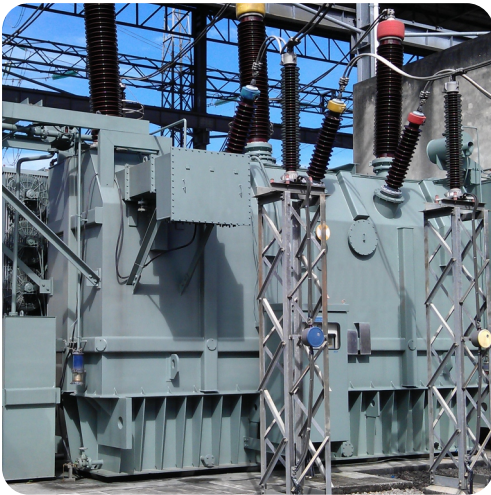


Solutions for Testing of Transformer Oil for Power Grid

made by **ECH**



ECH Elektrochemie Halle supports customers involved in the testing of transformer oil analysis within the power grid industries with instruments designed for the testing of critical transformer oil parameters such as water content in oil and insulating paper and total acid number.

All instruments supplied by ECH fully conform to the latest test standards from bodies such as ASTM, ISO and IEC.

Water Content of Transformer Oil

According to standard ASTM D 1533, ASTM D 6304, IEC 60814 by **Aquamax KF Plus**

Water Content of Transformer Oil

According to standard IEC 60814 by **Aquamax KF PRO Oil**

Water Content of Insulating Paper

Determination by using headspace technique by **AQUA 40.00 Vario**

Total Acid Number (TAN)

TAN according to ASTM D 664 by **Titramax VT TAN/TBN**

Water Content of Transformer Oil

According to ASTM D 1533, ASTM D 6304, IEC 60814

aquamax KF Plus

Description

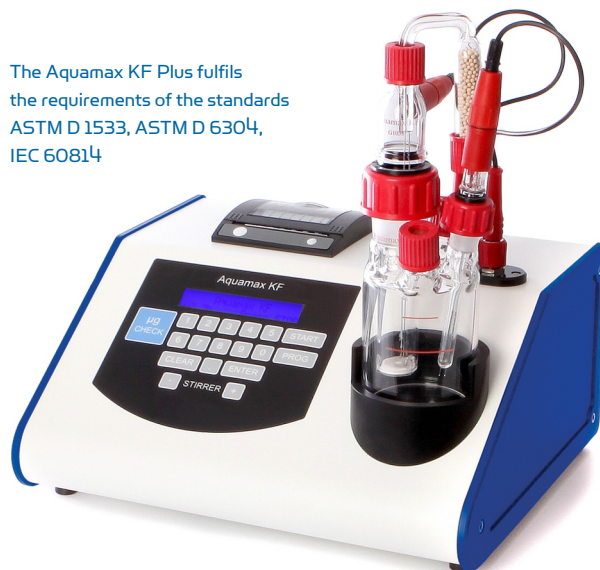
Water content in transformer oils is commonly performed using coulometric Karl Fischer titration, as this is the only available method which has the required sensitivity to measure sub 10 parts per million (ppm) water content.

Measuring water in transformer oils is critical parameter to ensure good operation, reliability and aging of the transformer. Excess water could cause failures within the transformer itself. As such, the testing of water in transformer oils is typically done both on-site and in the laboratory.

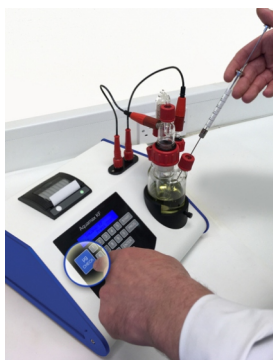
On-site testing is critical due to potentially hygroscopic nature of some transformer oils (meaning reaction with oxygen will cause moisture levels to increase). Therefore, using a coulometric Karl Fischer titrator which can be used as an on-site instrument is crucial.

The **Aquamax KF Plus/Portable** from ECH conforms exactly to ASTM D 1533, ASTM D 6304, IEC 60814 which are the industry standard test methods. Additionally, the systems have built in batteries, printer and keypad allowing for complete measurements to be taken directly at the transformer. The **Aquamax KF Plus/Portable** can also be used with a 12 V in-car charger so sample monitoring at transformer locations in one day can be achieved.

