FLAME
MARINE
DIAGNOSTIC



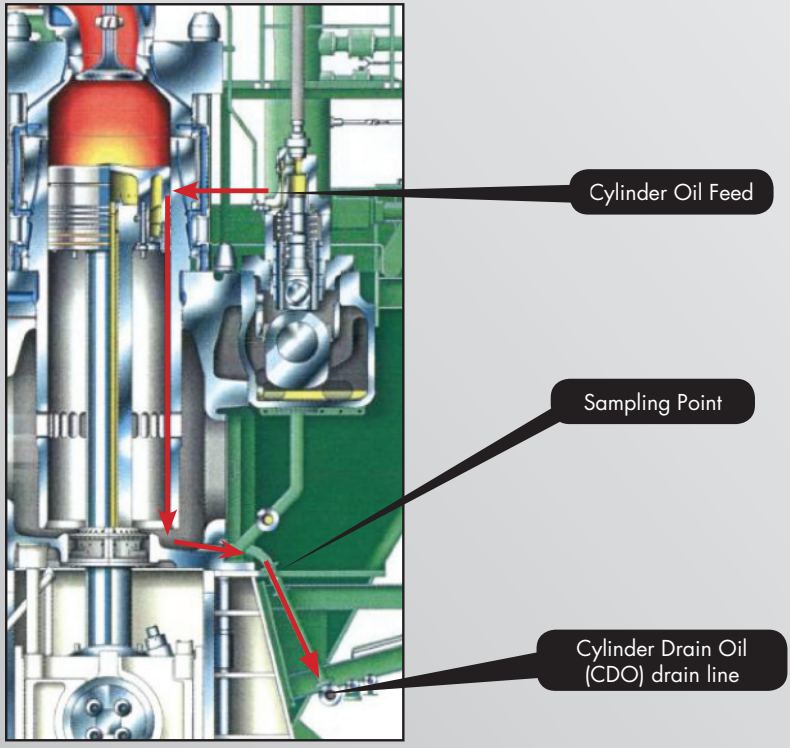
Instructions for Sample & Data Collection



Introduction

Engine operating and maintenance condition can be diagnosed by a comprehensive evaluation of engine performance data together with fuel and lubricant analyses.

By collecting samples during the time that engine performance is being recorded the cylinder drain oil will accurately reflect engine operating conditions.



WARNING

An incorrect diagnosis of engine condition may result if these instructions for collection of samples and recording of engine performance are not carefully followed.

It is important that Sampling Instructions are followed carefully to provide reliable samples

Rule 1:
Always collect samples at the same time that engine performance is being recorded.

a. Engine performance data is normally recorded once per month whilst engine is operating at engine load of 85%- 90% of MCR.

b. Cylinder Drain Oil should also be taken at similar engine load.

Rule 2:
Conditions for recording of engine performance and collecting samples

a. Calm Sea
when sea is not calm Fuel Rack to be locked during recording.

b. Stable engine operation
Load Change Device (if fitted) to be de-activated if engine load is increased for recording performance. Allow one hour before collecting samples after increasing engine load for engine condition to stabilize.

c. Piston rod diaphragm to be clean and free of excessive sludge
clean in port prior to sampling.

Samples to be collected

Fuel Oil

- ❑ Fuel Before Purifier - *Line sample from before Fuel Oil Purifier*
- ❑ Fuel Before Main Engine - *Line sample from before Main Engine Fuel Injection Pump*

System Oil

- ❑ New System Oil - *Line sample from topping up line (once per year only)*
- ❑ System Oil (Crankcase) - *Sample from Main Lubricating Oil Pump discharge*

Cylinder Lubricant

- ❑ New Cylinder Oil - *Line sample taken from line to Lubricator Pump*
- ❑ Cylinder Drain Oil - *One sample from under-piston drain line of each cylinder*

CDO Sampling Point

MAN B&W Engines





Sulzer RTA Engines



Previous Design
(below scavenge air receiver)



New Design
(fuel pump side)

Cylinder Drain Oil (CDO) - one sample from under-piston drain line of each cylinder

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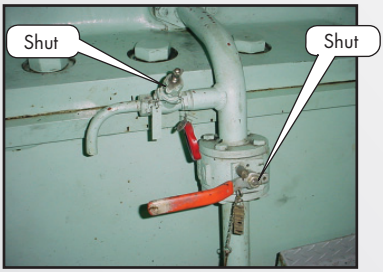
Sampling Procedure



1. Close the Shut-off Cocks.

   Open each Sampling Cock for a moment to blow out any oil or sludge remaining in the Sampling Cock and line.

