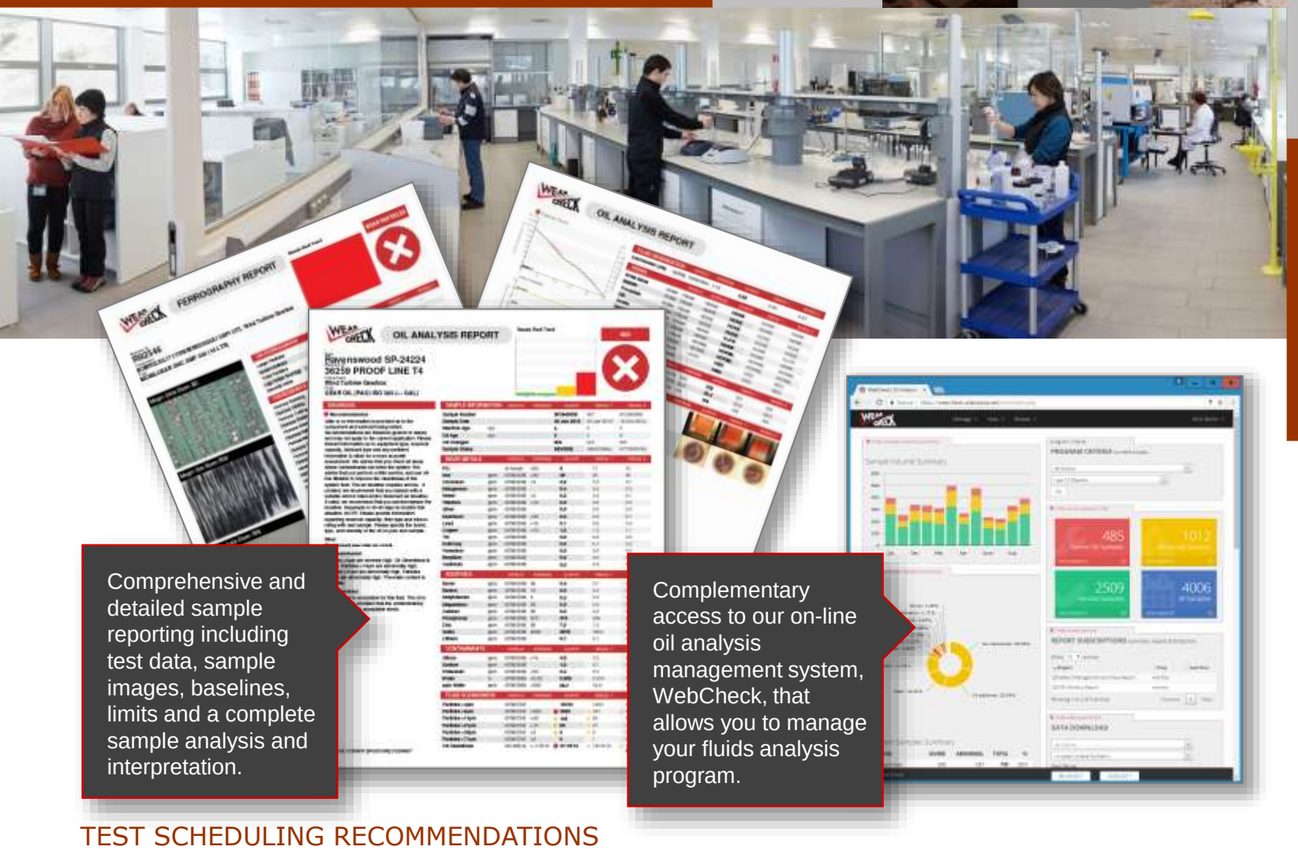
# Wind Turbine Fluid/Grease Analysis

Predictive Analysis for Wind Turbines




Comprehensive and detailed sample reporting including test data, sample images, baselines, limits and a complete sample analysis and interpretation.

Complementary access to our on-line oil analysis management system, WebCheck, that allows you to manage your fluids analysis program.

## TEST SCHEDULING RECOMMENDATIONS

**Wind turbine components should be sampled every 3 months.** The gearbox/bearing systems are critical and require level 3 testing once per year, which includes wear particle analysis (ferrography) to monitor for the early signs of catastrophic failure. Ongoing level 2 testing for gearboxes, bearings and hydraulics will provide you with early warning of harmful contaminants and a measure of the remaining useful life of the lubricant allowing you to maximize oil drain periods and minimize complete fluid change-outs. Quarterly COOL and TRF testing packages allow you to monitor the ongoing condition of your cooling system and electrical transformers to ensure that these systems continue to operate trouble free. WearCheck provides complete fluid and grease analysis for a complete predictive maintenance program for your wind turbine farm.

| Gearbox | Q1 | Q2 | Q3 | Q4 |
|---|---|---|---|---|
| Gearbox | IND 2 | IND 2 | IND 2 | IND 3 |
| Hydraulics | IND 2 | IND 2 | IND 2 | IND 2 |
| Pitch / Yaw Bearing | GRS 1 | GRS 2 | GRS 1 | GRS 3 |
| Cooling System | COOL | COOL | COOL | COOL |
| Transformer Fluid | TRF 2 | TRF 2 | TRF 2 | TRF 3 |

THE LEADER IN OIL ANALYSIS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# Wind Turbine Fluid/Grease Analysis

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# Wind Turbines

A COMPREHENSIVE FLUID AND GREASE ANALYSIS PROGRAM FOR WIND TURBINES INCLUDING PROGRAMS FOR THE GEARBOX, HYDRAULICS, PITCH AND YAW BEARINGS, TRANSFORMER AND COOLING SYSTEM.

