OIL LABORATORIES – PNG

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Welcome to **Oil Laboratories – PNG** this document provides you with some background data on the instrumentation used in the laboratory. The instruments have been selected to provide accurate, highly reproducible results with a fast turnaround. The equipment used in the laboratory is the latest available and selected for reliability and ability to seamlessly integrate into the Laboratory Information Management System (LIMS).

All oil samples submitted for analysis will be tested using the following instruments. The samples will be tracked using the bar code on the ID label. As a sample is analysed the results are transferred directly from each instrument to the LIMS, the bar code ensures the results are correctly consolidated. When the analysis is completed the Laboratory Lubes Engineer reviews the results, carrying out a diagnosis on the oil and machine condition. His observations are added to the report completing the oil analysis. The report is then emailed to the person submitting the sample. This process takes 12 to 48 hours from the sample arriving at the laboratory.

Following is a "Resume" of the laboratory instrumentation

Spectral Analysis – the **Spectroil Q100** is manufactured by Spectro Scientific its role is to measure the metals resulting from wear, contamination and additives in the oil samples. In this spectrometer the oil samples are not diluted with solvent before analysis, this leads to a more accurate determination.

The elements determined are

- Wear Metals: Al, Cd, Cr, Cu, Fe, Pb, Mg, Mn, Mo, Ni, Ag, Sn, Ti, V, Zn
- Contaminants: B, Ca, K, Si, Na
- Additives: Ba, B, Ca, Cr, Cu, Mg, Mo, P, Si, Zn

The Spectroil Q100 meets the requirements of ASTM D6595 for the determination of wear metals and contaminants in used lubricating oils or hydraulic fluids by rotating disc electrode atomic emission spectrometry. Analysis using this instrument also meets ASTM D6728 for alkali contaminants in fuel.

Viscosity an **Omnitex S-flow duel bath viscometer** is used for the determination of oil and fuel viscosities. Viscosity can be determined at 100°C and 40°C allowing full compliance with ASTM D7279 and as such, gives full correlation to ASTM D445.

The measurement and cleaning system is fully automated, each bath has four Houillon viscosity tubes. Viscosities between 0 and 1500 cSt can be determined with the current tube set.

Once the Laboratory technician identifies the sample using the bar code, they define the tube being use and load the sample. The measurement process is fully automated. On completion of the measurement cycle the result is

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automatically transferred to the LIMS then the system cleans the tube allowing the cycle to recommence.

Particle Counting - the laboratory uses a **PAMAS SBSS WG Particle Counting System** for liquids.

The SBSS laboratory particle counter is designed for use with liquids with a viscosity of up to 1600 cSt.

Typical fluids that can have particle count carried out

- Hydraulic oils
- Turbine and insulation oils
- Gear and engine oils
- Water based hydraulic fluids
- Phosphate ester based hydraulic fluids
- Fuels

The SBSS system is calibrated according to international standards including ISO 11171, ISO 21501-2, ISO 21501-3 or USP. These calibrations are traceable to NIST standards.

The results are reported according to the following standards: ISO 4406, SAE AS 4059, NAS 1638, GOST 17216, NAVAIR 01-1A-17, GJB 420B, SAE 749D, CHARN, ISO 11218.2 plus others on request.

However, it will be normal practice to report to ISO 4406

FTIR the instrument used for FTIR determinations in our laboratory is the **ERALYTICS ERASPEC Oil Condition Monitoring System**

What does FTIR analysis tell us about the Lubricant? If the lubricant is degrading and at what rate.

As Lubricating oil will exhibit various chemical changes during its life time, the FTIR allows us to measure and monitor these changes. The first changes are simple; such as fuel dilution of the fuel used or the uptake of soot (ASTM E2412) from the combustion. As the oil's operational life increases, numerous chemical reactions occur in the oil. These are associated mainly with combustible products and lead to oxidation (ASTM D7414), nitration (ASTM D7624) or sulfation (ASTM D7415) of the lubricant. These can be classified as degradation of products.

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The FTIR Spectrometer used in the Oil Laboratories – PNG laboratory will determine the following parameters in new and used oil.

