SERVICE REPORT

Heat Rate test

April 2013

Project 60095

Maersk Fluid Technology A/S

Index

1. Basic data

Plant:	Barbados Light and Power	
Customer:	Maersk Fluid Technology A/S	
Period:	7-15 April 2013	
Participants:	Maersk Fluid Technology A/S:	Henrik Bak Weimar
	BWSC A/S:	Carsten Otte
		Finn Hansson

<u>Maersk Fluid Technology A/S</u>
Technical & Operational Manager: Henrik B Weimar

<u>BWSC A/S</u>
Test Engineer: Carsten Otte
Manager Field Service Finn Hansson
Project Manager: Jeanett Grandjean

2. Technical systems

Diesel engine
Maker: MAN
Type: 9K80MC-S
Engine No.: D14
Running hours: 59915

Other equipment
<u>Power Meter:</u>
Maker: Zimmer Electronic System
Type: LMG450

<u>Flowmeter:</u>
Maker: KRAL
Type: OMG

3. Scope of work

In connection with a SEA-Mate® Blending on Board, tests were performed to check for any differences in the mechanical properties/efficiency related to friction in the bearings when operating an engine on "used, but useable" lubricating oil, e.g. lube oil which has been in operation for a long time, only replenished due to leakage or sweetened, when the BN (Base Number) are found to high compared to fresh new oil.

4. Executive summary

This heat rate test was performed to evaluate the differences in SFOC (Specific Fuel Oil Consumption) when operating a diesel engine on used/useable lubricating oil compared to new/fresh lubricating oil.
A fuel saving of 0.86g/kWh or 0.44% was noted as well as a lube oil temperature reduction of 0.7°C in the temperature increase between inlet and outlet.

5. Work carried out

A heat rate test was performed to evaluate differences in SFOC (Specific Fuel Oil Consumption) when operating a two stroke diesel engine on used/useable compared to new/fresh lubricating oil.

The engine was tested immediately upon a major overhaul, completed running-in and adjustment.
The engine was tested, first on the existing "used" lube oil and subsequently after complete replacement of all the lube oil with fresh lube oil.
During the replacement of the lube oil, proper cleaning of the bottom tank was carried-out.
The test was made within a few days and with no adjustment done between the two tests.
The test was performed with the engine at 27MW load, which is the normal operation load at 90%, and any differences in site conditions having an impact on the SFOC such as fuel oil temperature, cooling water temperature, air inlet temperature, humidity and ambient pressure were compensated for.

Each test was performed over a period of approximately 1 hour.
An average of the results from the tests carried-out was used as final result.
Any test, during which a load change or unforeseen circumstances occurred, was not included in the result.

Calibrated and certified instruments were used for all measurements taken:

- Power meter (see attachment #1)
- Flow meter (see attachment # 2)
- Temperature sensors (see attachment # 3)
- Humidity sensors (see attachment # 3)
- Barometer (see attachment # 3)
- Stopwatches (see attachment # 3)

Power meter connected to the CT and VT (current- and voltage transformer) (see attachments # 4a, b, c).
Flow meter installed in the fuel supply line (see attachments # 5a, b, c).
Existing return flow meter checked with the KRAL test meter and found within tolerances.
Fuel oil temperatures were measured at the fuel meter location
Cooling water temperatures were measured at scavenging air coolers and calculated to an average.
Air temperatures were measured at the T/C inlets and calculated to an average.
Lubricating oil temperatures over the bearings were monitored and recorded (see attachment # 6).
Fuel oil samples were taken during the test and used for correction of SFOC (see attachments # 7 & 8, used and new oil respectively).
Lubrication oil samples were taken for used oil (see attachment # 9) and new oil (see attachment # 10).

6. Measurements and findings

First set of measurements with used/existing lube oil, were taken during April 10 2013 (see attachments 11a, b, c, d, e).
On April 11, 2013, the engine was stopped due to planned scavenging port inspection.

Next set of measurements with used/existing lube oil were taken during April 12, 2013 (see attachments 11f, g, h).

On April 13 and 14, the engine was stopped for lubricating oil change.

A set of measurements with new/fresh lube oil was taken during April 15, 2013 (see attachments 12a, b, c, d, e).

A summary of measurements before and after oil change is enclosed (see attachment # 13).

7. Conclusion

- It can be concluded that Specific Fuel Oil Consumption has decreased by 0.86g/kWh equivalent to 0.44% after the oil change.
- It can be concluded that the temperature raise over the bearings has decreased 0.7°C after the oil change.
- As the test has been performed on a stationary engine coupled directly to a generator, the output may be justified as exact.

With the three above statements in mind, it can be concluded that when operating with the SEA-Mate® Blending on Board system, the mechanical efficiency has increased due to reduced friction in the bearings as a consequence of operating the engine on fresh oil, compared to "used".
As mentioned above, the test was performed on a stationary two stroke engine that does not have a large thrust bearing compared to a marine application, which may have even higher increase in mechanical efficiency than the stationary application when operating on clean lubricating oil.

8. Enclosures

Attachment # 1:	Power meter specification
Attachment # 2:	Flow meter specification
Attachment # 3:	Instruments
Attachment # 4a, b, c:	Photos of power meter installation
Attachment # 5a, b, c:	Photos of fuel meter installation
Attachment # 6:	Lubrication oil temperature drop
Attachment # 7:	Fuel oil sample during "used" oil test
Attachment # 8:	Fuel oil sample during "new" oil test
Attachment # 9:	Lubricating oil sample "used" oil test
Attachment #10:	Lubricating oil sample "new" oil test
Attachment #11a, b, c, d, e, f, g, h:	Measuring sheet during "used" oil test
Attachment #12a, b, c, d, e:	Measuring sheet during "used" oil test
Attachment #13:	Summary of measurements

