2-Stroke Marine Engines Optimization

Cylinder Oil Drain Analysis
Sweep Test /Quick Test
Engine Screening

TRIBOCARE

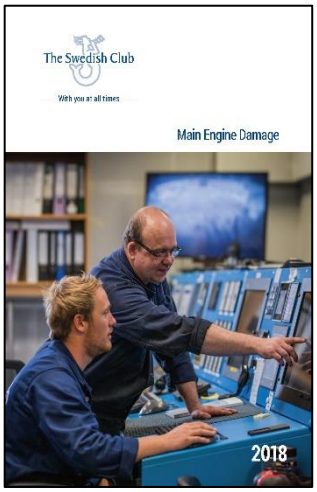
Singapore – Greece -United Arab Emirates – Germany – Hong Kong

WHY CYLINDER OIL DRAIN ANALYSIS?

Lubrication of 2-stroke Marine engines is becoming more complex and challenging with new regulations in Shipping, new Engine designs and a wide variety of fuels and lubricants in the market.

There is no doubt that 2-stroke Engines is the most valuable asset of your vessels. *Swedish Club Main Engine Damage report* (July 2018), noted the following significant points concerning engine lubrication:

- **"Main engine claims account for 28% of all machinery claims and 34% of the costs, with an average claims cost close to USD 650,000. The average cost of main engine claims has increased by 21% compared with the period 2010-2014."**
- **"Statistically a vessel will suffer between one and two incidences of main engine damage during its life time."**
- **"Lubrication oil related failure is the most common cause of damage."**



Under lubrication, leads to increased abrasive and corrosive wear resulting in unplanned maintenance costs. **Over lubrication**, on the other hand increases lubrication costs and cause a build-up of potentially damaging deposits.

An effective drain oil analysis program can be the difference between substantial engine maintenance overheads and lubrication cost efficiency, or between over lubrication of an engine and optimization of your feed rate.

OEM Testimonials

MAN Energy Solutions
Future in the making

"It is **MAN's** experience that, in addition to regular scavenge port inspections, drip oil analysis can be a very useful tool to monitor combustion and cylinder condition. Drip oil analysis can detect changes in cylinder liner wear and help with cylinder oil feed rate optimization programs."

WIN GD
Simply a better different

Win GD: "Measuring the total iron content of piston underside oil provides a very valuable feedback of the piston running conditions in each cylinder, and allows operator to optimize cylinder oil feed rates for a specific set of operating conditions."

Features and Benefits

Cylinder Oil Drain Analysis or Cylinder Scrapedown Analysis is an additional tool for monitoring the operation and condition of two-stroke engines and cylinder lubricants.

While CODA does not replace regular inspections, which are still essential to ensure safe operation, it allows evaluating the cylinder condition and engine wear condition.

The Cylinder Scrapedown Analysis allows the operator to assess the performance of each cylinder unit separately.

The Cylinder Scrapedown Analysis service is a tool to:

- Check and optimize cylinder oil feed rate.
- Increase the time between overhauls, by extending the lifetime of cylinder liners and piston rings.
- Monitor stuffing box performance.
- Reduce system oil consumption.

The residue oil taken from the piston underside and the system oil give an indication of:

- Wear performance, e.g. by measuring the content of Iron (Fe), Copper (Cu) and Chromium (Cr).
- Remaining base number (BN), which is an indicator of protection against corrosive wear.
- Contaminants such as water or system oil.
- Combustion quality

Benefits for Ship Operators

- Improved operational safety with the reduced risk of machinery breakdown.
- Optimized engine operation through oil condition monitoring.
- Extended time between overhauls
- Savings on engine spare parts and maintenance
- Reduced risk of off-hire

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WHY CHOOSE TRIBOCARE FOR CODA?

Tribocare Laboratories in Sharjah and Singapore possess vast experience on the analysis of Marine Lubricants. This is proven by the fact that we are trusted by Lube Oil Majors, like **Lukoil** and **Gulf Oil Marine** for their Used Oil Analysis Program, as well as Research and Development of their products.