   The Oil / Sludge drained should be disposed to waste.



2. Keep the Shut-off Cocks closed for about an hour or more whilst recording engine performance.



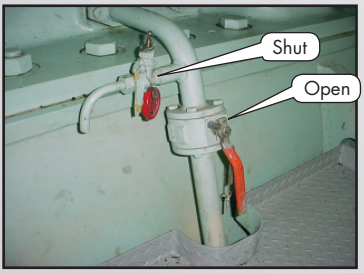
3. Open the Sampling Cock again briefly to drain off a small amount of oil from the Sampling Cock and sampling line.

   This small amount of oil drained should be disposed to waste.



4. Collect about 500 ~ 1,000 ml of cylinder drain oil in a clean container.

   Use clean container for each sample to avoid contamination from other cylinders.



5 Close the Sampling Cock.

Re-open the Shut-off Cock.



6 Stir the oil in the container thoroughly to make sure it is homogeneous.



7 Pour 100ml into a Flame Marine sample bottle.

Mark each bottle label with the following:

- Ship's Name
- Cylinder Number
- Date Collected

IMPORTANT

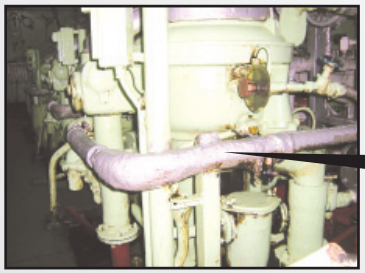
During the collection and labelling of the Cylinder Drain Oil (CDO) samples please take great care to be sure that each CDO sample bottle is marked with the correct cylinder number.

Fuel Sampling Point

Point 1 - Before Purifier

A sample of fuel is required to be collected at safe point before the Fuel Oil Purifier inlet.

Recommended safe points are:



Any cock before the purifier supply pump

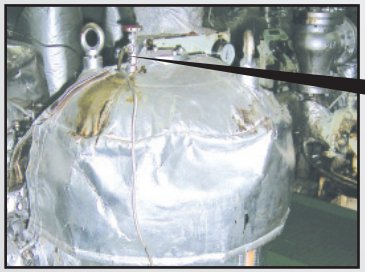


Vent line of the purifier fuel oil heater

Point 2 - Before Main Engine

A sample of fuel is required to be collected at nearest safe point before the fuel pump inlet.

Recommended safe point:





Vent line of the final fine filter before the Main Engine



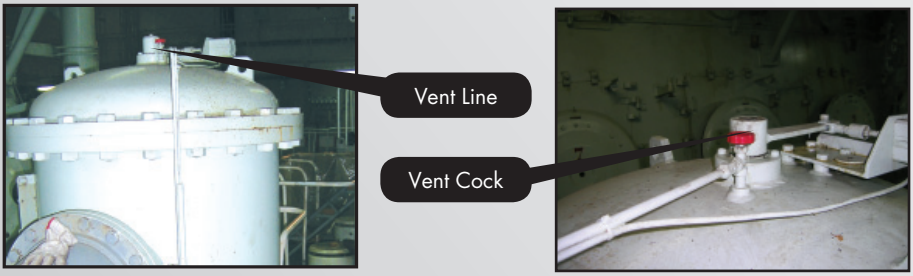
Pour 100ml into a Flame Marine sample bottle.
Mark each bottle label with the following:

- Ship's Name
- Before Purifier / Berfore Engine
- Date Collected

System Oil Sampling Point

A sample of main engine system oil is required to be collected from line between main engine lubricant oil pump and inlet to engine.

Recommended safe point is from the vent line of the final fine filter before the Main Engine.



Reference Fresh Oils

Sample of reference new oil will be required for the Cylinder Oil and System Oil.

1 Sample of New Cylinder Oil
(required to be collected at each sampling)

2 Sample of New System Oil
(required once every year)

New Oil Samples should be taken from suitable points on the top-up line.





Pour 100ml into a Flame Marine sample bottle.
Mark each bottle label with the following:

- Ship's Name
- System Crankcase / System New / CLO New
- Date Collected

Flame Diagnostic Sample Submission Form

Ensure that all relevant information is entered in the Sample Submission Form.

Enclose a printed copy of the Sample Submission Form with the samples in the plastic zip bag supplied.