## OVERVIEW

- Reduced operating and maintenance costs.
- Fault prevention and increase in reliability.
- Extension of the wind turbine's useful life.
- Reduce wind turbine downtime.
- Comprehensive testing and reporting makes the decision between oil extension and oil replacement easy.
- Provides a level of confidence on the operating condition of your critical wind systems.


## BENEFITS

**North America's reliance on sustainable energy from wind turbines increases every year**. Wind turbines have some of the most demanding lubrication requirements and even routine maintenance tasks on these behemoths are time consuming, difficult and costly. The wind turbine is comprised of several subsystems working together in harmony to deliver power from wind. A wind turbine is susceptible to shutdown if any of these subsystems fails.

**Undetected, contamination of the fluids will lead to premature failure** of the gears, bearings and hydraulics. Unmonitored, poor fluid condition will lead to cooling system or transformer failure. Repair costs for wind turbines are exorbitant. Crane rental and gearbox removal, for example, costs $40,000 or more, not including gearbox repair costs and lost energy revenues.

**In order to achieve peace of mind on the operating condition of your wind turbine fluids** and greases you need the comprehensive testing that WearCheck's Wind Turbine Fluid and Grease Analysis program provides. Specifically designed for wind turbines, WearCheck's program combines well established industry tests with more recent advances in industry testing to provide an unparalleled view of the operating condition of your critical subsystem fluids.

**WearCheck's Wind Turbine Fluid and Grease Analysis** program determines the condition of subsystem fluids, detects for unwanted contaminants and will accurately determine the suitability of the fluid for continued use. A comprehensive diagnosis will warn you of any potential for system damage and includes recommendations for any necessary maintenance actions to restore the fluids to proper operating conditions. WearCheck's Wind Turbine Fluid and Grease Analysis program is intended for use with horizontal and vertical axis wind turbine gearboxes, bearings, and integrated hydraulic and cooling systems.

THE LEADER IN OIL ANALYSIS

# Oil Analysis

## Gearbox / Hydraulics (IND 1/2/3)

**Oil analysis detects subtle changes in the levels of wear metals present in the system oil**. Failures due to worn out components can be avoided long before those components are worn out of specification. Additionally, oil analysis can detect the ingression of contaminants from the manufacturing environment, including process contaminants, dirt, and water in order to alert you in time to perform filtration service, to save the oil and avoid unnecessary wear. The wind turbine gearbox is especially susceptible to particulate and moisture contamination and the lubricants utilized in this application must be able to withstand high contact point loads under drastic temperature fluctuations. The oil must be able to endure long drain periods in order to provide a reasonable maintenance cycle, as a complete oil change requires significant effort on part of the maintenance personnel.

# Grease Analysis

## Pitch / Yaw Bearing (GRS 1/2/3)

**Grease analysis provides an assessment of the grease condition** to reveal whether the grease is ready to be changed, or if it is fit for further service. Grease analysis allows you to maximize your grease servicing intervals with the confidence. Additionally grease analysis can detect the ingression of contaminants from the environment, including process contaminants, dirt, and water and alert you in time to perform a grease service, and avoid unnecessary bearing wear. When the grease condition is routinely monitored, bearing wear will be minimized. Grease analysis detects subtle changes in the levels of wear metals present in the grease, so that failures due to worn out components can be avoided long before a failure occurs.

# Insulating Fluid Analysis

## Electrical Transformer (TRF 1/2/3)

**Transformers can be affected** by a wide range of internal and external conditions which, over time, may lead to rapid fluid ageing which can affect the internal insulation and windings and as a result lead to a reduction in the equipment reliability. Costly downtime can be averted by implementing cost effective transformer fluid analysis program. Fluid analysis provides a diagnostic state of the transformer and insulation system through a series of tests of the dielectric oil. Once the appropriate testing has been carried out, a report of the results, including an analysis of the fluid and system condition is provided.

# Coolant Analysis

## Oil Cooling System (COOL 1)

Coolant analysis provides an assessment of the condition of the cooling fluid and is used to determine optimum service intervals. Routine analysis of coolants can prevent radiator plugging, corrosion and thermostat fouling and alert the operator to issues with coolant technology mixing, low alkalinity and/or nitrite protection, high pH, and low or over high glycol concentrations.