The quality of our analysis and our reports cannot be doubted. Our laboratories are 17025 accredited for all parameters required from OEMs and we strictly follow their guidelines.

Having analysed a huge number of CLO samples and having monitored the performance of all-types of vessels, we are confident that we can offer the best available CODA program in the market.

Such programs are ineffective without expertise. When lacking the correct information, knowledge or specific guidance, data simply remains data.

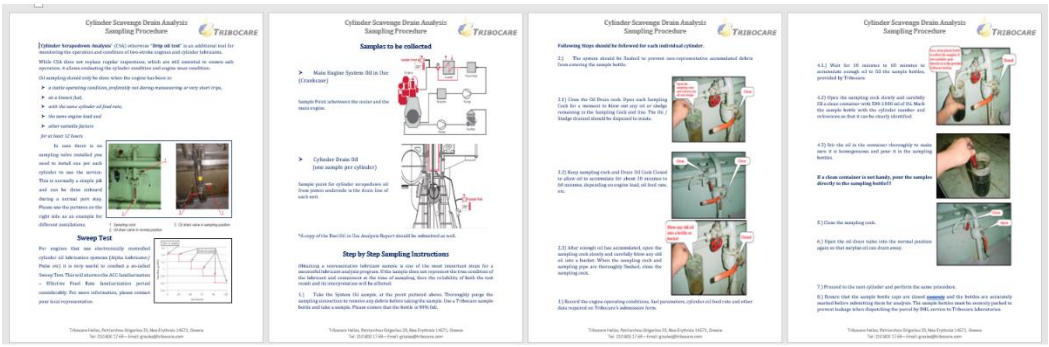
Underlining OEM advice on drain oil monitoring programs, Tribocare aims to simplify ship operators' daily operations by offering Cylinder Drain Oil Analysis services that ensure that lubrication onboard your vessel is optimized.

Our CODA program is designed to monitor and fine-tune the lubrication of marine two stroke engines, all driven by the expertise and professional advice of our highly-trained laboratory and technical teams.

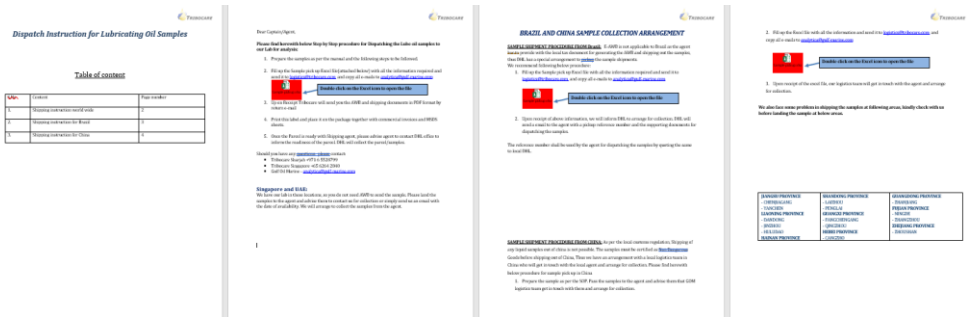
WHAT WE OFFER…

Specially designed Sampling Kits directly to our client's vessels or Stock Point.