The Aquamax KF Plus fulfils the requirements of the standards ASTM D 1533, ASTM D 6304, IEC 60814



The Aquamax KF Portable with carrying handle and transport case for on-site use



Water check button and syringe

Water check

The μg check button allows the operator to simply press go, inject 1 μL or maybe 10 μL of distilled water (as required by some ASTM methods) and verify if the instrument and reagent are working with in their required specification. The μg check overrides the programmed calculation and displays/prints out a report of the verification check. The coulometer then automatically reverts to the pre-programmed setting.

Features

- Simple operation
- 10 user programmable methods
- 1 ppm/100 %
- Results in ppm, mg/kg, % water, μg water
- Multi language display & printout
- Small footprint
- Integral high speed printer
- Integral battery
- Fully portable
- Low drift cell design
- Results Manager software
- Automatically compensated errors (patented technique)

Water Content of Transformer Oil

According to IEC 60814

aquamax KF

PRO OIL

Description

An additional technique used when measuring water content in transformer oils to IEC 60814 is to use a coulometer with an oil evaporator such as in the

Aquamax KF PRO Oil.

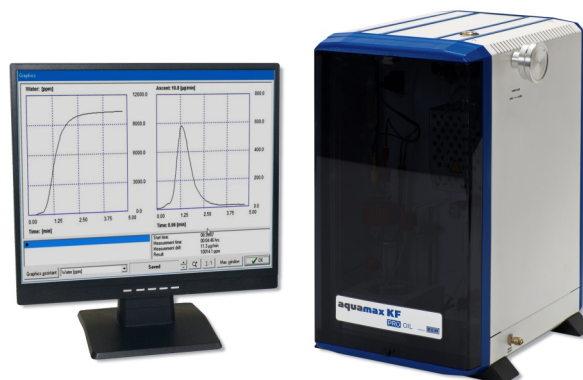
A known volume or mass of sample is to be injected via a gas tight syringe into the heating chamber and the sample should be heated to the point of water vaporization.

The water is transferred by a dry carrier gas (such as pre-dried ambient air with the ECH Closed Loop) directly into the titration cell where the coulometric reaction occurs.

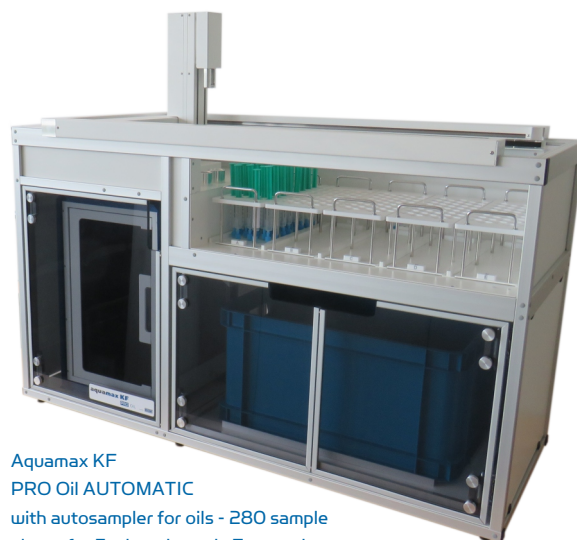
The sample itself remains in the evaporation chamber and is subsequently removed via automatic waste removal pumps. Sample heating must be monitored to avoid the risk of decomposition from the samples itself which could lead to unwanted compounds from the sample entering the titration cell and causing as a side reaction.

Using the correct temperatures and a closed loop carrier gas system yields benefits of analysing over 1000 samples in one charge of Karl Fischer solvent. Interferences of oil compounds are avoided by the indirect heating. There is no contamination of the coulometric titration cell.

The next generation of Aquamax KF systems, the **Aquamax KF PRO Oil** was specifically designed for titration according to IEC 60814 and allows transformer oil users to achieve a more efficient, cleaner titration.



The Aquamax KF PRO Oil fulfils the requirements of the standard IEC 60814: Insulating liquids - Oil-impregnated paper and pressboard - Determination of water by automatic coulometric Karl Fischer titration



Aquamax KF
PRO OIL AUTOMATIC
with autosampler for oils - 280 sample
places for 5 mL syringes in 7 magazines
(5 magazines in the unit and 2 for preparation)

Advantages of the Aquamax KF PRO Oil

- Closed loop principle avoids methanol evaporation from the KF solvent
- Reagent capacity is used completely
- Additive and Sulphur side reactions minimized
- By large sample amount low detection limit (LOD)
- By using of temperature programs it is possible to separate free and chemically bonded water
- Temperature ramping program allows you to distinguish between various types of bonded water
- No blank value meaning true ppm accuracy
- Aquamax KF PRO Oil can be used in the laboratory or used as part of a mobile lab when taking a measurement from the sample point is critical
- Compact and rugged device

Water Content of Insulating Paper

Determination by using headspace technique

aqua vario

40.00

Description

Moisture management in power transformers is a concern. Extensive drying procedures are applied at the manufacturing stage and sustained efforts are deployed in service to maintain high dryness. At high temperatures, the residual moisture in winding isolation can trigger the release of free gas bubbles, creating an immediate threat to the dielectric integrity of the insulation structure.

