

## PRODUCT INFORMATION

## BUSHING OIL

## GENERAL

The oil in a bushing is to be an electrically insulating and a cooling medium. The service-reliability of an oil insulated bushing depends therefore to a great extent on the quality of the oil. Properties of special importance, when determining the oil quality, are:

1. The viscosity, which is the main factor for determining the cooling properties of the oil. Other factors affecting the cooling properties are practically the same for all qualities of transformer oil.
2. The flash point, which is the temperature at which combustible gases are emitted by the oil in such a concentration that they may be ignited.
3. The lowest flow-temperature, which is the temperature at which the oil begins to change to such a viscous consistency that the cooling of the bushing is jeopardized.
4. The breakdown withstand, which is the voltage required to obtain a flashover in the oil between two electrodes of specified shape, and at a certain distance from each other. The breakdown withstand is an indicator of the purity from water, conducting particles, organic acids and other electrolytes.
5. The resistance against ageing, which is the ability of the oil to maintain its properties for a long times as an insulating and cooling medium. Because of the ageing, which is mainly an oxidation process, the oil darkens, becomes acid and forms finally insoluble sludge. The oil will thus gradually be damaged and cannot be used for its purpose any more.

The oxidation process is depending on the oxygen feed, and the speed of the reaction increases rapidly with rising temperature. As all our bushings are permanently sealed in our workshop, the amount of oxygen in the bushing is limited. Oxidation of the oil is therefore generally not a problem in our bushings.

The content of moisture is also an important factor, which to a great extent affects the insulating properties of the oil.

#### ABB COMPONENTS OIL

ABB Components bushing oil is specially selected to give good stability against oxidation. In order to improve the oil further and increase its life, an oxidation inhibitor is added. The name of this is diisobutyl paracresol, or in abbreviation DBPC. The inhibitor breaks the chain reaction, leading to formation of sludge and acids. DBPC is electrically neutral and has no harmful effect on the solid insulation. The inhibitor DBPC, which has been widely used in the oil industry, and is produced by European as well as American manufactures, is thus easily obtainable on the market.

Transformer/bushing oil, inhibited with DBPC, can without disadvantages be mixed with uninhibited transformer/bushing oils. However, the ageing properties of the mixture are generally not as good as for the inhibited oil.

Our oil complies with the demands according to IEC Publication 296. The oil shall be of class II, i.e. viscosity max. 25 cSt at 20 °C. Data for oil according to IEC Publication 296 are given in the table below.

|  |                         |
|--|-------------------------|
| Density at 20 °C (ASTM D 941-55)                           | < 895 kg/m <sup>3</sup> |
| Viscosity at 20 °C (ASTM D 445-65)                         | < 25 cSt                |
| Flash point (ASTM D 93-66)                                 | > 130 °C                |
| Lowest flow-temperature (ASTM D97-66)                      | < -45 °C                |
| Neutralization value (IEC 296)                             | < 0.03 mg KOH/g         |
| Corrosive sulphur (ASTM D1275-67)                          | nil                     |
| Dielectric strength in VDE gap at 2.5 mm spacing (IEC 156) |                         |
| a) before treatment  | > 30 kV                 |
| b) after treatment *                                       | > 60 kV                 |
| Dielectric strength (ASTM D 877)                           | > 35 kV                 |
| Dielectric losses tan δ at 90 °C (IEC 250)                 | < 0.005                 |
| Oxidation stability (figures after ageing)                 |                         |
| a) Uninhibited oil (IEC 74)                                |                         |
| Neutralization value (IEC 296)                             | < 0.4 mg KOH/g          |
| Sludge (IEC 474)   | < 0.1%                  |

b) Inhibited oil (IEC 474)

Induction period > 120 h

\* Treatment specified in IEC Publication 296 means:

Heating of the oil to 90 °C, filtration under vacuum (< 20 Torr) through a filter with pore diameter 3-20 um.

PCB content < 1 ppm

The supplier of the transformer/bushing oil shall guarantee by certificate that the oil on delivery complies with IEC Publication 296 and particularly that after treatment is specified in IEC 296.

Further information about the test methods used by ABB and equivalent methods of other standards can be obtained on request.

#### TRANSFORMER OILS ON THE MARKET

Transformer oils, available on the market, comply in general with the above requirements with the exception of - sometimes - viscosity and oxidation stability.

Examples on transformer oils complying with the demands according to IEC Publication 296 and the demands of ABB.

Inhibited oils:

Esso Univolt N61  
Shell Diala DX  
BP Energal-JSH-V  
Nynäs TRO 10X  
Mobillect 44

Uninhibited oils:

Esso Univolt 60  
Univolt 62  
Univolt 64  
Shell Diala D  
Gulf Transcrest H