Fluid Maintenance Guide - Distribution Transformers

General

MIDEL eN 1215 is a natural ester based fluid designed for long service in sealed transformer systems. As with mineral oil, in order to ensure that MIDEL eN 1215 gives continued good service it is possible to monitor a number of the fluid parameters throughout the life of the transformer. Testing the fluid also has the added benefit of picking up any potential problems with the transformer before a failure occurs.

Generally, for distribution transformers, sampling of the fluid is recommended before energising, after the first year of service and at five year intervals thereafter. For larger power transformers, highly loaded or critical units, the frequency of testing may be increased and annual checks are commonly used.

It is important to understand some fundamental differences between MIDEL eN 1215 and mineral oils when carrying out fluid testing for maintenance. Many laboratories are now experienced in the testing of ester based fluids, but at times a failure can be logged against a sample when the incorrect mineral oil limits are applied.

Applying the limits from this guide will ensure that the MIDEL eN 1215 fluid is in suitable condition for continued use. Users can also refer to the IEEE C57.147 'IEEE Guide for Acceptance and Maintenance of Natural Ester Fluids in Transformers'. It should be noted that this guide and the IEEE standard do not apply to retrofilled transformers, i.e. those that have been previously filled with another fluid. If there is any doubt about how the limits from these guides may be applied to MIDEL eN 1215 in service, please contact the MIDEL technical team.

Table 1 - **Common Test Parameters and Guidance Limits for Equipment at ≤69kV**

Parameter	Test Method	IEEE C57.147 (2008) Table 5
Water Content	ASTM D1533	max. 540mg/kg*
Breakdown Voltage	ASTM D1816 2mm	min. 40kV
Fire Point	ASTM D92	min.300°C

* same relative saturation as mineral oil at 20°C

Breakdown Voltage Testing

The breakdown voltage of new MIDEL eN 1215 is typically in excess of 50kV when tested to the ASTM D 1816 2mm gap method. Even at high moisture contents, up 300ppm at ambient temperature, testing has shown that the breakdown voltage of MIDEL eN 1215 will be preserved at a high level.

There are some issues that can cause a drop in breakdown voltage and the first is particulate matter in the fluid. Particles can float between the test probes and cause a localised weakness when carrying out the breakdown test. This can usually be identified by erratic results when comparing a series of breakdowns. If particles are suspected to be causing a breakdown issue then the fluid can be filtered through a fine paper filter and re-tested.

Another issue that can arise is if not enough settling time is allowed between each breakdown test. In this case, gas bubbles formed by the breakdown arc are not given sufficient time to dissipate and can cause a weak link between the probes. Typically an average of six breakdown tests are taken and it is recommended to leave a minimum settling time of fifteen minutes before the first breakdown test and then five minutes between each subsequent breakdown test to ensure that gas bubbles have sufficient time to disperse.

Kinematic Viscosity

If a natural ester fluid, such as MIDEL eN 1215, is exposed to air at elevated temperatures, for example when there is a leak in the transformer seal, then there will be a gradual increase in viscosity as the fluid reacts with oxygen. To monitor the sealing of a transformer system it is therefore possible to test the fluid viscosity periodically. When measured at 40°C an increase of more than 10% from the original starting value of 32mm^2/s should be a trigger for further investigation.

Fire Point Testing

Fire point testing can be conducted to determine if the MIDEL fluid has been contaminated with another fluid with a lower fire point, such as mineral oil. However, fire point is less indicative of the condition of the fluid than other tests, such as the neutralisation value. If there is no possibility of cross contamination then fire point testing may not be required on a routine basis.

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DGA and Furan Analysis

Diagnosis of transformer performance by traditional DGA and Furan analysis is still applicable to MIDEL eN 1215 filled transformers. The methods to diagnose faults with DGA in mineral oil can still be used, but adjustments need to be made to Duval triangle boundaries and table ratios. Guidance on DGA for ester fluids is contained in IEEE C57.155 'IEEE Guide for Interpretation of Gases Generated in Natural Ester and Synthetic Ester-Immersed Transformers'. For further information regarding ester DGA and maintenance users can also contact the MIDEL technical department on: mideltech@mimaterials.com.

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