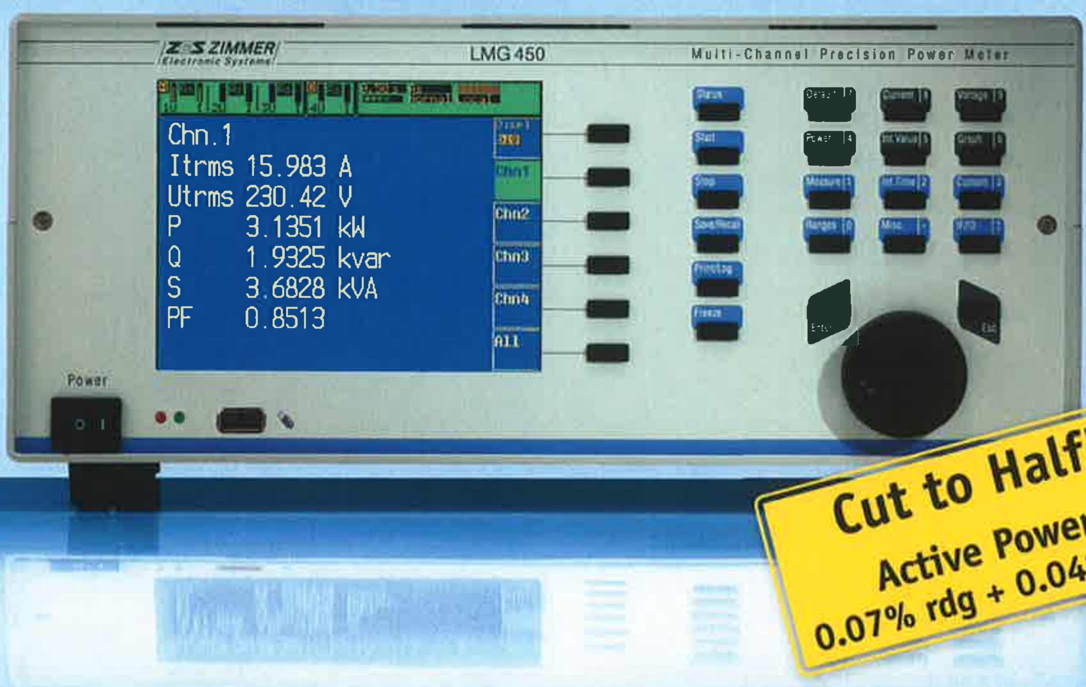
Attachment #1
8 pages

ZES ZIMMER
Electronic Systems

4-Channel Power Meter LMG450

Universal Meter for Motors, Power Electronics and Energy Analysis

Best Accuracy 0.1%



Cut to Half!
Active Power
0.07% rdg + 0.04% rng

LMG 450

LMG450 e 02.10

General

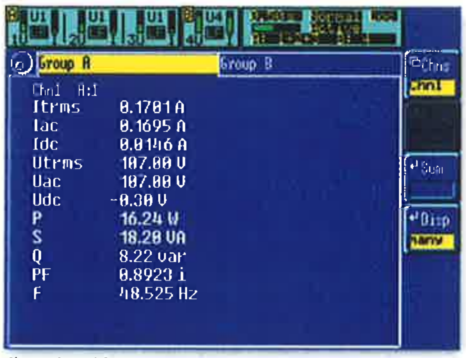
The four-channel LMG450 power meter is another advanced product from ZES ZIMMER LMG series of precision power meters, tried and tested and with great acceptance in the market. It is designed as a universal meter for the entire field of power electronics and network analysis. It can be used in practically all power electronics applications, in development and test systems, in quality assurance and maintenance. It is fully frequency inverter compatible.

Of course, it can also be used for measurements in motors, transformers, conventional and switched power supply units. It is also suitable for mains analysis measurements.

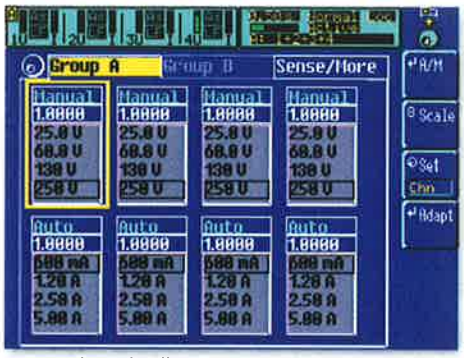
Easy operation thanks to colour graphics display and hotkeys for important measured values

Various value tables can be called on the colour graphics display at the press of a key, either with six values in large letters, which can also be read at a glance from a greater distance, with twelve values or with up to 40 values e.g. in range setting or in harmonics table. The graphics display allows scope and plot functions for waveform and timing diagrams, as well as xy diagrams or bar charts for the harmonics.
The status bar at the top of each display menu shows the input level of the four voltage and the four current inputs – an important item of information for the quality of the measurement.
The display also indicates what groups, A and B, the input channels are switched to and which signals the groups are synchronised to.

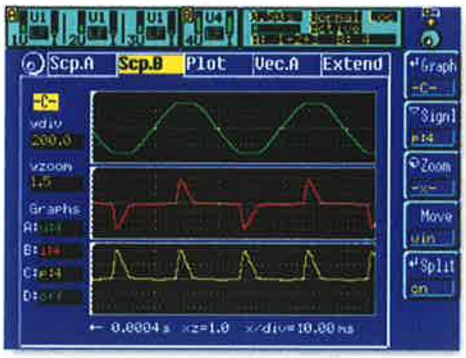
Status bar



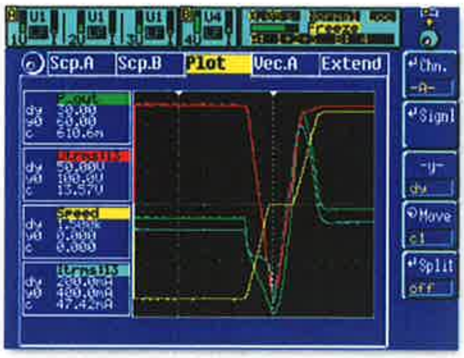
Channel 1 with 11 measuring values



Range setting and scaling



Scope function for waveform of sampling values



Plot function of calculated values

Measurement inputs

The direct measurement inputs for voltage and current have a very wide dynamic range:
Eight voltage ranges from 6V to 600V, and six ranges for current from 0.6A to 16A.
A further voltage input (six ranges from 0.12V to 4V), designed for isolating current sensors, extends the current measuring range almost indefinitely. With the help of the special current clamps supplied by ZES ZIMMER and designed for the LMG450, current can be measured during running operations, without interrupting the current path.

LMG450 – rear view

Compensated current clamp
Part No. L45-Z06

A special current measuring device is the compensated current clamp by ZES ZIMMER. It features electronic compensation of amplitude and delay errors. Even at low current levels of 1A to 40A, measurement is exact in the frequency range from 5Hz to 20kHz. Due to its high dynamic common-mode rejection, this current clamp is also very suitable for carrying out measurements at the frequency inverter output.


Compensated current clamp L45-Z06

Various methods of applying current to be measured

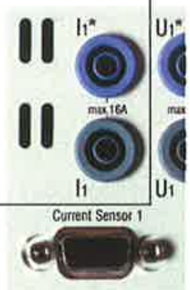

Direct measurement
0.6 ... 16A (6 Ranges)
DC ... 20 kHz


Standard current clamps
with current outputs >0.5A
100A ... 3000A
45Hz ... 3kHz


Compensated
ZES current clamps
1.2A ... 40A (6 Ranges)
5Hz ... 20kHz


Magneto-resistive
current transducer modules
5A ... 50A
DC ... 20KHz

4mm safety sockets
600V CAT III



HD15 sockets
for external sensors


PSU200/400/600/700
Precision current transducer
1A ... 700Apeak
DC ... 20kHz
(300kHz, bandwidth of sensor is limited by LMG450)


Standard current clamps with voltage/current (<0.5A) outputs
10A ... 200A
45Hz ... 3kHz


Hall effect transducers
5A ... 200A
DC ... 20kHz


DC/AC current clamps with voltage output
e.g. for oscilloscopes
10A ... 200A
DC ... 20kHz

4 independent power measuring channels

The current and voltage paths of the four power measuring channels are all isolated from each other and from earth. This allows a high degree of measuring freedom in many different power measurement applications.
The adjacent table shows various types of wirings for grouped and individual measurement channels. The table also assigns application examples for the respective types of wiring.
Power measurement channels 1 and 4 can each be synchronised to their input signals (fundamental waves etc.) independent of each other. Channels 1 and 4 are then the synchronisation references for the other channels contained in groups A and B.
This is a very useful method for carrying out efficiency measurements for equipment where the input and output have different frequencies, for example a 3-phase frequency inverter with single-phase mains supply.

Ch 1	Ch 2	Ch 3	Ch 4
4Ø 4W / 4Ø 5W			
1Ø 2W	1Ø 2W	1Ø 2W	1Ø 2W
3Ø 3W / 3Ø 4W / 4Ø 4W			1Ø 2W
3Ø 3W (Aron)		3Ø 3W (Aron)	
3Ø 3W (Aron)		1Ø 2W	1Ø 2W