Each sample is weighed into a vial, the vial is sealed and placed in the oven module. Each vial is heated to the point the water vaporizes from the sample. The vaporized water is then transported from the sample into the titration cell using a non-reactive carrier gas such as pre-dried ambient air as used in the ECH Closed Loop carrier gas technique. ECH also offers an automated version PLUS for the coulometric Karl Fischer titrator AQUA 40.00 Vario - with an autosampler and a large variety of sample plates.

Using a closed loop system with pre dried ambient air such as the **Aqua 40.00 Vario** from ECH can provide end-users with over 1000+ samples in one charge of coulometric KF reagents. No methanol can escape from the reagent into the laboratory air.



AQUA 40.00 Vario PLUS - automatic version with sampler

Flexible for different vial sizes



For different vial sizes:
Sample plate and oven unit
easily exchangeable

Advantages

- Easy automation with autosampler
- Reduced reagent consumption
- No external gas required
- No evaporation of methanol from the reagent
- Additional gas drying is not required due to closed-loop circulation of extraction gas
- Stand-by titration for automatic conditioning and easy blank tests
- Short measuring times, even with complicated samples
- Suitable for more than 15 different vial sizes (2 R - 50 R, correspond to 0.1 to 40 mL sample volume)

Features

- Configurable temperature programmes
- Automatic identification of interchangeable oven and sample plate of the autosampler
- Prioritized express samples can set individually by user
- Software complies with requirements of FDA to 21 CFR Part 11 (Software with user-specific access, routine methods for individual and definable user levels, profound documentation and archiving of all measured data)



AQUA 40.00 Vario
as manual version

Total Acid Number (TAN) of Transformer Oil

According to ASTM D 664

titramax VT

TAN/TBN

Description

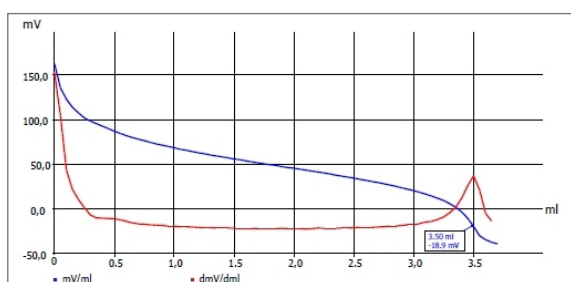
Total Acid Number (TAN)

The acid number of transformer oils is a common practice in the power grid sector. The acid number of transformer oils may rise due to exposure to high temperatures and potential for oxidation. High acidic concentration in the transformer oils is undesirable due to the corrosive nature which can cause several issues from breakdowns to blockages. Therefore, regular scheduled testing of the total acid number must be maintained.

ECH provide a solution by conform to the well renowned ASTM method D 664 (Standard Test Method for Acid Number of Petroleum Products by Potentiometric Titration). The **Titramax VT TAN/TBN** is available with an application guide specifically written for conformity to ASTM D 664 and is available both as manual system, or with 12, 16, 24 and 42 position autosamplers.



Titramax VT TAN/TBN



Titration graph of TAN determination of an oil sample

Advantages

- Complete measuring system for the determination of TAN/TBN
- Fully-automatic volumetric titration
- Precise adjustment of the titration parameters by control algorithms
- Preset measurement method allows an immediate start
- The result output can be adjusted to your needs by using a formula generator
- Universal titrator for a lot of other methods

Global Sales Division



ECH Scientific Limited

Building 69, Wrest Park, Silsoe

Bedfordshire, MK45 4HS

United Kingdom

Tel.: +44 (0) 1525 404747

Fax: +44 (0) 1525 404848

E-Mail: info@echscientific.com

Web: www.ech.de

Manufacturer



ELEKTROCHEMIE HALLE

ECH Elektrochemie Halle GmbH

Otto-Eißfeldt-Str. 8

D-06120 Halle (Saale)

Germany

Tel.: +49 (0) 345 279570-0

Fax: +49 (0) 345 279570-99

E-Mail: info@ech.de

Web: www.ech.de