Moving Forward

Leading the way for sustainable solutions

VPS POWER

Transformer Oil Testing (TOT)

For forty years, VPS has been at the forefront of providing independent laboratory testing and advisory services supporting its clients to achieve sustainable operations, asset protection, preventative maintenance, and environmental and legislative compliance. VPS recognises the importance of asset reliability as customers transition to electrification and strive towards achieving net zero.

Our TOT provides a bespoke service to prevent transformer failure ensuring consistent electricity supply for network providers and customers, as well as protecting our environment and the safety of people. Our world-leading service supports the electrical industry in many sectors such as power generation/renewables, transmission & distribution, industrial, OEM's, HV Operations & Maintenance and fluid purification.

EXPERIENCE ▶ INNOVATION ▶ SUSTAINABILITY

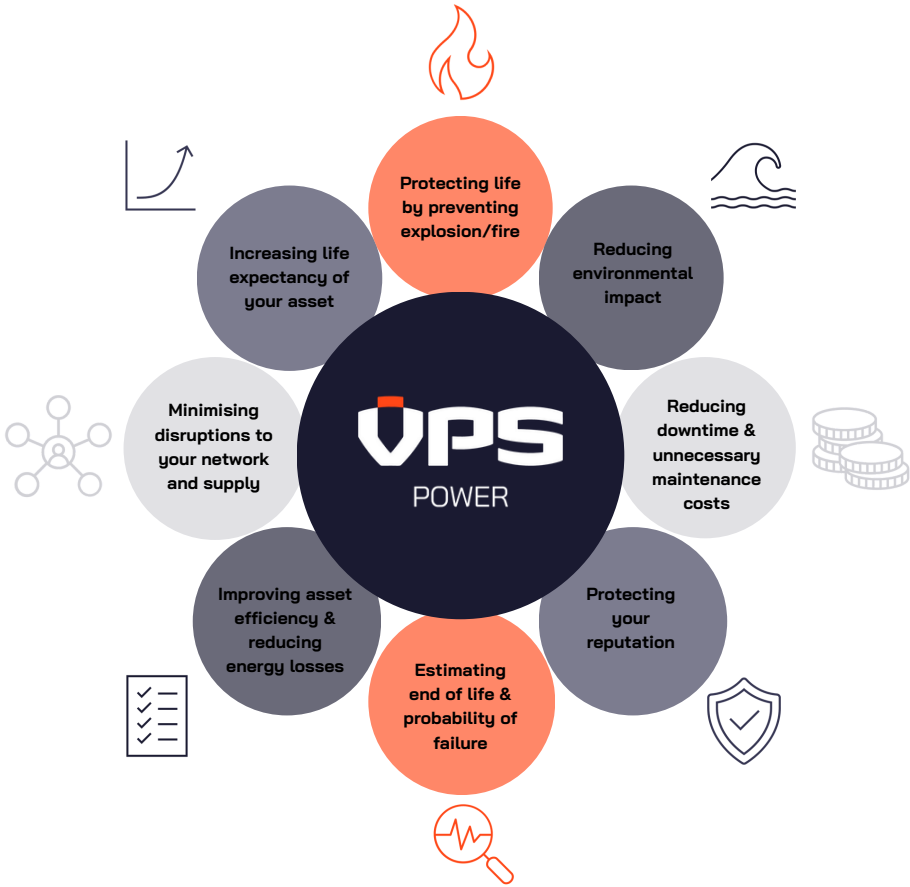
TOT works by testing the transformer insulating oil to provide information on the condition of the transformer, providing an early warning system for preventative action. It is a proven loss prevention technique that can form a key part of any condition-based predictive maintenance program.

Analysis of transformer insulating fluids provides an early indication of fault detection which can help reduce unplanned power outages and improve plant reliability.

Our TOT is performed to internationally recognised test methods and standards using the most up-to-date and innovative analytical equipment.