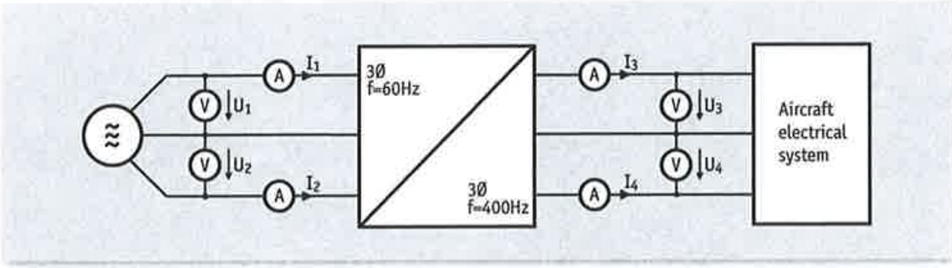
Device	Measured Value	Ch 1	Ch 2	Ch 3	Ch 4	Appropriate setting of wiring
4Ø motors	Power of all windings	Phase 1	Phase 2	Phase 3	Phase 4	4+0
High power batterie chargers (3Ø -> DC)	Input and output power, efficiency	Phase 1	Phase 2	Phase 3	DC-Out	3+1 (UΔ I• -> U• I•)
Rectifier section of inverters (3Ø -> DC)	Input power, rectifier efficiency	Phase 1	Phase 2	Phase 3	DC-Bus	3+1 (UΔ I• -> U• I•)
Output section of inverters (DC -> 3Ø)	Output power, chopper efficiency	AC-Out 1	AC-Out 2	AC-Out 3	DC-Bus	3+1 (UΔ I• -> UΔ IΔ)
1Ø -> 3Ø inverter Low power motor drives	Input and output power, efficiency	AC-Out 1	AC-Out 2	AC-Out 3	Phase 1	3+1 (UΔ I• -> U• I•)
Power supplies with multiple outputs	Input and output power, efficiency	DC-Out 1	DC-Out 2	DC-Out 3	Phase 1	3 +1
1Ø Transformers with multiple output windings	Input and output power, efficiency	AC-Out 1	AC-Out 2	AC-Out 3	AC-In	3+1
3Ø laods with auxiliary supplies	Complete input power	Phase 1	Phase 2	Phase 3	Aux. AC or DC	3+1 (UΔ I• -> UΔ IΔ)
3Ø -> 3Ø inverter High power motor drives	Input and output power, efficiency	AC-In 1	AC-In 2	AC-Out 1	AC-Out 2	2+2 (UΔ I• -> UΔ IΔ)
3Ø -> 1Ø AC power source	Input-, output- and DC-Bus power, efficiency	AC-In 1	AC-In 2	DC-Bus	AC-Out	2+2 (UΔ I• -> U• I•)

Wiring settings in () are featured by option „Star-Delta Conversion"

Group A | Group B

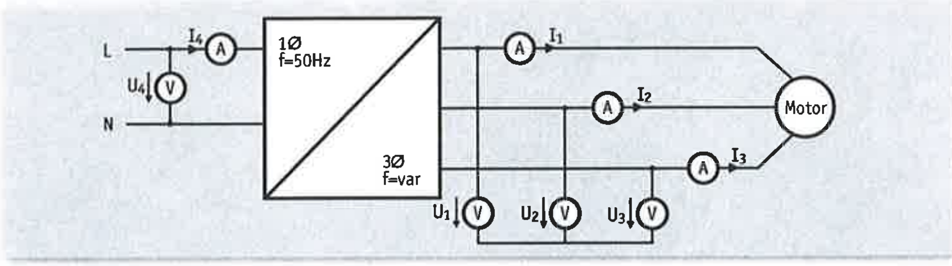
Measurement on two systems with different frequencies

In wiring A:1+2 B:3+4, the ARON circuit is two times used. The block diagram shows that only one LMG450 is needed for complete measurement. Generally frequency converters for speed variable drives or frequency conversion have no neutral on input or output.



60Hz -> 400Hz

The following block diagram applies wiring A:1+2+3 B:4 and is typical for a low power speed variable drive. This example is used to explain the settings and displays of the LMG450. The screenshots were made with the free software BMP2PC from ZES ZIMMER.

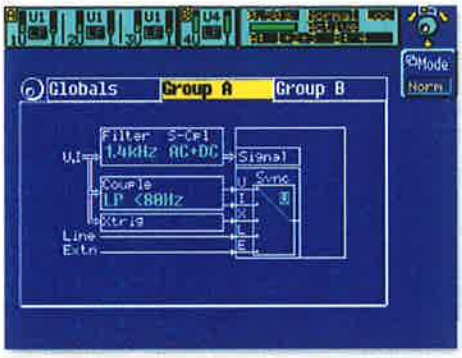


50Hz -> f=variable

1 Setting of global parameters, e.g. wiring (see table at previous page)

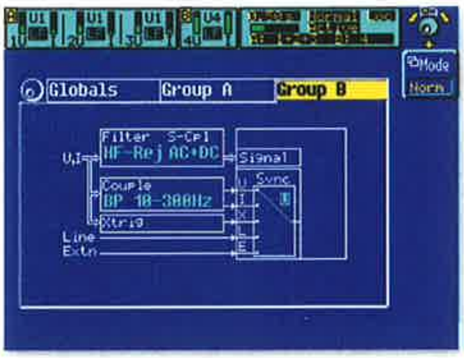
1

2 Configuration of measuring inputs and sychronisation source for group A



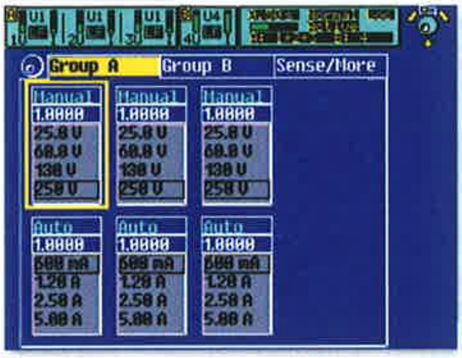
2

3 Configuration of measuring inputs and synchronisation source (same as picture 2, but for group B)



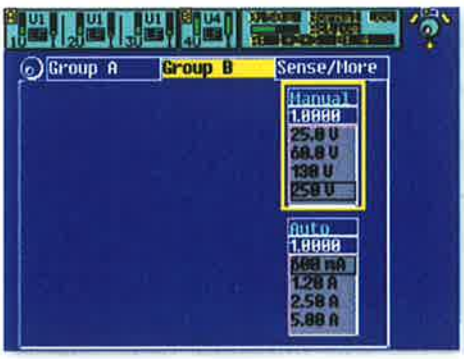
3

4 Measuring ranges, autorange or manual, setting of scaling factors for external CT's or VT's (group A)



4

5 Measuring ranges, autorange or manual, setting of scaling factors for external CT's or VT's (group B)



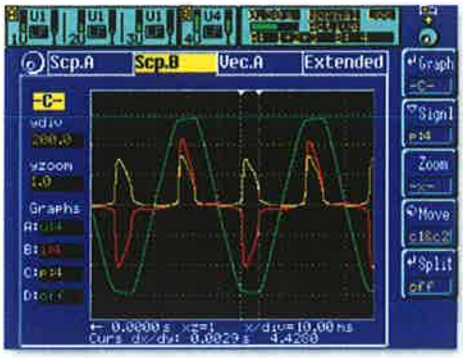
5

6 Display of different plugged external current sensor devices from ZES ZIMMER, here the bottom one is in use (enabled)

6

7 Scope of power (yellow), current (red) and voltage (green) of the frequency converter single phase input

8 Scope display of the low pass filtered 3Ø output, the chopper frequency is no more contained because of being outside the filtered range



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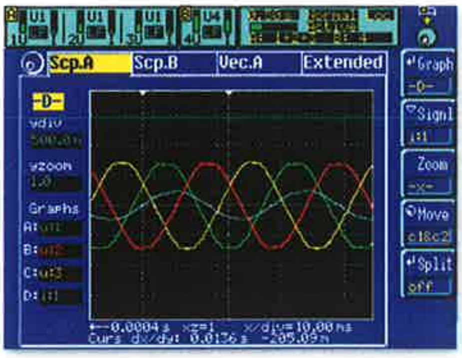
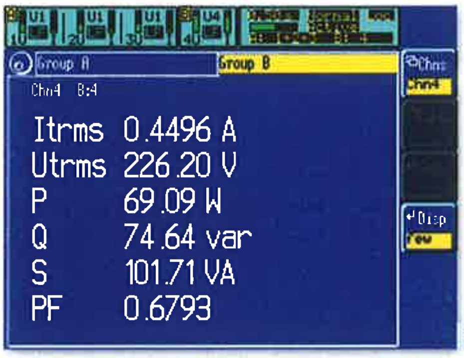