Oil Degradation	**Standard**	**Unit of Measurement**
Oxidation	ASTM E2412, D7414, JOAP, DIN 51453	A/cm
Nitration	ASTM E2412, D7624, JOAP, DIN 51453	A/cm
Sulfation	ASTM E2412, D7415, JOAP	A/cm
Contaminants	**Standard**	**Unit of Measurement**
Soot	ASTM E2412, JOAP, DIN 51452	A/cm, wt%
Water	ASTM E2412, JOAP	A/cm, wt%
Soot	ASTM E2412, JOAP, DIN 51452	A/cm, wt%
Water	ASTM E2412, JOAP	A/cm, wt%
Ethylene Glycol (Antifreeze)	ASTM E2412, JOAP	A/cm, wt%
Diesel Fuel	ASTM E2412, JOAP	A/cm, wt%
Gasoline	ASTM E2412, JOAP	A/cm, wt%
Properties	**Standard**	**Unit of measurement**
TAN	ASTM D664	mg KOH g^{-1}
TBN	ASTM D2896, D4739	mg KOH g^{-1}
Viscosity Index	ASTM D445, D2270	VI
Additives	**Standard**	**Unit of Measurement**
ZDDP	ASTM E2412, D7412, JOAP	A/cm, %, wt%
Phenolic Antioxidants	ASTM D2668	%, wt%
Aminic Antioxidants		%, wt%

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Ferrous Content (PQ)- the instrument selected to carry out this determination is the **FerroCheck 2100 ferrous analyser**

The **FerroCheck** measures the total ferrous content of both small particles from normal machine wear and large abnormal wear particles this can expressed as PQ or ppm magnetics by weight.

It gives high accuracy for total ferrous measurement of in-service lubricating oil and grease. Operation is fast, samples are analysed in less than 30 seconds. It uses small sample volumes, just 1.5 ml of oil or 0.75 ml of grease are needed to measure ferrous content in part per million (ppm) by weight.

Accurate and repeatable

- Low limit of detection.
- Highly repeatable – 3% of reading
- Wide range of measurement
- Validation standard included

ASTM Compliance - ASTM method D8120 "Standard Test Method for Ferrous Debris Quantification"

Flash Point – The flash point of a liquid is defined as 'the lowest temperature at which a liquid can form an ignitable mixture in air near the surface of the liquid. The lower the **flash point**, the easier it is to ignite the material."

Knowing the flash point of a fuel or lubricant is very important as it provides us with assurance the liquid is safe to use in surroundings it was designed for. Determining the flash point of a used engine oil can be vital when there has been a decrease in oil viscosity. The flash point will define if the oil has fuel dilution, from leaking injectors, and what percentage dilution.

The instrument we use to determine the flash point of a liquid is state of the art, an ERAFLASH manufactured by Eralytics based in Austria. This instrument will carry out Flash Point determination to ASTM D6450, D7094 and correlates to ASTM D93. The ERAFLASH is one the modern types of flash point instruments that have replaced the classic Pensky Martin Closed Cup dipping flame system with a sealed cup with an electric arc to initiate the flame using a gas pressure increase within the cup to determine

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the actual ignition point/temperature. Due to the unique design this instrument is safer to use and faster than other flash point techniques.

Water Content - The most accurate water determination procedure in hydrocarbon is the Karl Fischer coulometric titration. Oil Laboratories – PNG use an Aquamax automated Karl Fischer titrator manufactured by GR Scientific an part of "ECH Elektrochemie Halle GmbH" in Germany, this is latest in their extensive range of instruments. It has an accuracy of 1PPM water in any hydrocarbon. The ability to accurately determine the water content hydraulic fluids, turbine oils and general lubricants will be a great aid to maintainers allowing them to extend lubricant life by removing water as soon as it detected preventing additive degradation, oxidation and corrosion.

The ability to determine the water content in fuels especially diesel, will confirm the effectiveness of water management procedures preventing the growth of system killing, algae.

LIMS - The **LIMS** or Laboratory Information Management System holds and manages all the data (information) associated with the sample, machine and relevant customer information.

When a sample first arrives in the lab the bar code is read, or if it does not have one a bar code label is applied to the bottle. The bar code is the key to tracking the sample, assembling the analysis results associated with the sample and linking the results back to the person submitting the sample.

LIMS carries out the following functions:

- Aligns the bar code to a sample and customer
- Holds machine/equipment data
- Stores machine analysis history
- Consolidates the results from each instrument to a specific sample
- When all the analysis is complete carries out a preliminary diagnosis
- After the Lubes engineer reviews the results it prepares a report in PDF format ready for emailing to the client

Account clients will be given a log-in to LIMS this will allow then to access the historical data for the samples they have summitted.