Our technical team provides technical support to customers and advises on the most suitable testing requirements for your electrical assets including Transformers, Shunt Reactors, Tap Changers & Switchgear. Test suites cover fluid, gas, insulating paper, environmental and investigative assessments.

Given the nature of the industries we serve, we provide a 24-hour emergency support hotline for urgent customer testing requirements:
+44 (0) 758 406 9059



TOT Service Overview

Sample Kits

- For requests of Bespoke Sample Kits please contact reception.power.uk@vpsveritas.com or 0161 776 4536
- For emergency samples please contact 0758 406 9059

Customer

- Representative transformer oil sample is collected and labelled by the customer and sent to VPS Power via a courier service.
- PO to be sent with samples or in advance via email to reception.power.uk@vpsveritas.com to expedite testing.

Sample Tracking

- Samples are registered.
- Acknowledgement receipt sent to customer containing information of the sample and testing requirements

Lab

- The laboratory tests transformer oils, using internationally recognised standards according to customer requirements.

Advice

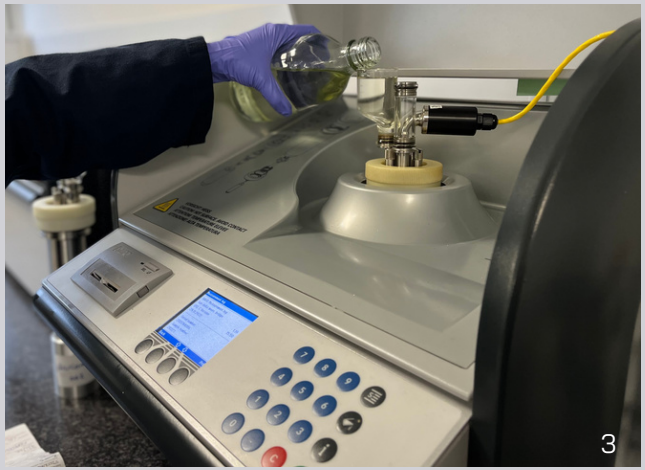
- The test results are trended and evaluated by experts, then reported to customers in a PDF file or other formats if requested.

Customer Portal

- The reports are uploaded to the VPS Customer Portal for easy online access.

Data Analytics

- Trending and asset management BI tool



VPS holds the following certifications:

Our certifications provide customers with the satisfaction and reassurance the service is delivered to the highest standard with quality, integrity, safety and the environment being core values of our business.

We are certified to:

- **ISO 45001:2018** **Occupational Health and Safety**
- **ISO 14001:2015** **Environmental Management**
- **ISO 9001:2015** **Quality Management**
- **ISO 17025:2017** **Laboratory Quality Management**

VPS are registered members of Achilles UVDB, BSI and the BSI GEL10 technical panel.

VPS participates in Proficiency Test Schemes and has established an internal data monitoring process, using quality control samples and certified reference materials, to ensure the constant validity of our test results.

Our TOT is performed to internationally recognised standards	Method	Fluid assessment (Routine)	Routine and Dissolved Gas Analysis (DGA)	Routine, DGA and Paper Assessment	Routine, DGA, Paper and Environmental Assessment	Routine, DGA, Paper, Environment and Contamination Assessment	Investigative (Any mix of tests dependant on issue)
Acidity	IEC 62021	▶	▶	▶	▶	▶	(▶)
Breakdown Voltage	IEC 60156	▶	▶	▶	▶	▶	(▶)
Appearance (visible sediment and fibres) & Colour	IEC 60422 & ASTM D 1500	▶	▶	▶	▶	▶	(▶)
Sediment	IEC 60422 Annex C						(▶)
Water content	IEC 60814	▶	▶	▶	▶	▶	(▶)
Hydrogen, Methane, Ethane, Ethylene, Acetylene, Carbon Monoxide, Carbon Dioxide, Oxygen, Nitrogen, Total Dissolved Combustible Gas	IEC 60567		▶	▶	▶	▶	(▶)
Polychlorinated Biphenyls (PCBs)	IEC 61619				▶	▶	(▶)
Furans Analysis (FFA) & Degree of Polymerisation (DP) Calculation	IEC 61198			▶	▶	▶	(▶)
Interfacial Tension (IFT)	ISO 62961/ASTM D971					▶	(▶)
Resistivity	IEC 60247					▶	(▶)
Dielectric Dissipation Factor (DDF)	IEC 60247					▶	(▶)
Permittivity at 90°C	IEC 60247					▶	(▶)
Wear Metal Analysis	ASTM D5185						(▶)
Corrosive Sulphur	IEC 62535/ ASTM D1275B/ DIN 51353						(▶)
Passivator Content	IEC 60666 Annex B						(▶)
Oxidation Inhibitor (DBPC Analysis)	IEC 60666						(▶)
Oxidation Stability	IEC 61125						(▶)
Particle Count	IEC 60970						(▶)
Dibenzyl Disulphide (DBDS)	IEC 62697						(▶)

