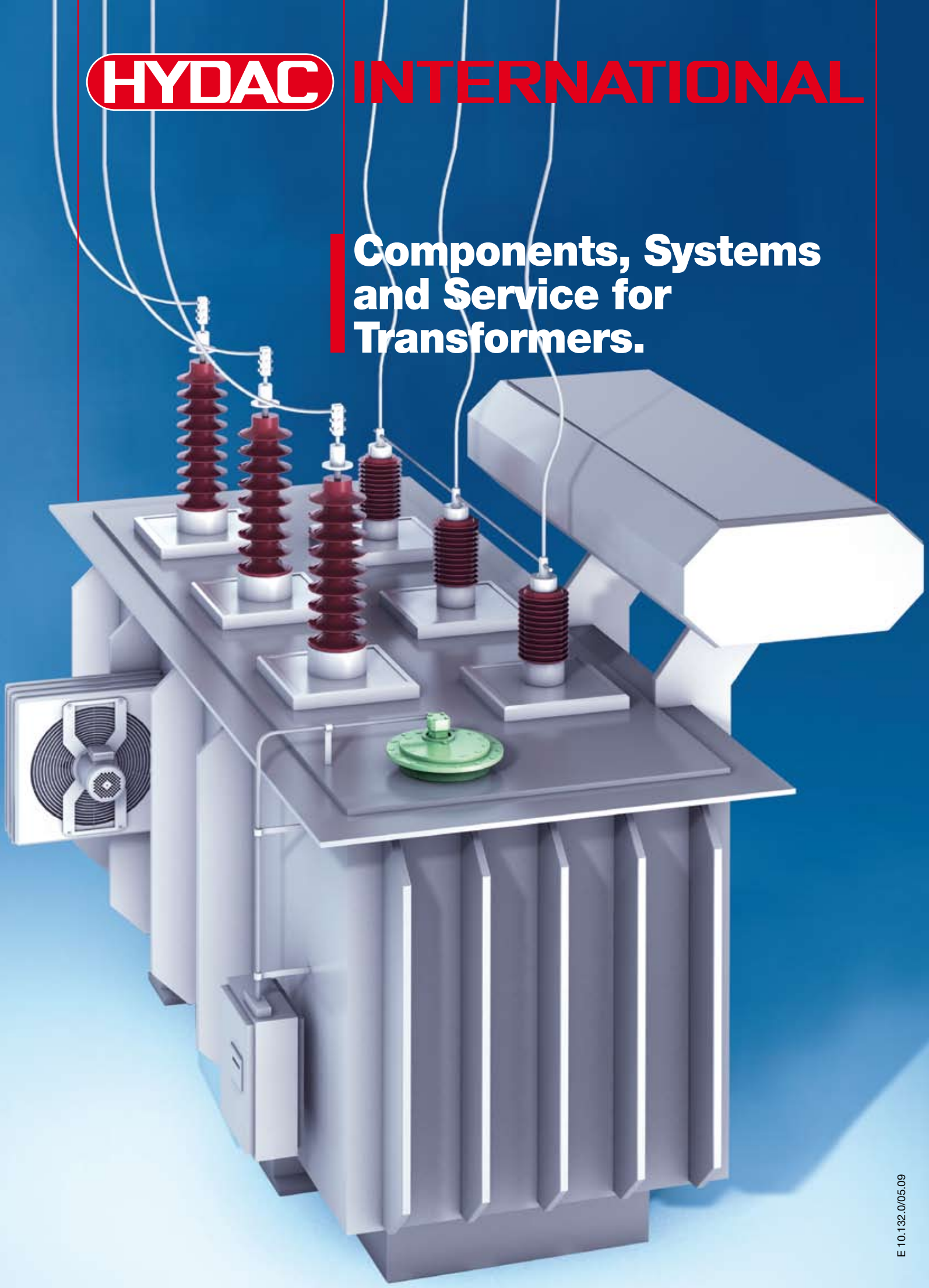
HYDAC INTERNATIONAL

Components, Systems and Service for Transformers.