Sample Submission Form

Construction Information

Ship Name		Engine Maker			MCR		
Owner/ Manager		Engine Model			MCR rpm		
Date Sampled		Displacement		MT	Deck Temp		°C
Date Landed		Ship Load Condition			Deck Humidity		% RH
Port Landed		Sea Condition			Sea Water Temp ºC		°C
Total Engine Hrs		Engine Load Condition			Engine Room Temp		°C

Power Information			Main Engine System Oil			Fuel Oil Bunker Information			
Engine rpm			System Oil Grade			Bunker Port			
Power Source **			Consumptions			Date Bunkered			
Power Type			Cylinder Oil			Fuel Specification			
Power			Cylinder Lub Name			Density @ 15ºC			
Load as % MCR		% MCR	Cylinder Lub BN			Viscosity @ 50ºC			
Load Indicator			SG @ 15ºC			Water			
Others			Oil Temp ºC @ Meter		°C	MCR			
Scav Air Temp ºC		°C	Consumption		Ltrs/hr	Sulphur			
Scav Air Press		kg/cm²	Specific Feed Rate			Vanadium			
Lubricator Setting			Fuel Oil			Sodium			
B&W Alpha	% HMI		FO Consumption		Ltrs/hr	Aluminum			
Sulzer	Lever Position	Pump Factor	Motor Freq	Temp at Flowmeter		°C	Silicon		
				Temp Before Engine		°C	Recommended Heating Temp	10cst	12cst	15 cst
				Specific Consumption						

Individual Cylinder Values

Unit No.	Lubricator Stroke Setting				Cylinder Pressures & Temp							Running Hours & Wear		
	B&W		Sulzer		Pcom (kg/cm²)	Pmax (kg/cm²)	MIP (kg/cm²)	Fuel Rack	VIT Index	Local Exhaust (ºC)	Indicated Power	Liner Total Hours	Hours Since Last Overhaul	Max Wear at Last Overhaul
	Stroke/ HMI	LCD Setting	Upper	Lower										
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														

Air cooler / Turbo-Charger

	T/C rpm	Gas Inlet (ºC)	Gas Outlet (ºC)	Blower Inlet (ºC)	Before Cooler (ºC)	After Cooler (ºC)	Cool Water Inlet (ºC)	Cooling Water Outlet (ºC)	Press Drop across Filter	Press Drop across Cooler
1										
2										
3										
4										

Measured By

Chief Engineer

Comments

** Power Source - method used to obtain the power of the engine (Diesel Analyzer/ Torque Meter/ Lxrpm/ Turbo-Charger rpm etc)

When agreed with your Technical Department you will receive Flame Diagnostic Software. Please click on setup.exe to install. For further instructions, please refer to the help documentation that comes with the software.

This software is to help reduce mistakes when entering data. Please help us to help you by using the software to provide your engine data.

Diesel Analyzer Data Printout

Tabulated Data

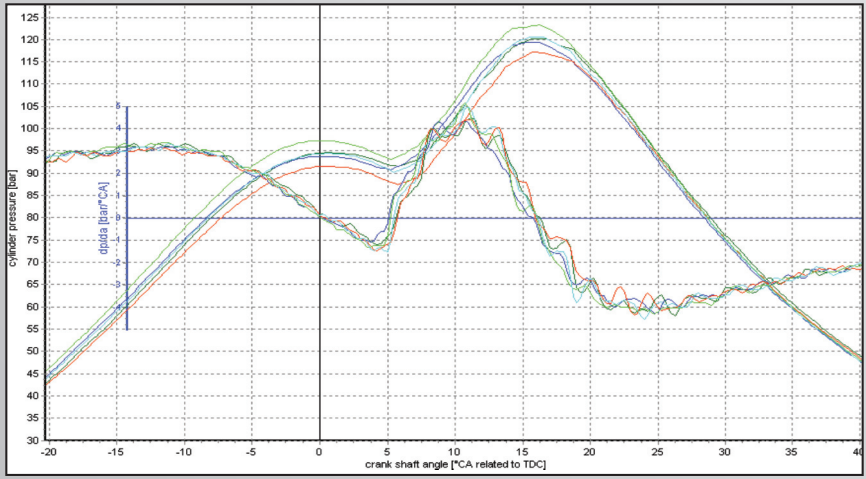
Printout of tabulated data and Indicator diagram from Electronic Diesel Analyzer to be included with the Sample Submission Form