** Further test parameters available on request*
*** Latest valid version of the international standards listed above will be used unless specified*

Fluid Quality Analysis

In our TOT, each parameter is analysed to provide diagnostic information on the transformer insulating fluid as detailed below:

Colour and Appearance

Changes in colour and the physical appearance of the insulating fluid can highlight changes within the asset. The change in appearance, presence of physical particles or free water or the turbidity of the fluid can all be identified with a visual assessment.

Acidity

Oxidation of the insulating fluid will occur during its service and form acidic products. Often noticed with a darkening of the fluid colour and if left unchecked can cause internal corrosion, degradation of paper and ultimately the formation of sludge.

Water Content

Elevated levels of water can damage the mechanical strength of the paper insulation and deteriorate the insulating fluid. Ingress can be from external sources (poor maintenance activities) or internal degradation of the paper or fluid. Once lost, the paper does not recover its mechanical properties. It is worth noting that doubling the water content can half the working life of a transformer.

Dielectric Strength

In-service insulating fluids must withstand electrical stress without failure. Contaminants such as water, particles, polar compounds, fibres can reduce the dielectric strength of the fluid.

Interfacial Tension (IFT)

Determines the presence of soluble polar material and products of fluid degradation. Changes to IFT values suggests fluid degradation, or perhaps incompatibility with transformer materials (varnishes) or other materials (gaskets etc).

Dielectric Dissipation Factor (DDF)

Measure the current leakage in the insulating fluid. Directly affected by the level of polar contaminants in the fluid. During service the DDF value tends to increase.

Resistivity

Measure of the fluids ability to resist the flow of direct current. Directly affected by the level of polar contaminants in the fluid. During service the resistivity value tends to reduce.

Furanic Compounds

Organic compounds formed during degradation of the paper insulation. Tool to determine the remaining useful life of the paper insulation via a relationship with the degree of polymerisation value of the cellulose.

Estimated Degree of Polymerisation (DP)

The estimated DP value indicates the average paper condition across the whole of the transformer. Provides an indication on the remaining useful life of the paper insulation and consequently the transformer.

Polychlorinated biphenyls (PCB)

Organic chlorinated compounds, previously used as transformer insulating fluids but subsequently banned due to health and environmental concerns. Now classified as Persistent Organic Pollutants and controlled as part of the Stockholm Convention. All transformers should be tested to determine the PCB content.

Transformer Health Analysis

Dissolved Gas Analysis (DGA)

Under electrical or thermal stress insulating fluids breakdown generating gases. The types and amount of gases generated indicate the type and severity of fault, allowing for specific faults (thermal, arcing, partial discharges) to be detected and therefore early maintenance actions to be scheduled. VPS uses several internationally recognised diagnostic tools (Roger ratios, Duval triangles and pentagons) for our expert interpretation.

