INTERPRETATION OF OIL ANALYSIS RESULTS

Oil analysis, when correctly used, can be a valuable preventative maintenance tool for the user. In many cases it enables the identification of potential problems before a major repair is necessary. It involves the sampling and testing of used oil for various properties to monitor wear and contamination. Sampling and testing on a regular basis establishes a baseline of normal wear and can help indicate when abnormal wear or contamination is occurring. Listed below is a brief guide to possible causes/sources of abnormal indicator levels. *(Please note that this is a guide only).* Before commencing any major disassembly, thoroughly investigate and determine source of the problem and if necessary, re-sample and test.

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| **PHYSICAL TESTS** |
| **Viscosity Decrease** | Thinner oil may increase bearing and component wear. Can result from fuel dilution or the addition of a lower viscosity make-up oil. |
| **Viscosity Increase** | Thicker oil will not circulate as rapidly when cold. This can occur through extended high temperature operation, oil oxidation, over-extended oil drains or higher viscosity make-up oil. |
| **Water (W)** | Promotes oil oxidation, rust and affects oils ability to lubricate. Can result from low temperature operation, water ingress or internal water leaks. |
| **Fuel (F)** | Dilution reduces viscosity, prevents proper lubrication and may lower oil pressure. Can result from over fuelling, incomplete combustion, cracked or broken fuel lines, extended idling or defective fuel injectors. |
| **Total Base Number (TBN)** | Depleted TBN reduces the ability of the engine oil to prevent acidic corrosion occurring. Usually results from over extended oil drains. |
| **Total Acid Number (TAN)** | Increased TAN occurs due to oil oxidation and degradation. Results from over extended oil drain periods or extended high temperature operation. |
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| **DEPOSITS / CONDITION (DEP)** |
| **“VD” -** | Visible non-magnetic debris/particles. | **“VM” -** | Visible metallic (ferrous) debris. |
| **“VB” -** | Visible brass/copper/bronze debris. | **“VA” -** | Visible alloy (non-magnetic metal particles). |
| **“TD” -** | Sample appears very dark (cannot be particle counted). | **“OX” -** | Oxidised odour. |
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| **PARTICLE COUNT (PC)** |
| This is a measure of the number of particles present in 1 ml of sample. The ISO code reported is a simple way to quantify particulate matter by size and is indicative of the “cleanliness” of the sample. |
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| **PARTICLE QUANTIFIER (PQ)** |
| The PQ Analyser measures ferrous particles using magneto meter technology and reports it as a trendable PQ Index Number. |
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| **INFRA-RED ANALYSIS (FTIR)** |
| This is a measure of oil condition (by Differential Scanning between the new and used oil) to indicate if oil is suitable for continued use. |
| **SOOT (ST)** | Soot is a normal by-product of combustion. Excessive soot will increase the oil viscosity and may be caused through over extended oil drains, incomplete combustion or excessive blow-by. |
| **OXIDATION (OXI)** | Oil oxidises with age and service and from improper operating conditions. This may result in an increase in viscosity, because of the formation of sludge and varnish deposits. |
| **NITRATION (NIT)** | Nitrogen compounds which contaminate the oil are formed by the combustion process and are an indicator of blow-by which can result in oil thickening and plugged filters. |
| **SULPHATION PRODUCTS (SUL)** | These are by-products of diesel fuel combustion that contaminate the oil. These by-products are corrosive and deplete the neutralising properties of the oil. |
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| **INORGANIC CHLORIDES** | A positive result indicates the presence of salt water. |
| **GLYCOL** | A positive result indicates the presence of anti-freeze engine coolant. |
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| **WEAR ELEMENTS (ICP)** |
| Induction Coupled Plasma (ICP) Spectrometer measures in parts per million (PPM). This is a microgram measurement by weight of dissolved elements in the oil sample. |
| Copper (Cu) | Bushings; bearings; thrust washers; oil coolers; trans friction discs; swash plates; “Kopr-Kote” anti-seize compound. | Boron (B) | Detergent/dispersant additives; anti-freeze inhibitors. |
| Iron (Fe) | Liners; piston rings; gears; crankshafts; cam shafts; valve guides. | Magnesium (Mg) | Detergent/dispersant additive. |
| Chromium (Cr) | Piston rings; ball & roller bearings; chrome plated parts; water treatment; hydraulic cylinder liners. | Zinc (Zn) | Anti-wear additive. |
| Lead (Pb) | Main & con rod bearings; turbocharger bearings; bushings; thrust washers; oil additives. | Cadmium (Cd) | Internal Standard. |
| Aluminium (Al) | Pistons; bearings; thrust washers; torque converter components; pump bushings. | Nickel (Ni) | Trace element in steel. |
| Silicon (Si) | Sand/dirt/dust ingress; oil anti-foam additive; sealants. | Silver (Ag) | Wrist pin bearings in EMD engines. |
| Sodium (Na) | Coolant inhibitors, road salt; ingested dirt; proprietary oil additives. | Potassium (K) | Coolant inhibitor; additive in some oils. |
| Tin (Sn) | Piston coatings; bearing overlay. | Calcium (C) | Detergent/dispersant additive. |
| Molybdenum (Mo) | Anti-wear additives; some types of piston rings. | Phosphorus (P) | Anti-wear additive. |
| Manganese (Mn) | Trace element. | Barium | Detergent/dispersant additive. |
| Titanium (Ti) | Trace element. | Vanadium (V) | Heavy fuel oil contamination. |
| **REPORT OVERALL EVALUATION** |
| One of the following codes has been assigned to this report interpretation, and may be influenced by previous results. |
| **“A”**   **-** | Normal wear is occurring; no action required | **“B” -** | Increased wear is occurring; corrective action may be required, or more information is required by the laboratory. |
| **“C” -** | Abnormal wear is occurring; corrective action is required | **“X” -** | Extreme or critical wear is occurring; immediate corrective action is required |

For further information contact Caltex Technical support on Freephone 0800 733 835 selecting Option 3.

**DISCLAIMER: This analysis is intended as an aid in predicting mechanical wear and should be used in conjunction with (and not as a replacement for) your normal maintenance routine for the care of your machinery. Due care has been taken in the processing of the oil sample/samples supplied by the user and in the preparation of this analysis but Z Energy 2015 Ltd, New Zealand will not have any liability or bear any responsibility for any failure of any machinery or parts thereof or any other loss or damage suffered directly or indirectly as a result of the analysis provided. The user remains responsible for the proper maintenance and care of the subject machinery.**