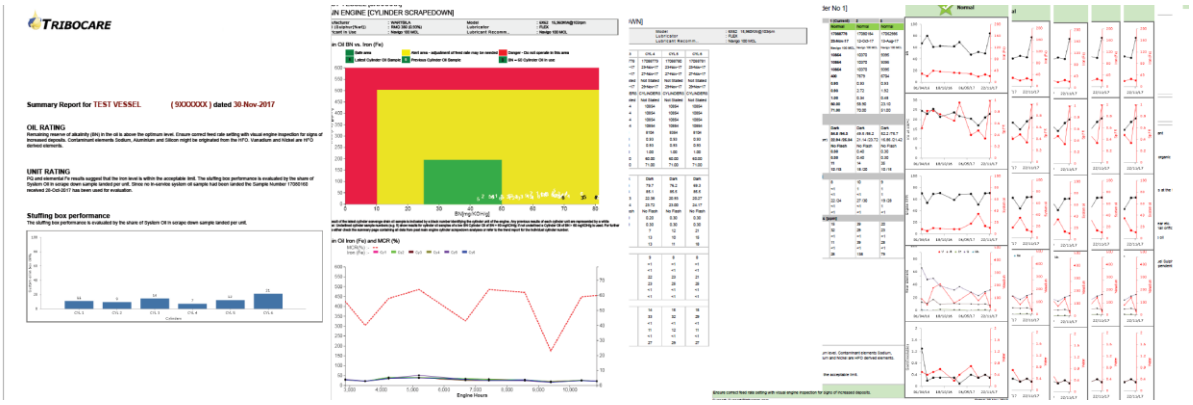
Detailed Step-by-Step Instructions for correct sampling.



Sample Transportation arrangements through our Logistics Program.



Expert CODA sample analysis and reports according to OEM guidelines.



Customer Based Specific Feed Rate Optimization Advising.

24/7 Technical Customer Care

THE ANALYTICAL PROTOCOL

It must be understood that the drip oil is analysed to evaluate the condition inside the combustion chamber. There is a common misunderstanding that the only parameters that play a role is Iron Content and the residual BN. The reality is that they are the most significant parameters.

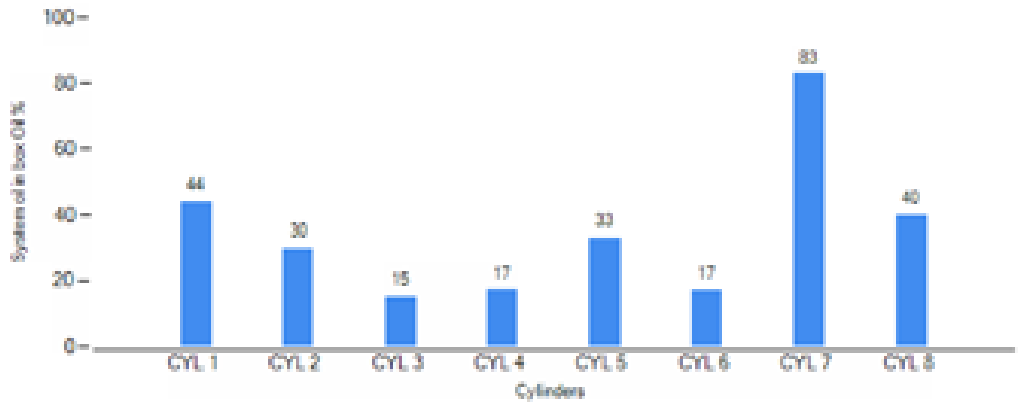
Nevertheless, in order to assess the true condition and subsequently engage to the necessary corrective actions, there are many other factors to take to consideration and need to to be checked.