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HYDAC Headquarters in Germany

HYDAC China

HYDAC USA

HYDAC France

HYDAC Italy

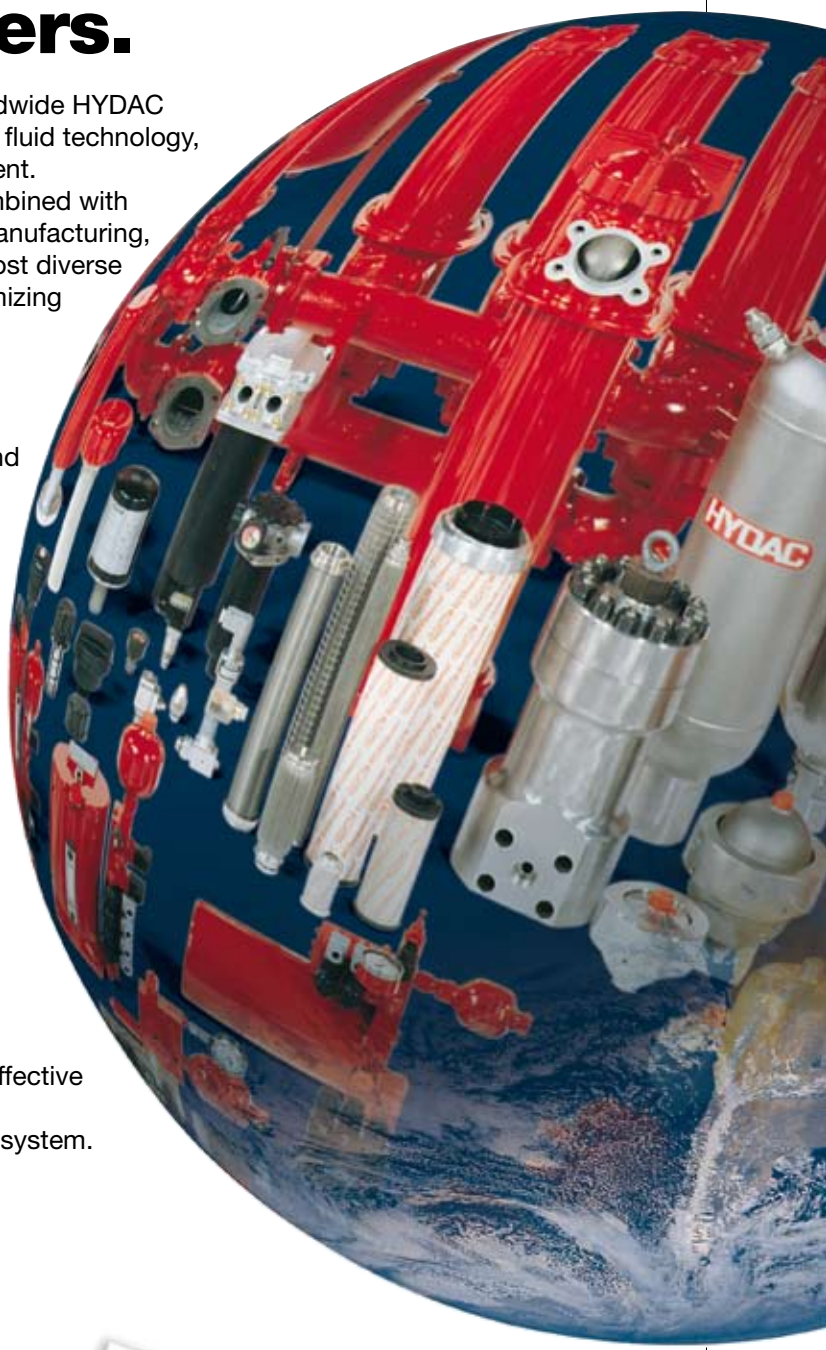
HYDAC Netherlands

HYDAC Great Britain

Your Professional Partner for the Optimization of Transformers.