8

9 Large display with six important values of the frequency converter input, measured in group B

10 Phase values and summing values of the frequency converter 3Ø output gives a quick overview (group A)



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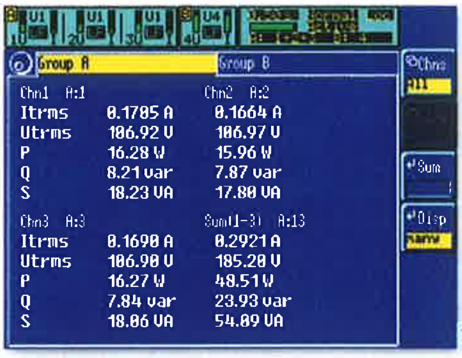
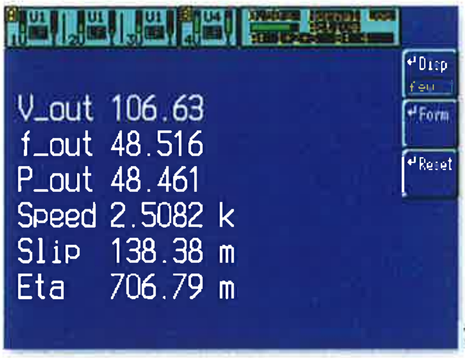


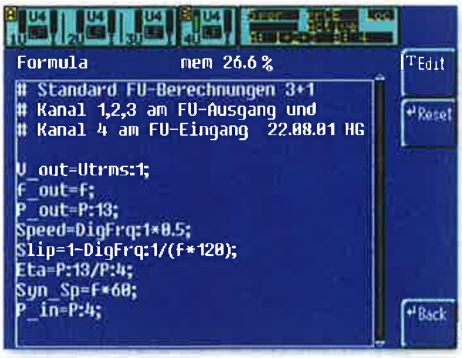
10

11 Efficiency, slip, speed and other interesting values calculated by user defined formulas

12 The formula editor provides the individual calculations shown in picture 11



11

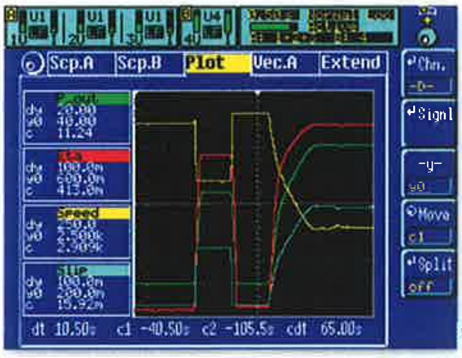


12

13 Vector display of 3Ø systems immediately checks the phase sequence and shows phase interchanges

14 Plot display works like a strip chart recorder and can plot all measured or formula calculated values

13



14

15 Harmonic analysis conform to CE standards (precompliance tests)

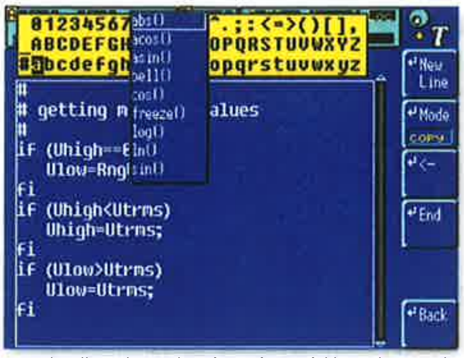
16 Frequency spectrum for current, voltage (as bar chart), with CE-limits, linear or logarithmic

15

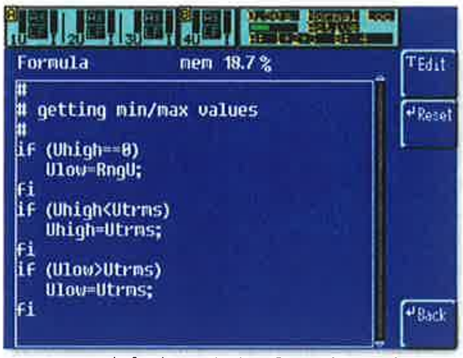
16

All necessary functions in the basic device:
- **Printer interface**
- **RS232 interface**
- **Formula editor**
- **Harmonics analysis for CE pre-compliance**

All necessary functions are included in the basic device at reasonable price. Printer and RS232 interfaces, formula editor, harmonics analysis of current and voltage for pre-compliance tests in accordance with EN61000-3-2.

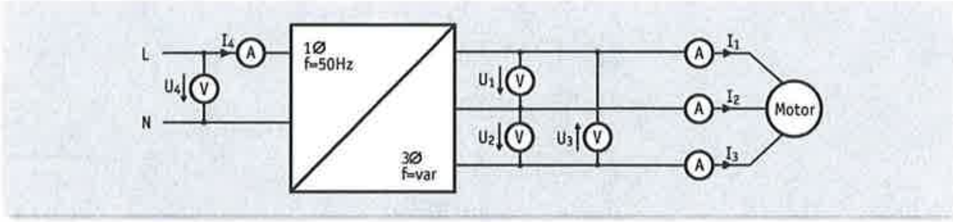


Formula editor: the window shows the available mathematical formulae, functions and logical conditions



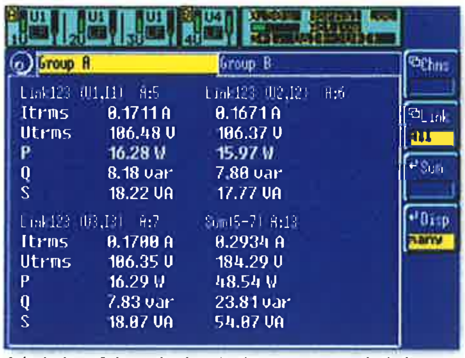
Program example for the monitoring of overvoltage and undervoltage

Options
- **Star-Delta Conversion**
  Part No. L45-06

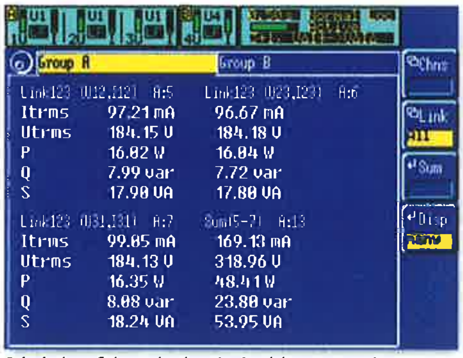


50Hz -> f=variable, instrument for motor measurement in I UΔ wiring*

For detailed test and evaluation of 3Ø motors the electrical quantities for each winding phase is needed. In some cases you have access to the motor terminal block with start and end of all three windings. Then you can measure all what you need. But in most cases the motor has only three terminals and the internal star point or the delta winding as to measure its current is not accessible. Also far away from the motor you have only the three wires. With the option star-delta conversion you have the capability to calculate the not accessible values (e.g. voltages, currents, power, harmonics). This intelligent solution with an additional DSP works well at all waveforms and every unbalance of mains and load. Simply connect the voltage paths in delta and click the current clamps around the wires. Select the internal connection of your load and press the „Link" softkey.



Calculation of the real values in the star connected winding phases (wiring: 3+1, UΔ I -> U* I*)*



Calculation of the real values in the delta connected winding phases (wiring: 3+1, UΔ I -> UΔ IΔ)*

Further options:

IEEE488 interface
(Part No. L45-01)
Interpretation of the complete SCPI, as well as the LMG450 specific command set. The data transfer yields up to 1Mbyte/sec.

Disk or memory card
(Part No. L45-02F or L45-02)
The two memory media, disk or memory card, can be used as required. They serve to record measured and sampled values and to save and recall device settings (setups).

Flicker meter
(Part No. L45-04)
Compliant to EN61000-4-15. The evaluation of the voltage fluctuations by currents up to 16A compliant to EN61000-3-3, by currents up to 75A compliant to EN61000-3-11.

Process signal interfaces, digital and analog inputs and outputs
(Part No. L45-03)
To monitor further process magnitudes like revolution, torque etc. With assistance of the formula editor efficiency and other magnitudes can be deduced and be applied as control parameters.

Harmonics up to 99th from U, I and P
(Part No. L45-08)
The harmonics up to 99th option can be used to analyse current, voltage and power related to the fundamental ranging from 1Hz to 1.2kHz. It is possible to detect interharmonics by a selectable division factor giving a new fundamental as reference.

Transients
(Part No. L45-05)
The transients option detects peaks and dips up to a resolution of 20µsec, scanning taking place at 50kHz.

Torque determination
(Part No. L45-016)
Precision Power Meter Series LMG calculates torque and speed of three-phase asynchronous motors from motor current and voltage without torque measuring shaft.