PARAMETERS	METHODS	PURPOSE
Base Number (BN)	ASTM D 2896	The base number describes the alkalinity of the oil, which is necessary to neutralize the acidic components formed during combustion to prevent the risk of corrosive wear.
Iron (Fe)	ASTM D 5185	Is, beside the base number, the most important indication for any problem in the liner. It can indicate corrosive or abrasive wear. Corrosive wear is due to acid condensation on the liner wall. Abrasive ware is most probably due to liner or ring wear.
Kinematic Viscosity (KV)	ASTM D445	Changes in Kinematic Viscosity can indicate contamination.
Flash Point	ASTM D 3828	change in the Flash point of the oil shows fuel ingress or contamination.
Soot/Insoluble	ASTM E2412/ IP316	The soot or oil-insoluble level in the oil gives an indication on combustion quality.
System Oil Dilution	In-house method	The System oil dilution shows the performance of the stuffing box and helps to make the necessary corrections in the test results for viscosity, BN, Fe and PQ Index.
PQ Index	Manufacturer	The PQ Index identifies ferromagnetic particles in the oil. This allows to assess the iron wear level and to categorize it as abrasive or corrosive wear.
Wear elements: Aluminium (Al), Chromium (Cr), Copper (Cu), , Lead (Pb), Tin (Sn)	ASTM D 5185	Wear and contaminant metals are either wear particles in the oil caused by abrasive or corrosive wear on machinery parts or ingress of external contaminants. Elemental spectroscopy analysis by ICP can precisely determine all metals, including wear, contaminant and additive metals from trace level to higher concentrations. For some elements, there are several possible sources. For example, silicon in the oil can be caused by wear (piston crown material), antifoam additives or contamination (dirt or sand). Only by evaluating the complete set of results is it possible to determine the exact sources of the particles.
Contaminant elements: Sodium (Na), Silicon (Si), Molybdenum (Mo), Nickel (Ni), Silver (Ag), Vanadium (V)	ASTM D 5185	

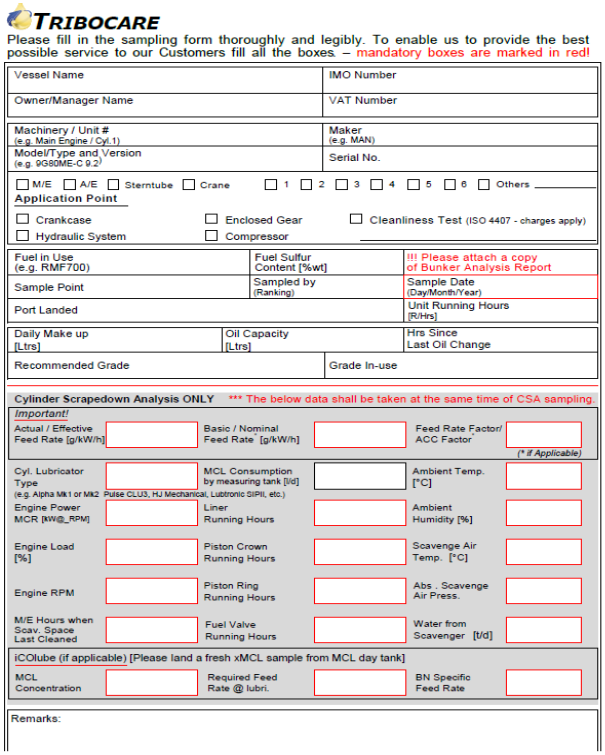
INTERPRETATION OF RESULTS

The drip oil that is collected in the piston underside space, contains not only the Used CLO, but also System Oil that has leaked through the Stuffing Box.

This means, that actually, the results of the analysis of the Drip Oil do not reflect the true condition inside the Cylinder and they have to be corrected according to the extent of the System Oil Dilution.



Example on Stuffing box performance by system oil leak rate per unit.



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Please fill in the sampling form thoroughly and legibly. To enable us to provide the best possible service to our Customers fill all the boxes. – mandatory boxes are marked in red!

Vessel Name	IMO Number
Owner/Manager Name	VAT Number
Machinery / Unit # (e.g. Main Engine / Cyl.1)	Maker (e.g. MAN)
Model/Type and Version (e.g. 9080ME-C 9.2)	Serial No.

