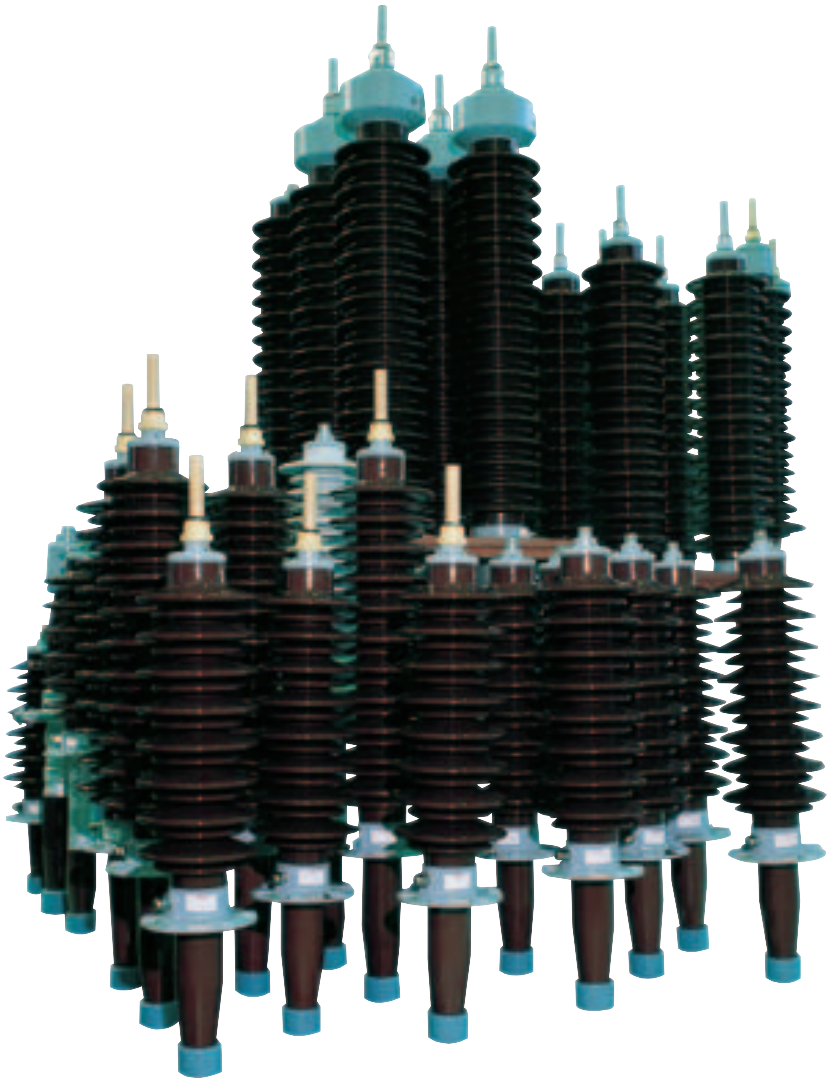
Dissipation factor (tan δ) over the main insulation on high voltage bushings

Product information



General

The dissipation factor is one of the crucial parameters in an oil insulated condenser bushing and is determined mainly by the moisture content in the paper, and contamination in the insulation system. The dissipation factor is also very dependent on the temperature, see Fig. 1.

The dissipation factor is considered important for two main reasons:

- Capacitive losses generate heat, which could result in premature ageing of the insulation, if the bushing is not properly designed, or even worse, could lead to a thermal breakdown.
- Quality check of the production process.

The aim is to have a dissipation factor that:

- Shows just a small variation with temperature. Increasing dissipation factor with temperature indicates a moisture level in the main insulation above 1 %.
- Remains stable during the bushing's entire service life. Increasing dissipation factor indicates moisture ingress and/or ageing of the insulation.
- Matches the intended service voltage. Dielectric losses (and hence heating) are proportional to the voltage squared.