Dimensioning of insulation for all standard low voltages

The measurement inputs are dimensioned for 600V/CAT III, with option L45-015 up to 1000V. This makes it possible to measure in all standard 3-phase low voltage networks.
The adjacent table shows that the voltage "Line to Neutral/ Earth" is always less than 600V.

3 Phase/ 4 Wire	3 Phase/ 3 Wire	Line to Line Voltage	Line to Neutral/Earth
66/115V		115V	66V
	120V	120V	69V
120/208V		208V	120V
	240V	240V	139V
230/400V		400V	230V
277/480V		480V	277V
	500V	500V	289V
400/690V		690V	400V
	1000V	1000V	578V

Technical Data

Voltage measuring ranges

Nominal value /V	6	12.5	25	60	130	250	400	600
Maximum trms value /V	7.2	14.4	30	60	130	270	560	720
Maximum peak value for full scale /V	12.5	25	50	100	200	400	800	1600
Overload capability	1500V for 1s							
Input impedance	1MΩ, 20pF							

Current measuring ranges

Nominal value /A	0.6	1.2	2.5	5	10	16
Maximum trms value /A	1.3	2.6	5.2	10	18	18
Maximum peak value for full scale /A	1.875	3.75	7.5	15	30	60
Overload capability	18A permanent, 50A for 1s, 150A for 20ms					
Input impedance	2mΩ					

Isolation All direct current and voltage inputs of power measuring channels against each other and against earth isolated, max. 600V/CAT III

Voltage measuring ranges for external isolated current transduceers

Nominal value /V	0.12	0.25	0.5	1	2	4
Maximum trms value /V	0.15	0.3	0.6	1.2	2.5	5
Maximum peak value for full scale /V	0.25	0.5	1	2	4	8
Overload capability	250V for 1s					
Input impedance	100kΩ, 10pF					

Measuring range selection Automatic, manual or remotely controlled

Measuring accuracy

Measuring accuracy	± (% of measuring value + % of measuring range)				
	DC	1Hz..1kHz	45...65Hz, AC-Coupling	1kHz..5kHz	5kHz...20kHz
Voltage	0.2+0.2	0.1+0.1	0.05+0.05	0.2+0.2	0.3+0.4
Current (direct)	0.4+0.4	0.15+0.1	0.05+0.05	0.2+0.2	0.5+0.5
Active power (direct)	0.5+0.5	0.2+0.1	0.07+0.04	0.3+0.2	0.6+0.5
Current (via ext. current transducer)	0.2+0.2	0.1+0.1	0.05+0.05	0.2+0.2	0.3+0.4
Active power (via ext. current transducer)	0.3+0.3	0.15+0.1	0.07+0.04	0.3+0.2	0.6+0.5

Accuracies based on:
1. sinusoidal voltage and current
2. ambient temperature (23 ± 3) °C
3. warm up time 1h
4. definition of power range as the product of current and voltage range, $0 \le |\lambda| \le 1$, (λ=Power factor=P/S)
5. calibration interval 12 month

Other values: All other values are derived from the current, voltage and active power values. Accuracies for derived values depend on the functional relationship (e.g. $S = I * U$, $\Delta S/S = \Delta I/I + \Delta U/U$)

Synchronization The measurement is synchronized on the signals period. There is a choice to determine the period from u(t), i(t), p(t), further $u^2(t)$, $i^2(t)$ by using a settable filter . By this very stable readings are achieved, even at signals of pulse width modulated frequency inverter and amplitude modulated electronic ballast, synchronization also with external signal or „Line"

Scope function Graphical representation of sampled values over the time

Plot function Time diagram of max. four readings, minimal resolution 50ms

Harmonic analysis prCE Harm Measuring of current and voltage according to EN61000-4-7 with evaluation according to EN61000-3-2 (Pre-compliance)

Harmonic analysis Harm100 Analysis of current, voltage and power up to 99th harmonics (max. 10kHz), in total 100 harmonics, when including DC part. Fundamental in the range from 1Hz to 1.2kHz. By selectable integer divider (1...50) a new reference fundamental can be created as to detect interharmonics.

Flicker measuring Flicker Meter according to EN61000-4-15 with evaluation according to EN61000-3-3

Transients – monitoring and storing Storing and graphical displaying of transients with a resolution of 20µs. Storing depth is 1.4 Millions sample values/channel, selectable recording duration from 0.05 to 60 seconds. Adjustable pre-trigger, different possibilities of triggering

Computer interfaces Interfaces: **RS232** and **IEEE488.2**, only one interface can be used at the same time
Remote control: All functions can be remote controlled, keyboard lock for measuring parameters available
Output data: Output of all readable data, data formats equal for all interface types, SCPI command set
Transfer rate: RS232: max.115200 Baud, IEEE488.2: max. 1MByte/sec

Printer interface Parallel PC-Printer interface with 25-pin SUB-D socket for printing measuring values, tables, graphics to matrix, inkjet or laser printers

Processing signal interface 25 pin SUB-D socket with (The option processing signal interface can be built in twice):
- four analog inputs for registration of process magnitudes (16Bit, ±10V, 1kHz)
- four analog outputs for output of readings or measured magnitudes (16Bit, ±10V, 100kHz)
- four digital inputs for registration of states (1kHz, U_{LOW}<1V, U_{HIGH}=4...60V/2.5mA)
- four digital outputs to signal states and alarms (open collector, output high max. 30V@100µA, output low max. 1.5V@100mA)
- one input for registration of frequency (0.1Hz...500kHz) and rotation direction of motors (U_{LOW}<1V, U_{HIGH}=4...10V, 1MΩ)

In- and outputs are isolated groupwise against each other and against the other electronics (testing voltage 500V)

Other data

Display	STN colour display, 320 x 240 pixel, 5,7"
Dimensions	- Bench case, W 320mm x H 147mm x D 307mm - 19"-chassis, 84PU, 3HU, D 307mm
Weight	about 6,5kg
Protection class	EN61010 (IEC1010, VDE0411), protection class I, overvoltage category III
Electromagnetic compatibility	EN50081, EN50082
Protection system	IP20 in accordance to DIN40050
Operating/storage temperature	0...40°C, -20...50°C
Climatic class	KYG in accordance to DIN40040
Power supply	85...264V, 47...440Hz, about 45W

LMG450 accessories

ZES ZIMMER compensated current clamps

Nominal value /A	1.25	2.5	5	10	20	40
Permissible trms value /A	2.5	5.0	10	20	40	80
Permissible peak value for full scale /A	3.75	7.5	15	30	60	120
Overload capability	500A for 1s					
Max. cord diameter	12mm					
Isolation	300V/CAT III, 600V/CATII					

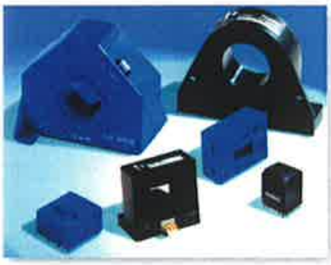
Part No.
L45-Z06 (1 pc.)
L45-Z07 (Set of 4 pc.)