With over 5,500 employees worldwide HYDAC is one of the leading suppliers of fluid technology, hydraulic and electronic equipment.
Our wide range of products, combined with our expertise in development, manufacturing, sales and service enables the most diverse challenges associated with optimizing and extending the service life of transformers to be overcome.

Our quality and environment certification to ISO 9001/2000 and ISO 14001 denote first class quality and responsible management of our resources.



Global and yet local.

With 40 overseas companies and over 500 distributors and service partners, HYDAC is your reliable partner worldwide.

System solutions. One supplier. One contact.

Wherever you need us, we are there to help you find the most effective solution – for every application, from components to a complete system.

Worldwide specifications and approvals.

HYDAC in the Building and Operation of Transformers.

The components and systems developed by HYDAC offer many advantages for the building and operation of transformers – the principal ones being:

- **Effective protection of the insulation**
- **Servicing of the transformer oil**
- **Monitoring of the oil condition**
- **Significant extension of the service life of transformers**

Sectors and Applications

Energy production
- Gas and coal-fired power stations
- Hydroelectric power stations
- Atomic power plants
- Wind turbines

Energy distribution

Industry
- Paper industry
- Steel industry
- Automotive industry
- Chemical industry

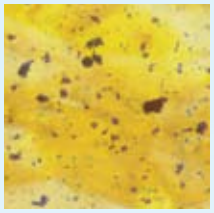
Applications
- Servicing the insulating oil
- Monitoring the insulating oil
- On-load tap changer filtration
- Cooling

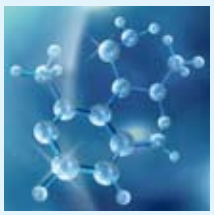
Size of the transformers
0.5 – 100 m^3 oil volume

Capacity of the transformers
From 0.2 - 1,500 MVA

Transformer applications
- Power transformers
- Compensating throttle pumps
- HVDC transformers
- Phase shifter transformers
- Polytransformers

Single-phase transformers


Particles


Gas


Water


Temperature


Breakdown voltage

Influences which reduce the Service Life of the Transformer

- Electrical and electro-magnetic overstressing of the insulation (cellulose) and insulating oil
- Ageing and oxidation of insulation (cellulose)
- Ageing and hydrolysis of insulating oil
- Thermal effects due to load fluctuations
- Wear in the on-load tap changer

Consequences

- Gas formation due to degradation or electrical overstressing of the insulation (cellulose) and of the insulating oil
- Occurrence of water due to degradation of insulation (cellulose)
- Overheating of insulation (cellulose) and insulating oil
- Formation of acids due to ageing of the oil and cellulose
- Particles in the on-load tap changer due to wear
- Reduction in the breakdown voltage caused by water, particles, gases and acids

„The insulation causes most transformer breakdowns“ [1]

„The average age of transformers which failed due to insulation damage was 17.8 years – far below the expected lifetime of 35 to 40 years“ [2]

[1] Study of the IEEE of 33787 transformers, extract from concluding study and report „Transformer Diagnosis: Part 1“

[2] An analysis of Transformer Failures, William H. Bartley 1997, Hartford Steam Boiler Inspection and Insurance Co.

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Condition Monitoring, Measuring Technology and Electronics

- Conditions in the insulation oil can be monitored using sensors
- Changes in an output condition, such as water content, oil cleanliness, temperature or pressure can be visualized and used as a basis for maintenance planning
- Critical conditions in the transformer can be detected in good time and prevented

Water and Solid Particles in Oil

FluidMonitoring Module FMM
(Combination of AquaSensor AS 1000 and ContaminationSensor CS 1000).

Oil Ageing

HYDACLab®
Ageing sensor, % humidity / viscosity / dielectric constant, temperature.

Fluid Level

Electronic Level Sensor ENS 3000.

Pressure

Pressure Switch EDS 1700
For wall-mounting.

Temperature

Temperature Switch ETS 300.