☐ M/E ☐ A/E ☐ Sterntube ☐ Crane ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ Others

Application Point

☐ Crankcase ☐ Enclosed Gear ☐ Cleanliness Test (ISO 4407 - charges apply)
☐ Hydraulic System ☐ Compressor

Fuel in Use (e.g. RMF700)	Fuel Sulfur Content [%wt]	!!! Please attach a copy of Bunker Analysis Report
Sample Point	Sampled by (Ranking)	Sample Date (Day/Month/Year)
Port Landed		Unit Running Hours [R/Hrs]
Daily Make up [Ltrs]	Oil Capacity [Ltrs]	Hrs Since Last Oil Change
Recommended Grade	Grade In-use	

Cylinder Scrapedown Analysis ONLY *** The below data shall be taken at the same time of CSA sampling.

Important!

Actual / Effective Feed Rate [g/kW/h]		Basic / Nominal Feed Rate [g/kW/h]		Feed Rate Factor/ ACC Factor (* if Applicable)	
Cyl. Lubricator Type (e.g. Alpha Mk1 or Mk2 Pulse CLU3, HJ Mechanical, Lubtronic SIPII, etc.)		MCL Consumption by measuring tank [l/d]		Ambient Temp. [°C]	
Engine Power MCR [kW@_RPM]		Liner Running Hours		Ambient Humidity [%]	
Engine Load [%]		Piston Crown Running Hours		Scavenge Air Temp. [°C]	
Engine RPM		Piston Ring Running Hours		Abs. Scavenge Air Press.	
M/E Hours when Scav. Space Last Cleaned		Fuel Valve Running Hours		Water from Scavenger [t/d]	

iCOlube (if applicable) [Please land a fresh xMCL sample from MCL day tank]

MCL Concentration		Required Feed Rate @ lubri.		BN Specific Feed Rate	

Remarks:

Total evaluation takes place, after obtaining the corrected values and in accordance with the info given in the submission form.

Investigations have shown, that engines of the same design may experience very different piston running behaviours. The factors that influence the

- Operation pattern
- Engine load
- Fuel
- The cylinder lubricant applied
- The specific engine tuning

Our technical team will give tailor-made instructions for the optimization of Cylinder Oil feed rates, based on all the above information.

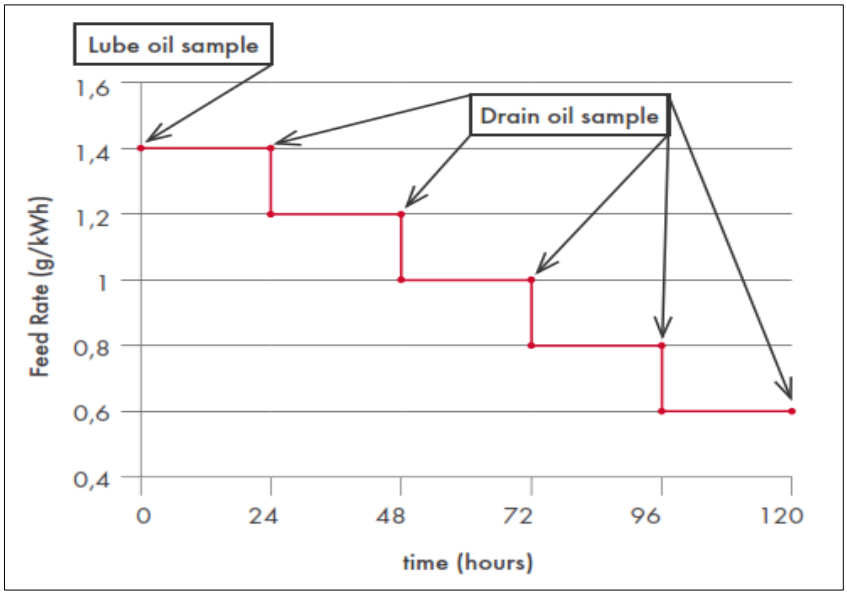
SWEEP TEST

MAN Energy Solutions
Future in the making

The sweep test is a tool to optimize the feed rate of MAN engines, with Alpha Lubricators. Each engine is different and should be individually evaluated.

The sweep test should be done at steady load above the lubrication breakpoint and preferably on high Sulphur fuel. The feed rate is adjusted to different values. Each feed rate must be operated for 24 hours before taking a sample and switching to the next feed rate.