Measuring accuracy of clamp	Current: ± (% of measuring value + % of measuring range) / Phase: degrees					
	1Hz...10Hz	10Hz...45Hz	45Hz...1kHz	1kHz...5kHz	5kHz...20kHz	20kHz...50kHz
Current	1.5+0.25	0.4+0.15	0.15+0.05	0.3+0.15	1.0+0.25	4.0+0.5
Phase	6	3	0.5	2	6	20

Hall current sensors for range extension

Part No.	Current nominal	trms	peak	Supply
L45-Z28-Hall50	35A	50A	70A	Internally
L45-Z28-Hall100	60A	100A	120A	by LMG450
L45-Z28-Hall200	120A	200A	240A	via HD15
L45-Z29-Hall300	250A	300A	500A	Externally e.g. with
L45-Z29-Hall500	400A	500A	800A	ZES power supply for
L45-Z29-Hall1000	600A	1000A	1200A	up to four sensors
L45-Z29-Hall2000	1000A	2000A	2100A	Part No. SSU-4

Current transducers with Hall effect sensors for range extension of LMG450, DC...20kHz, accuracy class 0,5 connected to LMG450 via HD15 sensor input, incorporated EEPROM for scaling and adjustment data as well as data for automatically setting of appropriate current range



Power supply unit for up to 4 Sensors
Part No. SSU-4

Power supply unit for up to 4 Sensors for L45-Z29 and PSU-600 series, device fitting under LMG450/95, design equal to NDL5 (see below)

Adapter for 3-phase measurements
Part No. LMG-MAK3

- CEE-Plug, 5 pins, 16A, 2m supply cord
- CEE-Socket, 5 pins, 16A, for EUT
- Socket for supplying the meter LMG450
- 4mm safety sockets, measuring access to current and voltage
- Safety acc. IEC61010: 300V/CAT III

RS232 - Ethernet - converter, 10/100mbit
Part No. L45-Z318

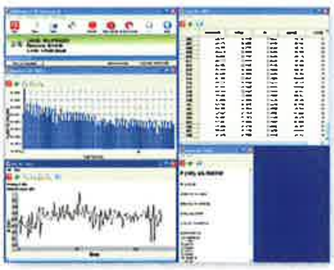
External adaptor, all connectors will fixed at the LMG, supply by LMG

PC Software
Order no. LMG-CONTROL-B

PC software for data transfer, configuration and visualisation, Modular design, saves and loads device configurations. Interactive mode to set up the measurements. Recording and storage adds timestamps with accuracy in the range of milliseconds. Analysing modules for different applications. Basic version is free of cost.

Order no. LMG-CONTROL-WA

Additional module for LMG-CONTROL, logging and analysis of all sampling values of the LMG, harmonic analysis up to 1MHz, frameanalyser, logging of transients.



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Attachment #2
10 pages

KRAL Volumeter® – OMG Series.
Universal Flowmeters.

KRAL

OMG.
Flowmeters for a wide range of applications.

Operating conditions and materials.

☐ Flow Range:	0,1 to 7.500 l/min.
☐ Max. Pressure:	250 bar.
☐ Temperature Range:	-20 to 200 °C.
☐ Viscosity Range:	1 to 1 x 10^6 mm^2/s.
☐ Liquid:	chemically neutral, lightly lubricative, clean, non-abrasive.
☐ Accuracy:	±0,1% of rate.
☐ Casing:	cast iron EN-GJS-400.
☐ Spindles:	nitrided steel.
☐ Ball Bearings:	bearing steel.
☐ Seals:	Viton®.

KRAL Volumeter® – the original.

KRAL developed the Volumeter over 20 years ago as a solution to an internal requirement. We needed a precision flowmeter as part of our production test stands but could not find a flowmeter that would meet our demands of accuracy, rangebility and robustness. Since we had expertise gained from 30 years of manufacturing positive displacement pumps, we had the idea to turn around the working principle of the pumps. Instead of a motor driving the pump spindles, we used flowing liquid to rotate the spindles. We found the ideal solution to assure precision, and reduce pressure drop, even for diverse operating conditions. Since then the KRAL Volumeter® line has grown to meet a wide variety of industrial needs.

Robust and precise.

In most flow measuring instruments robustness and precision are mutually exclusive, but the OMG offers both.

At KRAL, our core competence in profiling screw spindles guarantees precision measuring chambers in the meter. Therefore extremely accurate measurements are possible and the OMG's operation is smooth and responsive. This is evident in quick recovery time when there is rapid flow fluctuation and pressure loss.

The OMG is an extremely sturdy design and protecting it against vibrations and mechanical loads that are typical in industrial plants.

Wide range of operating conditions.

Flowmeters are often specified for a given set of operating parameters. The performance of those meters may suffer if those operating parameters change.

Being a precision-made spindle PD meter, the exact measurement of the OMG covers a wide range of:
- ☐ liquids
- ☐ viscosities
- ☐ temperatures

Any selection of an OMG meter is therefore suitable for a wide variety of applications.

Easy installation.

There is often limited space available to install a flowmeter.

KRAL Volumeter are extremely compact devices. They are also insensitive to flow disturbances, so there are no upstream or downstream installation requirements. The OMG is also able to measure in any installation position, horizontal or vertical. Even bi-directional flow can be measured precisely.

The solution.

Wide range of applications.

As a PD meter, the OMG covers a wide range of liquids and viscosities. OMG has a turn-down ratio up to 100:1.

Compact design.

The axial arrangement of the measurement system allows laminar flow with no change in direction making it a very compact design.

Fast response measurement.

The fast response spindles can follow any rapid fluctuations in the flow causes by pulsations.

High accuracy.

Because of the precision measurement chamber, extremely accurate measurements are possible.

Minimal pressure loss.

The precision screw design of the Volumeter operates with minimal friction and pressure loss.

Various connections.

Available are:

- ☐ Pipe thread
- ☐ DIN flange, ANSI, SAE and JIS
- ☐ Custom

No flow conditioning.

The OMG operating principle is insensitive to flow disturbances. Flow conditioners are not required. Valves and pipe elbows are allowed close to the flowmeter. That allows for easy installation in tight spaces.

Robust and precise.

The rigid casing protects precisely manufactured spindles. That is why the OMG offers both robustness and precision.

Bi-directional flow measurement.

Because of the operating principle, bi-directional flow can be measured. With a flow direction sensor, a change of the flow direction or brief reverse flow can be detected and measured.

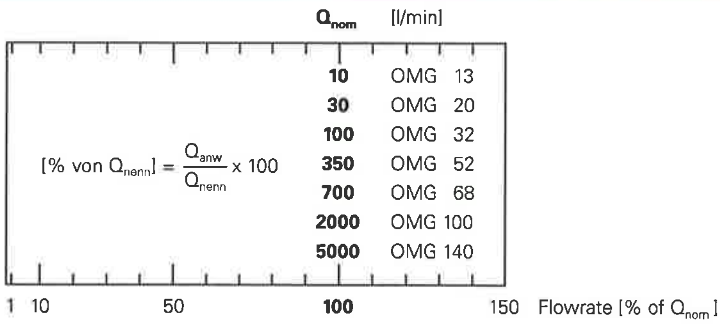
Standard output signal.

The flow sensor output signal is an industry standard square wave.

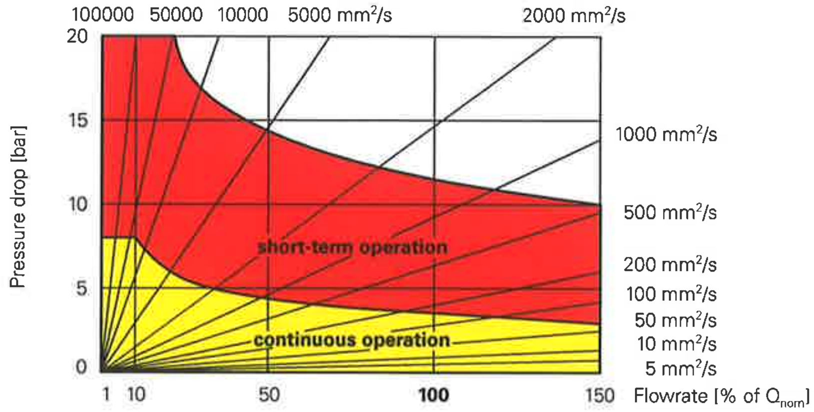
A dry sleeve seals the meter completely, for troublefree sensor installation and verification.

