

Limits of Transformer oil test values

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What are the limits of IFT, Acidity, PF of healthy Transformer oil?

The principal indicators to assess the degree of degradation of the insulation system (lead conductor, winding, core, and the oil insulation) are:

(i)Inter Facial Tension(IFT).

(ii)Acid Neutralisation.

(iii)Power Factor Test.

These indicators should be reviewed for any abrupt changes as they would normally change very little from year to year.

A significant change in these values may indicate over heating of any part of the insulation system.

(i)The Interfacial tension (IFT) Test:

IFT indicates the sludging of Transformer oil. It is a test of water reaction against oil(different from surface tension of the water, in contact of air). The attraction between the water molecules at the interface is influenced by the presence of polar molecules in the oil in such a way that the presence of more polar compounds affect the IFT. This test measures the concentration of polar molecules in suspension in the oil and gives an accurate measurement of dissolved sludge fore- runner in the oil long before any sludge is precipitated.

New Transformer oil: Minimum 36 dynes/cm.

In-service oil : Min 25 dynes/cm.

An IFT of less than 0.015 N/m (15 dynes/cm) shows sludging.

An IFT of 15 to 22 dyne/cm shows an uncertain condition.

An IFT of more than 22 dynes/cm indicate no sludging.

If there is an IFT decrease of 20 % or more (with a change in the colour between annual readings), the oil should be resampled and tested for confirmation of the results. A significant change in IFT values denotes an accelerated aging of the insulation system, and it's overheating. The transformer should be tested for Tan delta and action to be taken accordingly.

(ii) Acid Neutralisation Number or Acid Number:

The Acid Neutralisation number, or Acid Number, is the amount of potassium hydroxide (KOH in mg) required to neutralise the acid in one gram of oil which indicate the acid content in the oil. With aged oils, it also indicates the presence of contaminants, like sludge. It should be recognized that the acidity test alone determines conditions under which sludge may form but does not necessarily indicate that actual present sludging conditions.

New transformer oil contains practically no acids. The acidity test measures the content of acids formed by oxidation.

The oxidation products polymerize to form sludge which then precipitates out. Acids react with metals on the surfaces inside the tank and form metallic soaps, another form of sludge.

For mineral oil, sludging has been found to begin when the acid number reaches or exceeds 0.4 mg KOH/gram. New oil has an

acid number of less than 0.05 mg KOH/gram. Oil showing an acid number of 0.15 or higher can indicate accelerated acid formation. Typically, results of 0.10 mg KOH/gram of oil or less are considered good and higher values indicate a problem. If there is an acidity increase of 25 percent or more (with a change in the colour between annual readings), the oil should be resampled and tested for confirmation of the results. A significant change denotes an accelerated aging of the insulation system.

(iii) The power factor Test:

The power factor of Transformer oil is the cosine of the phase angle between an AC voltage applied and the resulting current. Power factor indicates the dielectric loss of the Transformer oil and hence, its dielectric heating. The power-factor test is widely used as an acceptance and preventive maintenance test for Transformer oil. A high power factor in aged oil indicates deterioration and contamination with moisture, carbon, or deterioration products.

The PF of new oil :< 0.05% at 25deg C.

PF of aged oil > 0.5 % -should be further analyzed in laboratory.

PF >2.0% is operational hazard and should be investigated and oil should be either reconditioned or replaced.