Additional Analysis

Particle Counting

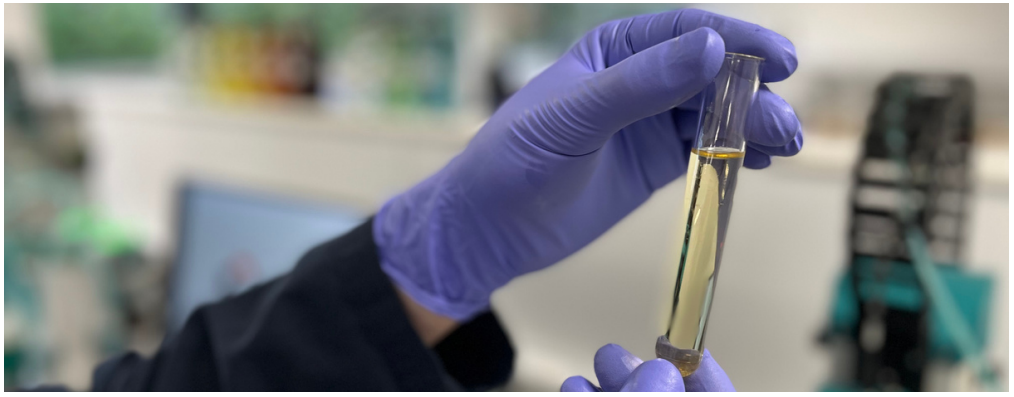
Insulating fluid cleanliness is affected by paper degradation and external contamination. Particle counting measures particles present in the fluid often unseen by the human eye, reducing dielectric strength and catalysing further oil degradation.

Metals Analysis

Pumps, fans and other components can undergo wear and can contaminate the insulating fluid with wear metals. These can catalyse further fluid degradation and reduce the dielectric strength.

Corrosive Sulphur

Metallic sulphides can be formed at high temperatures on hot surfaces which leads to a reduction of the electrical insulation properties.



Test Methods & Reporting

Our TOT reports contain trended analysis results with diagnostic commentary from our technical advisers.

Green	Amber	Red
Pass	**Caution**	**Action**
Continue operation and sampling as normal.	**An intervention may have to be carried out or more regular sampling performed.**	**Immediate action or re-testing required.**

The reports can be emailed, uploaded to your database or reviewed directly on the VPS customer portal. Our service combines the expertise of diagnostic professionals with the latest analytical and diagnostic techniques to examine the sample.

By interpreting the test data, VPS delivers a trended report, visibly tracking data over time with expert commentary and advice.

TOT Sampling Equipment

Effective sampling is paramount to the delivery of a quality analytical and diagnostic service. We recommend that International standard IEC60475 (Method of sampling insulating liquids) is followed as closely as possible. This will produce a representative sample allowing our experts to provide world leading guidance, supporting your business and keeping your assets in optimum health. Our kits contain all the necessary items to take, label and safely return samples to our dedicated laboratories. Whilst we can supply a standard kit, we can also provide custom kits based on your requirements. Contact us for details.

Starter/Emergency Buchholz Sampling Kit

Contains all the necessary items to allow samples to be taken from a transformer. Contents include various sized nitrile bungs, valve, tubing, digital thermometer, 50ml gas tight syringe with 3-way valve and postal tube, 500ml Bottle with postal tube, labels, disposable gloves, spill matt, together with how to guides all packaged in a case for repeat usage.

Transformer Sample Kit

Contains all the necessary items to provide representative samples from your transformers. Various kit options are available which are supplied in hard outer cases for safe carriage with sampling guidance.

Glass Bottle

Contents include 500mL clear or brown glass bottles, black plastic bags for UV protection, sample labels and protective packaging.

Aluminium Bottle

Contents include 500mL aluminium bottles, sample labels and protective packaging.

Syringe Kits

Contents include 50mL clear glass syringe, black plastic bags for UV protection, sample labels and protective packaging.

Contact

Sample equipment, dispatch, collection and registration enquiries:

reception.power.uk@vpsveritas.com
+44 (0) 161 776 4536

For analysis of emergency samples out of hours please call:

+44 (0) 758 406 9059

Sales, technical and all other enquiries:

power@vpsveritas.com
+44 (0) 161 776 4534

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