The following questions can assist you in selecting an OMG meter.	Explanation.	Instructions.	Notes.
Which size is suitable for the flow range to be measured?	The selection of the correct size ensures a long service life, high measuring accuracy and an excellent cost-utilization ratio.	From the **Size** table, select a size, OMG 13 - 140, whose nominal flowrate, Q_{nom}, is near that of your application, Q_{app}. Then calculate flowrate in [% of Q_{nom}] using the equation shown at right.	The value of flowrate [% of Q_{nom}] is used in the following diagrams. Draw a line downward from this value to intersect the same value in the other diagrams. Moving the line left or right shows the effects of meter size on load rating and linearity.
Does the selected unit have the required service life? **What is the pressure drop?**	Service life and pressure drop are important factors in selecting a meter size. Verify that your selection will meet your expectations of service life and pressure drop. For increased service life and reduced pressure drop, select a larger size. This will reduce the flowrate [% of Q_{nom}] for a given application.	In the **Load rating** diagram, find the intersection point of the flowrate [% of Q_{nom}] and viscosity [mm²/s] for your application. To the left of this point, find the pressure drop for the nominal flow of your application. The color range where the point lies signifies either continuous operation (yellow) or short-term operation (red). A point in the white range is not a recommended load rating for an OMG.	The range of short-term operation can be purposely used for short times, such as a load reserve or safety factor.
What is the measuring accuracy of the selected unit?	High accuracy is expected from PD meters. The OMG delivers excellent accuracy over a wide range of flows. For the highest accuracy, linearization is possible. The KRAL BEM 500 can linearize the meter's performance curve for a defined viscosity. Special calibration may be required.	With the flowrate [% of Q_{nom}] and viscosity [mm²/s] you can obtain the meter accuracy curve from the **Linearity** diagram. Yellow range signifies: The device operates within the range of maximum accuracy of ±0,1% of rate. Orange range signifies: The meter accuracy is within the limits of ± 0,3% of rate.	The OMG begins measuring at an extremely low flowrate, due to very low slippage past the spindles. As viscosity increases, so does the linear region of the accuracy curve.

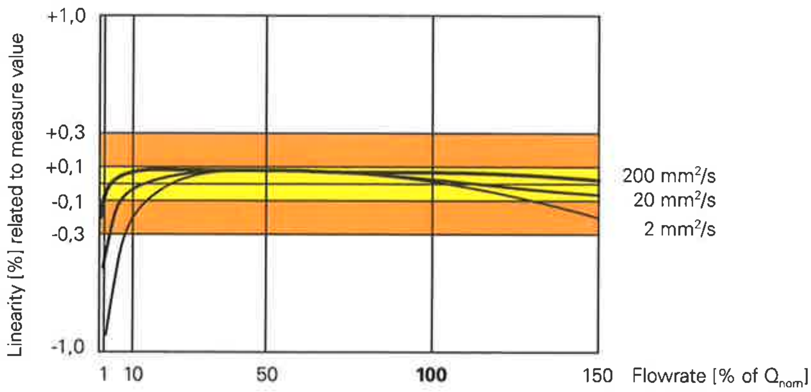
Size.



Load rating.



Linearity.



Are precision and sturdiness of the KRAL Volumeter fully utilized?

The OMG combines service life and accuracy to produce a measuring range of unmatched magnitude. Since normal flow conditions are never static, a wide range of acceptable viscosities and flows is important for precise measurement.

The **Measuring range** diagram provides a visual impression of the wide measurement range available with a Volumeter.

① This is where accurate operation of the OMG starts.

② The OMG can be operated continuously up to this line.

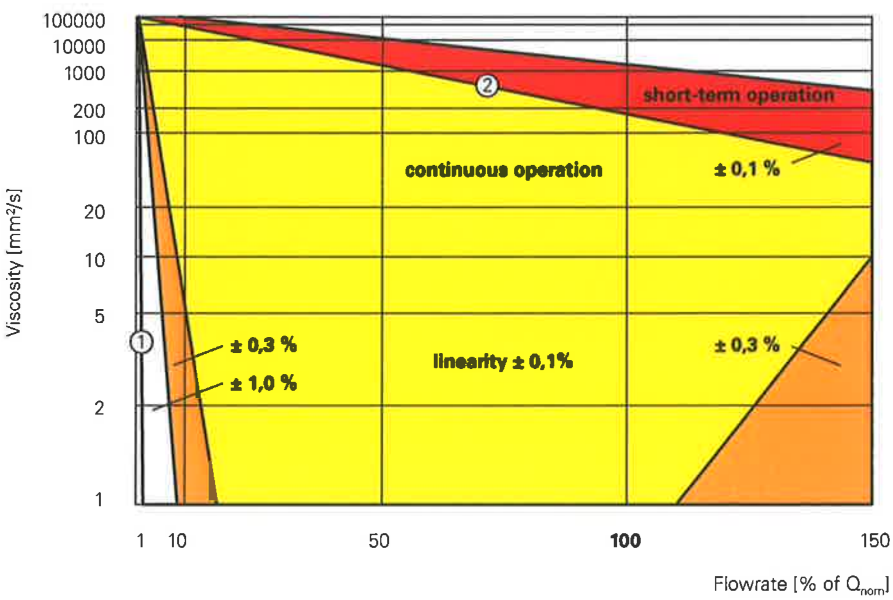
Notice the wide range of conditions where the OMG will measure with a linearity of ±0,1% of rate.

Yellow range signifies: Best combination of accuracy and service life.

Orange range signifies: The meter is suitable for continuous operation with an accuracy of ±0,3% of rate.

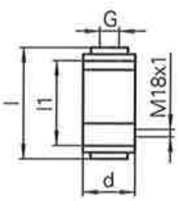
Red range signifies: Short-term operation. The linearity will be within ±0,1% of rate.

Measuring range.

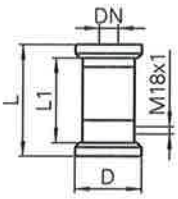


Technical data.		OMG 13	OMG 20	OMG 32	OMG 52	OMG 68	OMG 100	OMG 140
Flow								
Q_{max}	l/min	15	45	150	525	1050	3000	7500
Q_{nenn}	**l/min**	**10**	**30**	**100**	**350**	**700**	**2000**	**5000**
Q_{min}	l/min	0,1	0,3	1	3,5	7	20	50
Pressure p_{max}	bar	250	250	250	160	100	40	40
Temperature t_{min} to t_{max}	°C	-20 to +200	-20 to +200	-20 to +200	-20 to +200	-20 to +200	-20 to +200	-20 to +200
Viscosity v_{min} to v_{max}	mm²/s	1 to 1x10⁶	1 to 1x10⁶	1 to 1x10⁶	1 to 1x10⁶	1 to 1x10⁶	1 to 1x10⁶	1 to 1x10⁶
K-Factor	K1 pulses/l	1216	640	234	71	39,8	16,8	8,85
	K2 pulses/l	2432	1280	468	142	79,6	33,6	17,7
	K3 pulses/l	7296	2560	1014	302	167	57,6	22,1
Frequency	f1 at Q_{nenn} Hz	203	320	390	414	464	560	738
	f2 at Q_{nenn} Hz	405	640	780	828	929	1120	1475
	f3 at Q_{nenn} Hz	1216	1280	1690	1760	1949	1920	1842

Dimensions/Weights.		OMG 13	OMG 20	OMG 32	OMG 52	OMG 68	OMG 100	OMG 140
G	**inch**	**1/2"**	**3/4"**	**1"**	**1 1/2"**	**2"**	**4"**	**6"**
p	bar	250	250	250	160	100	40	40
l	mm	145	145	215	295	355	480	645
d	mm	90	74	104	118	138	188	267
l1	mm	94	145	215	240	295	400	537
m	kg	4,6	4,1	11	18	29	70	180



DN	**mm**	**15**	**15**	**15**	**20**	**15**	**15**	**32**	**25**	**25**	**40**	**40**	**50**	**50**	**100**	**100**	**150**	**150**
PN	bar	40	160	250	40	160	250	40	160	250	40	160	40	100	16	40	16	40
L	mm	145	145	145	185	185	195	265	265	275	285	295	340	355	450	460	600	610
D	mm	95	105	130	105	105	130	140	140	150	150	170	165	195	220	235	285	300
L1	mm	94	94	94	145	145	145	215	215	215	240	240	295	295	400	400	537	537
m	kg	4,7	4,8	6,0	6,0	6,0	8,1	16	16	19	21	23	31	37	65	70	170	180



KRAL Electronics.

Sensor selection.

You have the choice between a PNP sensor for standard applications and an Ex-sensor for use in explosive areas.