Overview of the sweep Test Procedure



The sweep test procedure is very similar to the standard CSA sampling procedure:

- Clean piston underside of all cylinder units.
- Take one FRESH cylinder oil sample from cylinder oil day tank.
- Take one USED system oil sample at the engine inlet during engine operation.
- Take drain oil samples at each feed rate after operating the engine for 24 hours.
- Fill in the submission forms at the time of each sampling.

Detailed instructions and guidance is given to operators by our technical experts.

QUICK TEST & ENGINE SCREENING

Win GD has a similar procedure with Sweep Test, called “Quick Test”.

Further to that they have come also with an Engine screening procedure which is somewhat different

After you have done the running-in of the engine, you can get initial data for the engine.

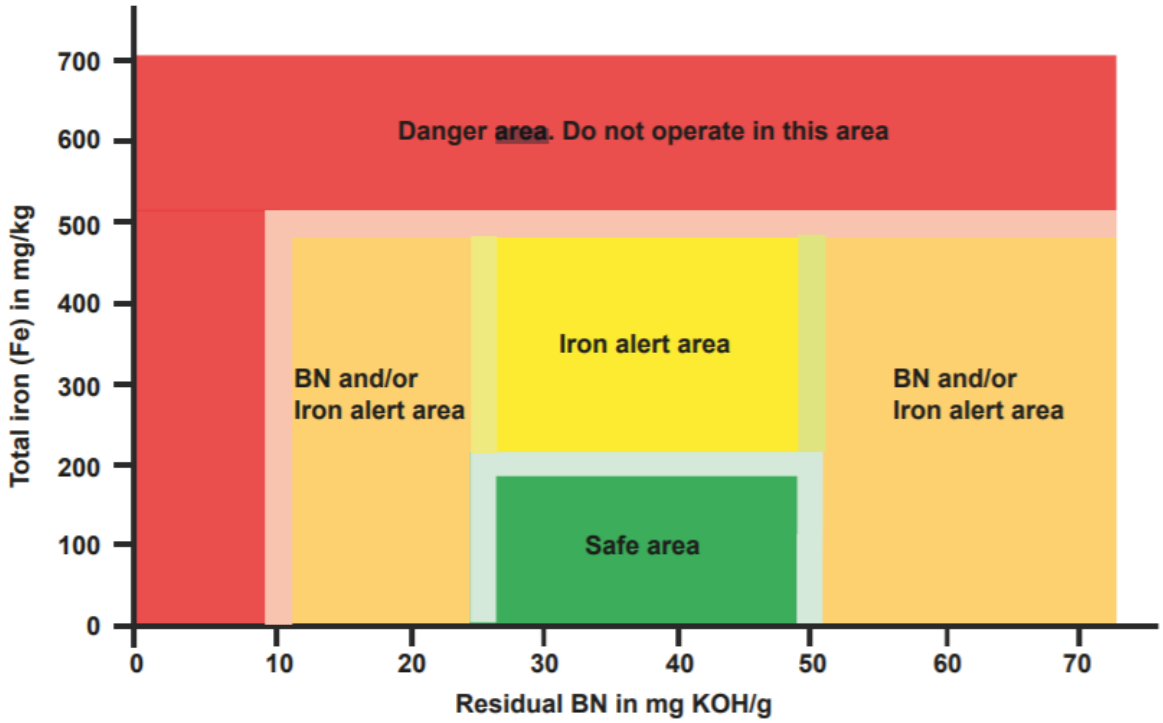
WinGD recommends to do an engine screening procedure as follows:

1) Set the base feed rate to 0.9 g/kWh of the selected cylinder oil.

2) Operate the engine at different loads, eg 10%, 20%, 30% etc related to the sailing conditions.

3) For each load do a piston underside drain oil sampling.

4) For each load do an interpretation of the oil analysis.



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