Cooling

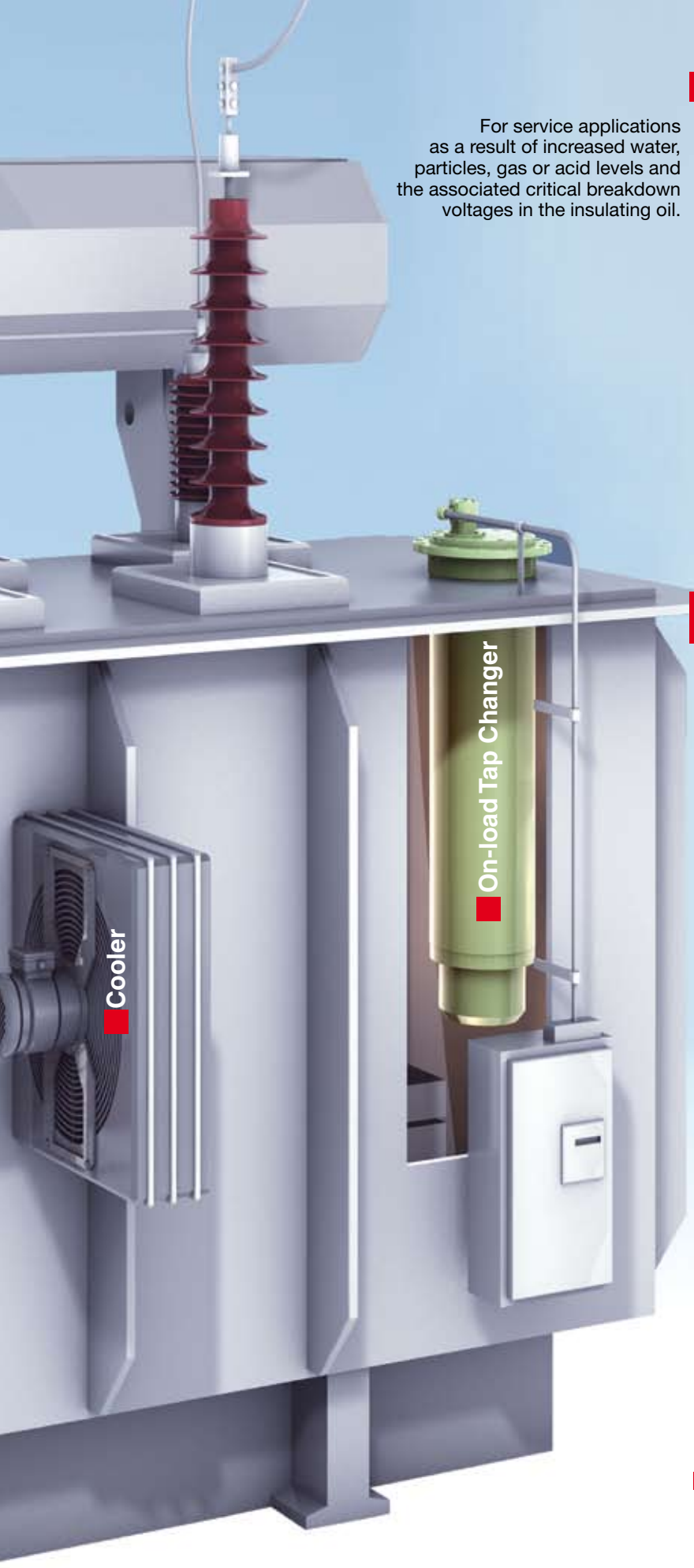
To ensure reliable and efficient removal of the heat on oil-cooled transformers.

Oil/Air Cooler.

Plate Heat Exchanger,
Gasketed.

Accessories

Mounting Technology and Ball Valves.



For service applications as a result of increased water, particles, gas or acid levels and the associated critical breakdown voltages in the insulating oil.