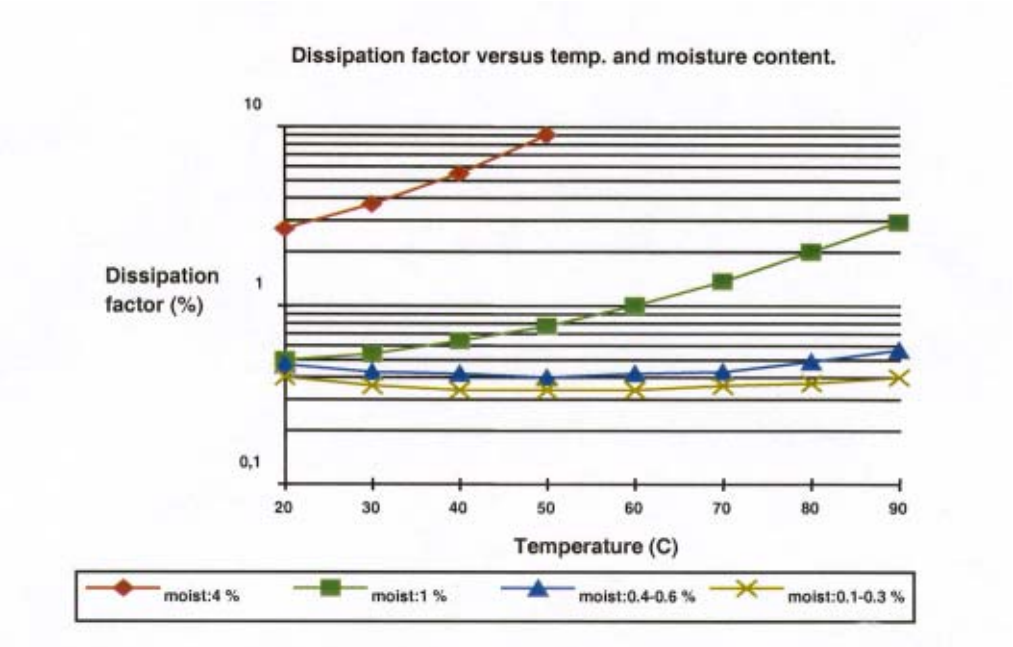


Fig. 1. Tan δ as a function of moisture level and temperature on OIP bushings.

Production process

The main insulation in ABB bushings consists of a number of aluminum foils, concentrically located in the paper core. The manufacturing process facilitates continuous drying while manufacturing the condenser core. A proper selection of material also contributes to keeping the dissipation factor under control.

For more than 40 years, hundreds of thousands of bushings have been delivered according to this concept - proof that the concept with aluminum foils is extremely stable over time as far as dissipation factor is concerned. This has not been the case with some other concepts used by the industry, which have shown signs of increasing dissipation factor over time and hence accelerated ageing.

Design philosophy

Preventing moisture from penetrating into the bushing is crucial. This is accomplished by:

- Using a sufficient and well proven sealing system, utilizing o-ring gaskets made of oil and heat resistant synthetic nitril rubber, located in turned grooves with and cross section area of approximately 80 % of the area of the gasket. When compressed, the rubber completely fills the groove and the residual part of the rubber forms a cushion preventing the solid parts from coming into direct contact with each other. The compressing force will provide the adequate tightening pressure. This sealing system has been used in ABB bushings since 1964.
- Using a well-proven system for joining porcelains together, when necessary. ABB have been using a special heat resistant, one-component epoxy glue since 1972, which has proven to have an excellent long-term behavior.

Bushings are sealed and tightness tested before being cleared for delivery, and we do not recommend any oil sampling, except when a problem is known. There is always a risk of improper sealing after sampling with water ingress as a consequence. See product information 2750 515-142, *Bushing diagnostics and conditioning*, for further details.

Summary

Using a design and production philosophy, which ensures a stabile dissipation factor with temperature and throughout the bushing life, is essential.

Our opinion is that starting off with an extremely low dissipation factor shows the bushing has been subject to overheating. Doing this on purpose shows lack of confidence in the bushing design, with the increased risk of premature ageing and hence reduced lifetime as a result.

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