Cyl	pcomp	pmax	apmax	pexp	pmi	Pind	IHP	rpm	Texh	Frack	VIT	pscav
	[bar]	[bar]	[°CA]	[bar]	[bar]	[kW]	[hp][PS]	[1/min]	[°C]	[mm]	[mm]	[bar]
1	94.6	120.1	15.8	58.3	17.3	2,341	3,183	78.8	349	94.0	3.2	2.00
2	93.8	119.3	15.3	57.0	16.4	2,222	3,021	78.8	351	94.0	2.9	2.00
3	91.5	117.3	15.8	57.7	16.8	2,268	3,083	78.9	377	95.0	3.1	2.00
4	97.3	123.3	16.3	57.5	16.4	2,213	3,008	78.7	349	94.0	3.4	2.00
5	94.4	120.6	16.5	57.1	16.4	2,215	3,012	78.9	355	94.0	3.5	2.00
Avg	94.3	120.1	15.9	57.5	16.7	2,251.6	3,061.3	78.8	356	94.2	3.2	2.00
Sum						11,258.0	15,306.4					

abs
dev %
devabs
ISO corrected
No
Yes

calc. mech. Eff.: 93.3 % calc. BHP: 14284 hp/PS calc. engine load: 81.5 %

Indicator Diagrams



Document Check List

With every set of samples:

- Flame Diagnostic Sample Submission Form (fully completed)
  - ❍ Ensure that all information on Engine Performance Data is entered.
  - ❍ Ensure that fuel oil bunker analysis results are entered.
- Printout from Electronic Diesel Analyzer (Tabulated Data and Indicator Diagrams). Archive data may be provided on diskette.

First report only:

- Main Engine Shop Test datasheet or Performance Curves

Preparing to send



Before placing the documents and bottles in the Mailing Box please refer to the Check List and be sure that you have all the required samples and documents, and that the Sample Submission Form has been completed with all required information

- Place all samples and documentation in Flame Sample Mailing Box
- Hand Flame Sample Mailing Box to Ships Agent at next port.
- Request Agent to send promptly by courier to lab address on Mailing Box

What happens next

The Mailing box should arrive at the laboratory within 5 days. Within a further 5 days the fuel and lubricant analyses and documentation will be transmitted to Flame Marine.

Flame Marine interprets the combustion, lubrication and engine conditions and prepares a report and recommendations. The report is transmitted to your Technical Department within about 10 days from receipt of the samples at the laboratory.

The purpose of the report is to alert you to unstable combustion and wear, to diagnose the reasons and to advise you of required corrective action. Visit Flame Marine website for more detailed information.

Water

- **High Water in Units 1, 2, 3, 5 and 6 poses risk of emulsification and disruption of cylinder lubricant.**

  There are no signs at the time of sampling that water is causing emulsification/increase in Viscosity or contributing to wear in Units 4 and 7.

  There are signs that high water in Units 1,2,3, 5 and 6 is causing emulsification/ increase in Viscosity but water does not appear to be having any influence on wear.

  Sampling Procedure should be followed carefully as incorrect sampling can cause high Water in the CDO samples. It is important that a correct reading for water is obtained as it is the indicator for unusual Water ingress into the combustion space.

  Note that the first liquid from the Sampling Cock should be run off to waste as water may accumulate in the line prior to commencement of sampling.

- **High Water may be due to poor condensation and separation of water in the intake air due to inadequate cooling as indicated cooling as indicated by the high scavenge air temperature after air cooler (44 and 49°C).**

System Oil Contamination

- **Sample of System Oil from the crankcase and sample of new System oil were not landed.**

  Please ensure that all required samples are provided - see Sampling Notes at the end of this report.

Feed Adjustment

- **Upper Stroke Setting for Units 1, 3 and 5 have been increased.**

  Lever position is not reported.

  It is recommended that Lubricators are maintained at a uniform setting unless there is a good reason for a variation in feed, e.g. during running-in. Please report reason for variations of settings in sample submission form.

- **Cylinder Drain Oil (CDO) analyses indicate adequate reserve for current Fuel and Engine Load when account is taken of Fuel and System Oil contamination.**

  The causes of combustion instability need to be addressed and cylinder lubricant feed reduced in order to maintain both piston cleanliness and low wear.

- **We recommend that lubricator stroke is adjusted to a uniform setting and overall feed reduced by not more that 0.05 g/bhph (0.07 g/kWh).**

  After approximately 250 hours following reduction, another set of samples should be taken for analysis to confirm conditions.

  We advise that no further reduction should be made until the analysis results confirm possibility to do so.

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