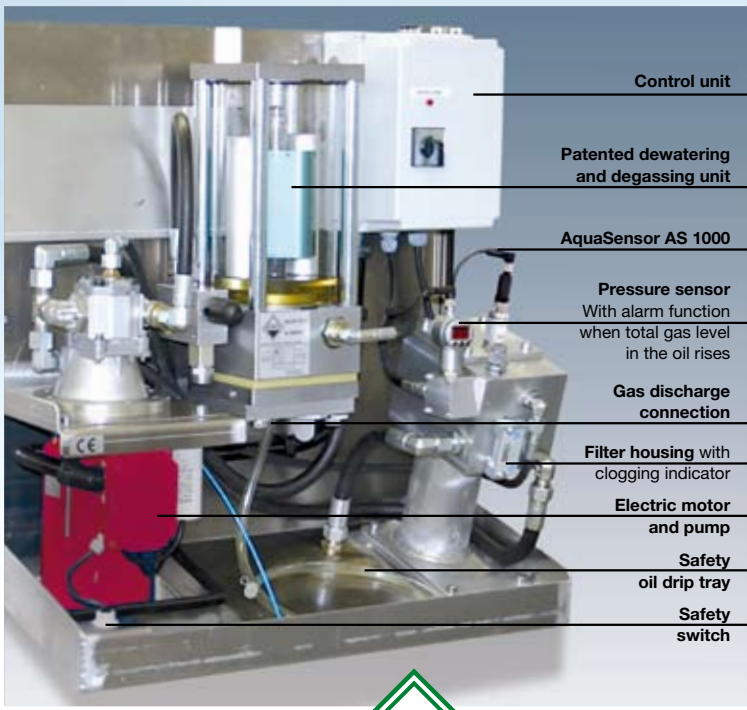
Short-term Fluid Service

Service unit for dewatering, degassing and filtration.

Unit for filtration and for removing acids from the oil.

Continuous Fluid Service REDFOX* TransformerCare Unit TCU

Continuous and lifelong degassing, dewatering and filtration of the insulation oil ensures that the oxygen level, water level and particulate contamination in the transformer are kept uniformly low, which means the breakdown voltage of the insulation oil increases, the formation of acids is minimized and as a consequence the life expectancy of the insulation (cellulose) and of the insulation oil increases.

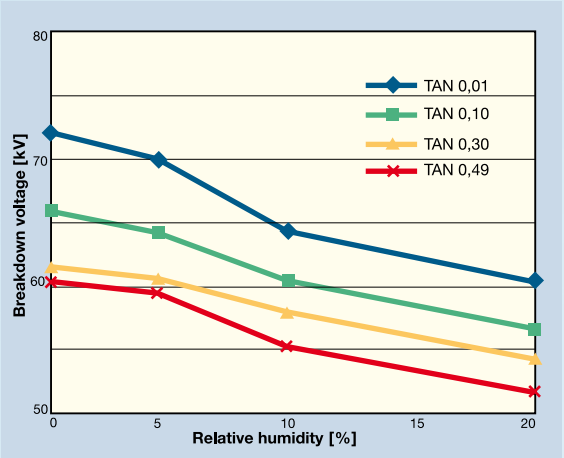


REDFOX* TransformerCare Unit TCU.

*REDFOX a division of HYDAC. REDFOX has for many years stood for **RED**ucer of Fluid **Ox**idation.

Advantages of using the TCU

- Preserves the breakdown voltage of the insulation oil
- Reduces of the oxidation and ageing of the cellulose
- Measures the gas formation rate
- Reduces the formation of gas bubbles in the transformer due to low gas levels
- Expensive short-term regeneration measures can be avoided through lifelong servicing
- Extends the remaining life of the transformer



The breakdown voltage (kV / 2.5 mm) as a function of saturation level (relative humidity) and the acid number (TAN).

Increasing the breakdown voltage and reducing wear.

High contamination retention capacity and water absorption of the filter elements used.

Source:
The Breakdown Voltage of Insulation Oil Under the Influences of Humidity, Acidity, Particles and Pressure.
M. Koch, M. Fischer, S. Tenbohlen, University of Stuttgart

On-load Tap Changer Filtration

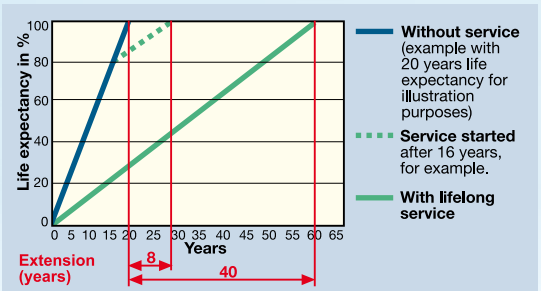
On-load tap changer filtration and dewatering in one unit.