# TEST PROGRAM & ANALYTICAL METHODS

| | | Gearbox Hydraulic | Pitch/Yaw Bearing | Cooling System | Insulating Fluid |
|---|---|---|---|---|---|
| **ICP Analysis** ASTM D5185 | Determines the parts per million (ppm) of all wear metals (iron, chromium, nickel, lead, copper…), contaminants (silicon….), and additives (calcium, phosphorus, zinc, magnesium, molybdenum…) in the oil. Approximately 30 elements are analyzed. | 1 | 1 | 1 | 1 |
| **Color/Appearance** WC Method/ASTM D1500 | The appearance is a very important parameter when evaluating the condition of a fluid or grease. It includes the subjective assessment of its color, any visible debris and odor (and additionally texture for grease). | 1 | 1 | 1 | 1 |
| **Wear Index (PQ)** ASTM D8184 | PQ Analysis to provide a rapid indication of metallic debris in a lubricant sample. Detect ferrous wear debris that may be missed by spectrometric (ICP) analysis. | 1 | 1 | | |
| **Viscosity @ 40/100°C** ASTM D7279 | Measures the kinematic viscosity of the oil at 40°C to determine if oil is still within specification. High viscosity can indicate oxidation, low viscosity can indicate contamination, improper make-up oil. | 1 | | | |
| **Viscosity Index (VI)** ASTM D2270 | Calculated from the viscosity measurements at 40°C and 100°C, the viscosity index is an indication of an oil's change in viscosity with changing temperature. | 1 | | | |
| **Consistency** SKF Method | Changes in grease consistency may indicate mixture of incompatible thickeners, elevated levels of contamination or wear, or a high consumption of antioxidants. | | 1 | | |
| **Nitrites** WC Method | Measures the amount of remaining supplemental coolant additives (SCAs) present in the coolant. SCAs provide corrosion protection to the cooling system. | | | 1 | |
| **Freezing Point** ASTM D3321 | Measures the gelation point of the coolant. From the freezing point the relative percentage of glycol to water can be determined. | | | 1 | |
| **Reserve Alkalinity** ASTM D1121 | A determination of the remaining alkalinity reserve in the coolant. The reserve alkalinity is an indication of the fluids ability to maintain an optimal pH level. | | | 1 | |
| **Dielectric BDV** ASTM D1816 | The dielectric breakdown is the voltage at which the insulator no longer prevents an electrical discharge across two electrical contacts submerged into the fluid. | | | | 1 |
| **Interfacial Tension** ASTM D971 | A measure of the fluids surface tension as compared to water. Decreases in interfacial tension are an indication of fluid degradation. | | | | 1 |
| **Moisture Content (KF)** ASTM D6304/D1533 | Determines level of moisture or water contamination in the lubricant. | 2 | 2 | | 2 |
| **Acid Number (TAN)** ASTM D664/D974/D8045 | Determines overall acidity of the oil which is an indication of oil oxidation and degradation. Used to determine appropriate change-out interval. | 2 | 2 | | 2 |
| **Particle Count ISO 4406** ASTM D7647 | Determine cleanliness levels of oil and generate an ISO Cleanliness Code (i.e. 17/15/12). High particle count levels can indicate gross contaminant ingress, wear, filter by-pass or all of these issues. | 2 | | | |
| **Oil Bleed** SKF Method | Provides an indication of changes to the base oil viscosity, and detects when a grease is drying out due to grease ageing. | | 2 | | |
| **Ferrography** ASTM D7690 | Detailed morphological analysis of the wear particles present in the oil. Determines the wear modes present in the system. | 3 | 3 | | |
| **Remaining Life (RULER)** ASTM D6810/D7527 | Measures the levels of aminic and phenolic anti-oxidants remaining in the oil. Determines the necessity for oil replenishment or replacement. | 3 | 3 | | |
| **Dissolved Gases** ASTM D3612 | Dissolved Gas Analysis is a must have tool to ensure your equipment remains in peak condition. By looking at concentrations of specific combustible gases then applying various diagnostic tools to identify fault conditions within the system. | | | | 3 |
| **Membrane Patch Colorimetry** ASTM D7843 | Varnish potential rating that measures the relative amount of insolubles present in the oil and the resulting potential for sludge and varnish formation. | A | | | |
| **Foaming Characteristics** ASTM D892 | Multi-stage test (stages I, II, III for both foaming tendency and stability) Determines the oils tendency to entrap air and cause oil foaming as well as the ability of the oil to dissipate this foaming tendency (stability). | A | | | |
| **Rust Test** ASTM D665 | Indicates how well the oil inhibits the formation of rust in the presence of water contamination. | A | | | |
| **Furans** HPLC | Furan analysis monitors derivatives in the fluid that identify possible deterioration or ageing of the solid insulation. | | | | A |

1 *Level 1 testing* 2 *Level 2 (also includes all tests from level 1)* 3 *Level 3 (also includes all tests from level 1 & 2)*

A *Additional / Advanced Testing – available additionally or with the Advanced Oil Monitoring™ program*