

1.) Moisture Analysis (ASTM D7546; ASTM D6404, modified)

Moisture content may be obtained by several different methods including Karl Fischer Titration (modified ASTM D6404 oven method) and Vapor Pro (ASTM D7546). Results are recorded as parts per million (ppm).

Report location: **Contamination Data**

2.) Particle Count (ISO 4406, D7647)

Particle Count by laser scattering counts the number and size of all particulates (including moisture, soft and hard contaminants) in a given sample. The results are reported per ISO 4406 giving an ISO rating and count in the 4-, 6-, and 14-micron range. Per ASTM D7647, the sample will be diluted if it is above 150 cSt. Then particle count was run on the dilution to remove contamination from water and soft particles. Then, the cumulative particle calculations and ISO code ratings are reported. Report Location: **Contamination Data**.

3.) FT-IR (ASTM D7418; ASTM 7414, modified)

Fourier Transform Infrared Spectroscopy (FT-IR) is used to fingerprint the molecular bonds in the oil. An IR beam is passed through a portion of the sample, and the resulting absorbance spectrum is used to characterize the organic components of the oil. By comparing the in-service sample to the baseline, oxidation, lubricant mixing, and organic contamination (including water) may be detected.

Report Location: **Contamination Data, Physical Properties, and Image “FT-IR”**

4.) Rotating Disc Emissions (RDE) Spectroscopy (ASTM D6595)

RDE is a type of Atomic Emission Spectroscopy where oil is vaporized in the sample chamber. The atoms are excited with an electric arc and the light patterns emitted are compared with the known patterns of 26 different elements. The spectrometer detects most wear particles such Iron and Babbitt, as well certain additive elements that could be characteristic of a given oil series. All results are recorded in parts per million (ppm). The detection limit for particle size using RDE analysis is six microns and smaller.

Report Location: **Wear Data, Contamination Data, and Physical Properties**

5.) RULER (ASTM D7590)

The RULER measures the Remaining Useful Life of the anti-oxidant additive package by Linear Sweep Voltammetry. A voltage sweep is applied to the sample and the current is measured. The results are reported as a percentage of the concentration found in the baseline oil (RUL % Peak 1, RUL % Peak 2, RUL % Peak 3).

Report Location: **Physical Properties and Image “RULER”**

6.) Direct Reading Ferrography

The sample is passed through a clean glass tube held over a constant magnetic field. As the ferrous particles drop out of the oil, they cover an optical sensor, which correlates the percent coverage of the window to a Wear Particle Concentration (WPC). The WPC is a unitless number reported as the sum of the D_L , which corresponds to large particles, and D_s , which corresponds to small particles. If the WPC is abnormally high, analytical ferrography may be suggested to characterize the severity and types of wear present in the sample. Report Location: **Wear Data**

7.) Viscosity (ASTM D445)

Viscosity is a measure of the oil's resistance to flow. Viscosity is obtained by measuring the amount of time it takes a quantity of oil to flow through a calibrated viscometer (under gravity) in a controlled temperature environment at 40 °C or 100 °C. Results are reported in cSt. Report Location: **Physical Properties**

8.) Analytical Ferrography (ASTM D7690, modified)

Analytical Ferrography involves microscopic inspection of the wear particles to determine the amount, shape, composition, and severity of the wear in the sample. This test is recommended when wear levels are elevated, or abnormal wear conditions are suspected. *Add-on test*. Report Location: **Analysis Comments and Images**

9.) Ferrous Debris Level

Ferrous Debris Level, which is a way to measure wear concentration, is monitored by the FerroQ Ferrous Wear Analyzer, which determines the amount of ferromagnetic material present in the sample by measuring the change in voltage as it is dropped through an electromagnetic field. *Add-on test*. Report Location: **Wear Data**.



Oil Analysis – Glossary of Terms

10.)Total Acid Number / Total Base Number (ASTM D974, modified, ASTM D5984)

Total acid number measurements are used to trend the accumulation of oxidation by-products in the oil. As the additives are consumed and the oil degrades the acid number will trend up signaling a time to change out or sweeten the oil. Total base number tracks the depletion of detergent additives in crankcase oils. *Add-on test.*

Report Location: **Physical Properties and Analysis Comments**

11.)Water Separability (ASTM D1401)

The ability of the oil sample to separate from water is tested by mixing equal portions of the oil with reagent grade water and stirring for five minutes. The rate of separation is tracked, and the results are reported as time to full separation or the percent remaining emulsion after 30 min. *Add-on test.* Report Location: **Separate Report**

12.)Membrane Patch Colorimetry (ASTM D-7843)

Membrane Patch Colorimetry (MPC) is a method to track the formation of varnish, varnish precursors, and other insoluble colored bodies. Through a filtration process, the insoluble contaminants are extracted onto a membrane patch and the color of the patch is analyzed using a spectrophotometer. Color is reported as a change in ΔE . *Add-on test.*

Report Location: **Separate Report**

13.)Microbial content (ASTM D7687)

Cellular-ATP is an indicator of metabolically active microbial contamination within an oil sample. The cellular-ATP is extracted from the oil and measured using a bioluminescence enzyme assay. The assay generates measurable light proportional to the concentration of cellular-ATP present in the sample. This value is reported in pg ATP/mL. *Add-on test.*

Report Location: **Analysis Comments**

14.)Pentane Insolubles (ASTM D4055)

Insoluble particles above 0.8 microns can lead to increased wear in hydraulic and turbine applications. In this method the sample is dissolved in pentane and filtered through a 0.8-micron patch. The patch is weighed before and after the test and a mass percent of insoluble content in the sample is determined. *Add-on test.* Report Location: **Separate Report**