



Power Industry

Technical bulletin

# Transformer insulation fluids



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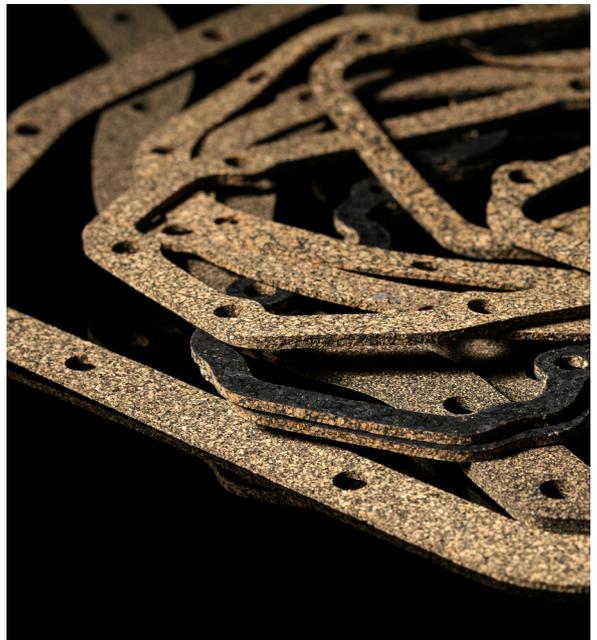
# Transformer insulation fluids

Many transformers and T&D Equipment such as load-tap changers, voltage regulators, bushings, switchgears and circuit breakers use oil as an insulating medium between contacts.

Because many problems in transformers and other T&D equipment are directly related to changes in the dielectric properties of the oil, an effective proactive approach to maintaining oil-insulated equipment is to control polar contaminants, such as particles, moisture and by-products of oil oxidation – i.e. the forcing factors associated with a change in the dielectric constant (insulator properties).

The high cost of repairing transformers and other T&D equipment and the loss of revenue associated with failure, have caused electric power industry organizations to place considerable emphasis on strategies for extending equipment life and improving operational reliability of T&D system components such as insulating oil.

The industry has devised several standards that regulate oil specifications and others that dictate the compatibility between the T&D construction material and the insulating oil (view last page), namely the gasket material.



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**Colour [clear & bright]** Indicates a colour change and whether or not for further research is required.

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**Interfacial Tension Test** Measured in milliNewtons(mN) per metre of mineral oils against water, indicating the amount of polar contaminants (such as water).

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**Neutralisation Number [mg KOH/g]** Determines the amount of acidic constituents in the insulating oil.

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**Dielectric Dissipation Factor or Power Factor (tgδ) [%]** Indicates the dielectric loss (leakage current associated with watts loss) of the insulating oil.

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**Dielectric Breakdown Test (kV)/ Dielectric Strength** Measures the voltage at which the oil electrically breaks down and begins to conduct.

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Fluid cleanliness and condition is a key metric that affects the performance of electrical insulating oils, and directly impacts T&D equipment’s performance and longevity.

**ASTM D 3455-95** compatibility between construction material and electrical insulating oil of petroleum origin.

The acceptance criteria are based upon Industry Reference bodies such as IEC and IEEE, which generally have a wider acceptance range when compared to ASTM standard criteria.

# Nynas Nytro 1 OXN (mineral oil)

## Oil compatibility

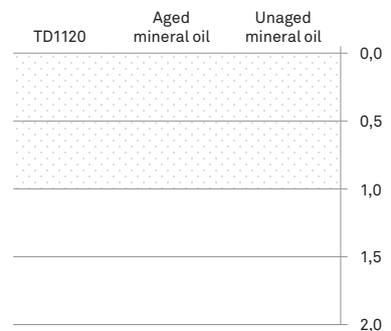
According to: ASTM D 3455- 95 compatibility between construction material and electrical insulating oil of petroleum origin.