Service life extension

The REDFOX TransformerCare Unit TCU is the service unit for extending the service life of oil-filled transformers and reactors. The remaining life of the cellulose and therefore of the transformer can typically be increased by a factor of 3*.

* Lampe, Spicar: „Oxygen-free Transformer, reduced Ageing by continuous Degassing“, Cigre, paper 12-05, Paris, 1976 **(ASEA).**

Kachler, Höhlein: „Aging of Cellulose at Transformer Service Temperatures. Part 1: ...“, Vol. 21, No. 2, IEEE Electrical Insulation Magazine, 2005 **(Siemens).**



Extension of the remaining life expectancy of the insulation (cellulose) through continuous service. „The earlier the better“.

Determining the gas formation rate

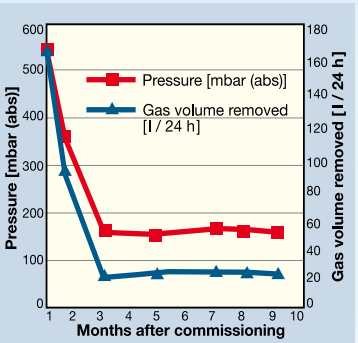
The volume of the gases removed using the TCU per time unit corresponds to the gas formation rate in the transformer. An interpretation, for example to DIN EN 60599*, is also possible, along the lines of the DGA (Dissolved Gas Analysis).

* DIN EN 60599 – Mineral-oil impregnated electrical equipment in service – Guide to the interpretation of dissolved and free gases analysis.

Simple gas discharge to determine the gas formation rate.

Monitoring

In addition the TCU is used to monitor the humidity and the total gas level in the insulation oil. This means that an alarm can be triggered if there are significant changes.



Typical pressure trend
in the dewatering and degassing unit of the TCU and of the gas volume removed per time unit. The total gas level in the oil is proportional to the measured pressure. After 3 months, steady conditions are reached. From this time, the gas formation rate can be determined.

Before Installation	
Pressure	550 mbar (abs)
Removed gas volume	170 l / 24 h
Total gas volume in the oil	10.6 %
Breakdown voltage	42 kV / 2.5 mm

After 3 Months	
Pressure	120 mbar (abs)
Removed gas volume	50 l / 24 h
Total gas volume in the oil	2.1 %
Breakdown voltage	79 kV / 2.5 mm

Applications of the TCU

Fluid Engineering and Service. Worldwide.

Analysis and Diagnostics.

70- 80 % of all breakdowns in hydraulic and lubrication systems are due to contamination of the fluids and components used. In practice, this is often not sufficiently recognized.

HYDAC offers a comprehensive range of easy-to-use measurement and analysis equipment to monitor fluid and component cleanliness.

Fluid laboratory vehicles are at your service worldwide.

Commissioning, Optimisation, Engineering.

As a systems and fluid service specialist, HYDAC provides a comprehensive fluid engineering concept: from cleaning, to complete maintenance packages, to system optimisation, HYDAC is your principal partner.

Our concern is to improve the operational availability of machines and hydraulic systems.
Fluid engineering is the total package of technical and commercial services for the benefit of the customer.

HYDAC SERVICENTER

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HYDAC Austria

HYDAC India

HYDAC Korea

Brochure: Accumulators DEF 3.000

Broch.: Filtration Range DEF 7.000

Br.: Filters for Industr. Processing DEF 7.700

Br.: Systematic Fluid Service DEF 7.929

Broch.: Compact Hydraulics DEF 5.300

Brochure: Accessories DEF 6.100

Brochure: Electronics DEF 18.000

Broch.: Cooling Systems DEF 5.700

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