils, but do have a dielectric strength (minimum) of 38kV, by the required ASTM Standards Test. For applications where a true dielectric or transformer oil is required, such as transformers, switches and circuit breakers, LE's 6760 Transformer Oil is recommended. This is an ASTM D-3487 Type II electrical transformer oil.

Transformer oil received in drums, pails, etc. is subject to water contamination during storage. The bung closures and seals are not perfect and may, over a period of time, begin to 'breathe.' The mechanism is simple. The container heats up during the day and cools at night. The resulting expansion and contraction can be enough to pump moist air in and out of a drum sitting upright on a slab. This is more prevalent if the drum is stored outside. It is preferred that drums be stored indoors, in racks laying on their sides with the two bungs lined up horizontally. This keeps the closures under the surface of the oil and greatly minimizes the chances of "breathing." Drums stored outdoors should never be stored upright, as water can collect on the heads. This water can be pulled into the rim if breathing occurs. Do not expect drums on hand for prolonged periods of time to contain dry oil.

Bulk shipments of transformer oil should use dedicated tankers, storage tanks, hoses, pumps, etc. The tankers and storage tanks should be equipped with desiccant breathers. It is also advisable for the storage tank to be blanketed with dry air or nitrogen. Vacuum dehydration or gas sparging equipment should be available for re-drying the oil. Filtration is also recommended.

Because of the strong dependence of dielectric properties on the water content and particulate contamination levels of the oil many end users routinely re-dry and filter the oil during installation.



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