## Colour [clear & bright]

ASTM D1500 standard test method for the colour of petroleum products. Industry criteria's range from 0 to 1.0 max. change

The following characteristics were measured after ageing the transformer oil for 164h @ 100°C;

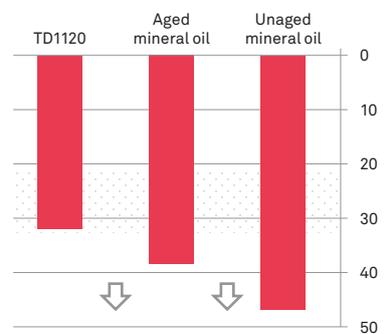
- With samples of TD 1120 immersed.
- Without any samples and comparing with unaged oil.



## Interfacial tension test [mN/m]

ASTM D971 standard test method for interfacial tension of oil against water by the ring method. Industry criteria's range from 22 to 32 min.

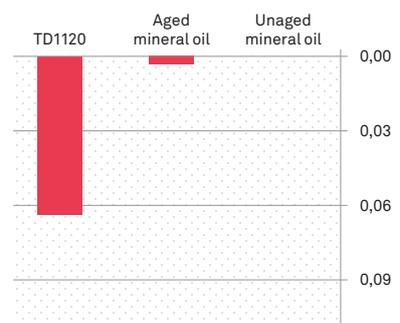
Particles in oil weaken the interfacial (lowering the IFT number) - a Measure of Contamination



## Neutralisation number [mg KOH/g]

ASTM D974 standard test method for neutralization number by colour indicator titration. Industry criteria's ranges up to 0,3mg max. change

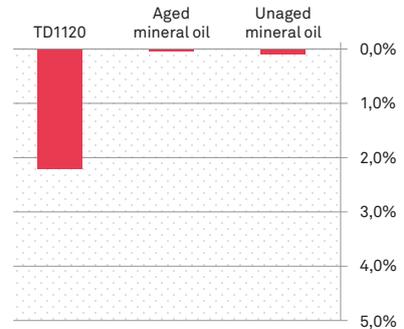
Unused transformer oils contain practically no acid. Oxidation of the insulating oils form acids as the transformer ages. The acids attack metals inside the tank and forms soaps (sludge). Acid also attacks and accelerates cellulose insulation degradation.



**Dielectric dissipation factor or power factor (tg δ)**

ASTM D924 standard test method for dissipation factor (or power factor) and relative permittivity (dielectric cant) of electrical insulating liquids. Industry criteria’s range up to 5% max.

A high power factor indicates deterioration and/or contamination from by-products such as water, carbon, or other conducting particles, including metal soaps caused by acids attacking transformer metals, and products of oxidation.



**Dielectric breakdown test (kV) or dielectric strength**

ASTM D1816 standard test method for dielectric breakdown voltage using VDE electrodes. Industry criteria’s range from 23 to 60 kvmin.

The dielectric strength test is not particularly valuable; moisture in combination with oxygen and heat will destroy cellulose insulation long before the dielectric strength of the oil has indicated anything is going wrong.



**Oil specifications**

**ASTM D 3487 - 93**  
Standard Specification for Mineral Insulating Oil Used in Electrical Apparatus

**ASTM D 5222- 98**  
Standard Specification for High Fire-Point Mineral Electrical Insulating Oils

**ASTM D 2225- 92**  
Silicone Fluids used for electrical Insulation

**ASTM D 6871 - 03**  
Standard Specification for Natural (Vegetable Oil) Ester Fluids Used in Electrical Apparatus

**CEI- IEC 60296: 2003**  
Fluids for electro technical applications- Unused mineral insulating oils for transformers and switchgear

**BS 148: 1998**  
Specifications for Unused mineral insulating oils for transformers and switchgear

**Oil compatibility**

**ASTM D 3455 - 95**  
Compatibility between Construction Material and Electrical Insulating Oil of Petroleum Origin

**ASTM D 5282 - 98**  
Compatibility between Construction Material and Silicone Fluid used for Electrical Insulation

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