Industry standard signals.

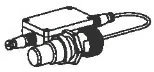
The BEG 40 sensor supplies PNP square wave signal. The BEG 41 Ex-sensor produces a Namur signal. Both of these can be processed by standard industrial interfaces.

KRAL Electronic BEM 300 and BEM 500.

For display of flowrate and consumption, the BEM 500 is an effortless solution. The compact unit is designed by KRAL to support the Volumeter as well as our various applications. BEM 300 is the economy single flowmeter device.

KRAL Industrial PC BEM 900.

For complex applications with up to 16 KRAL Volumeter connected, the pre-programmed BEM 900 is a perfect complement to OME. Beside flow and consumption measurement, this solution offers monitoring and data acquisition and evaluation.

Sensors. Amplifier.		BEG 43D	BEG 44	BEG 45 BEV 13	BEG 47D
Design M18x1					
Signal		PNP square wave inductive	PNP square wave inductive	PNP square wave inductive	Namur sine wave inductive
Material		Arcap/Ceramic	Arcap	Arcap	1.4401/Ceramic
K-Factor		K1	K2	K3	K1
Pressure p_{max}	bar	250	420	420	40
Temperature t_{min} to t_{max}	°C	-20 to 100	-40 to 150	-40 to 250	-25 to 100

Successful applications with the KRAL Volumeter OMG.

Fuel consumption measurement in boilers.

Liquid: heavy fuel oil.
Flowrate: 1,6 to 19 l/min.
Pressure: 40 bar.
Temperature: 130 to 150 °C.
Viscosity: 10 to 15 mm²/s.
Measuring device:
two OMG 20's.

The fuel consumption of the boiler is measured by determining the difference between the flow in the supply and return lines in order to:

- ☐ adjust the engine performance to an optimum
- ☐ continuously monitor the fuel consumption.

Since the fuel consumption makes up the greatest part of operating costs, high accuracy is important. Also at high temperatures, heavy fuel oil is aggressive and forms deposits.

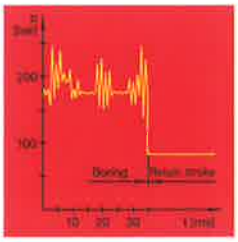
The accurate and self-cleaning OMG is perfect for this application.

Flow measurement in polyurethane blending.

Liquid: polyol, isocyanate.
Flowrate: 3,5 to 42 l/min.
Pressure: 250 bar.
Temperature: 10 to 80 °C.
Viscosity: 20 to 2.000 mm²/s.
Measuring device:
OMG 32.

Measuring task: Accurate flow measurement of components to maintain the proper blend.

Blend errors can result in flawed product, such as car dashboards that are sensitive to heat and sunlight. Problems such as these, which are not discovered until the product is delivered to the customer, can be avoided with accurate measurement before of the blending head. Precise, reliable measurements ensure proper, consistent blends, and no subsequent claims. The OMG meets these requirements.



Tunnel-boring hydraulics.

Liquid: hydraulic oil.
Flowrate: 0,3 to 45 l/min bi-directional.
Pressure: pulsating up to 250 bar.
Temperature: 40 to 80 °C.
Viscosity: 60 to 3.000 mm²/s.
Measuring device:
OMG 20.

The flowrate to the hydraulic cylinder of a tunnel-boring machine is measured in order to be able to determine the exact position of the boring bit. As the bit digs through dirt and rocks, the vibration is transmitted to the hydraulic cylinder as fluid pulsations. A diagram of these pulsations is shown above.

The OMG is trusted for reliable measurement in both flow directions although extreme vibrations and impacts occur during boring.

Returnability of measurement.

Each KRAL Volumeter is tested and calibrated on our in-house test bed. Depending on customer requirements, we perform either a factory calibration or a calibration in compliance to ÖKD (Austrian Calibration Service).

The factory calibration is KRAL Standard. Special standards requirements are also possible. As example, by adding further measurement points. ÖKD calibrated Volumeters are delivered to ISO IEC EN 17025 standards. The measured values are traceable to national standards. The measurement uncertainty of national standard to test unit is specified.

Our certified QA-system, in accordance with EN ISO 9001:2000, guarantees the highest quality and delivery reliability.

enderwerbung.com

KRAL

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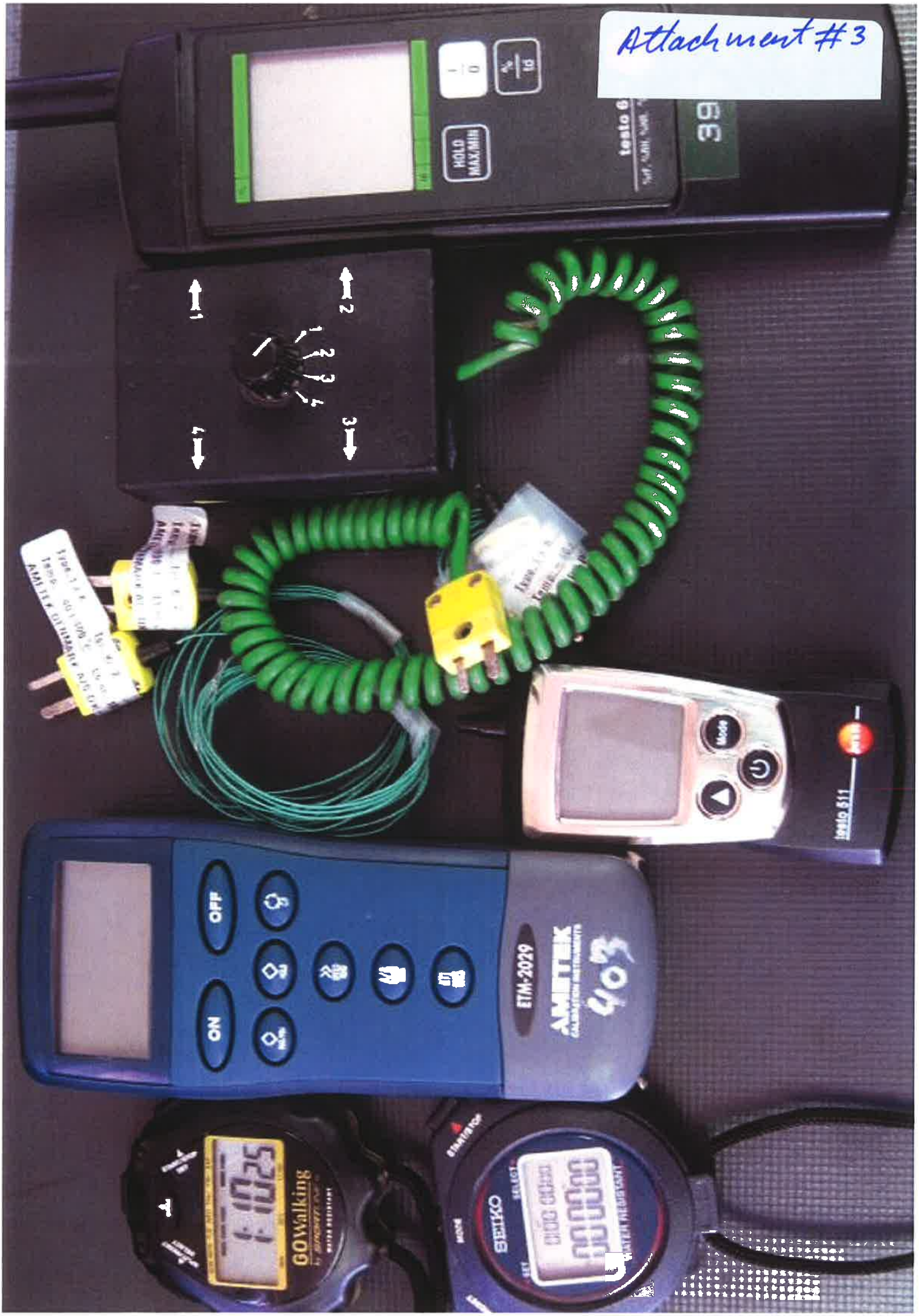
Änderungen vorbehalten 11/06.

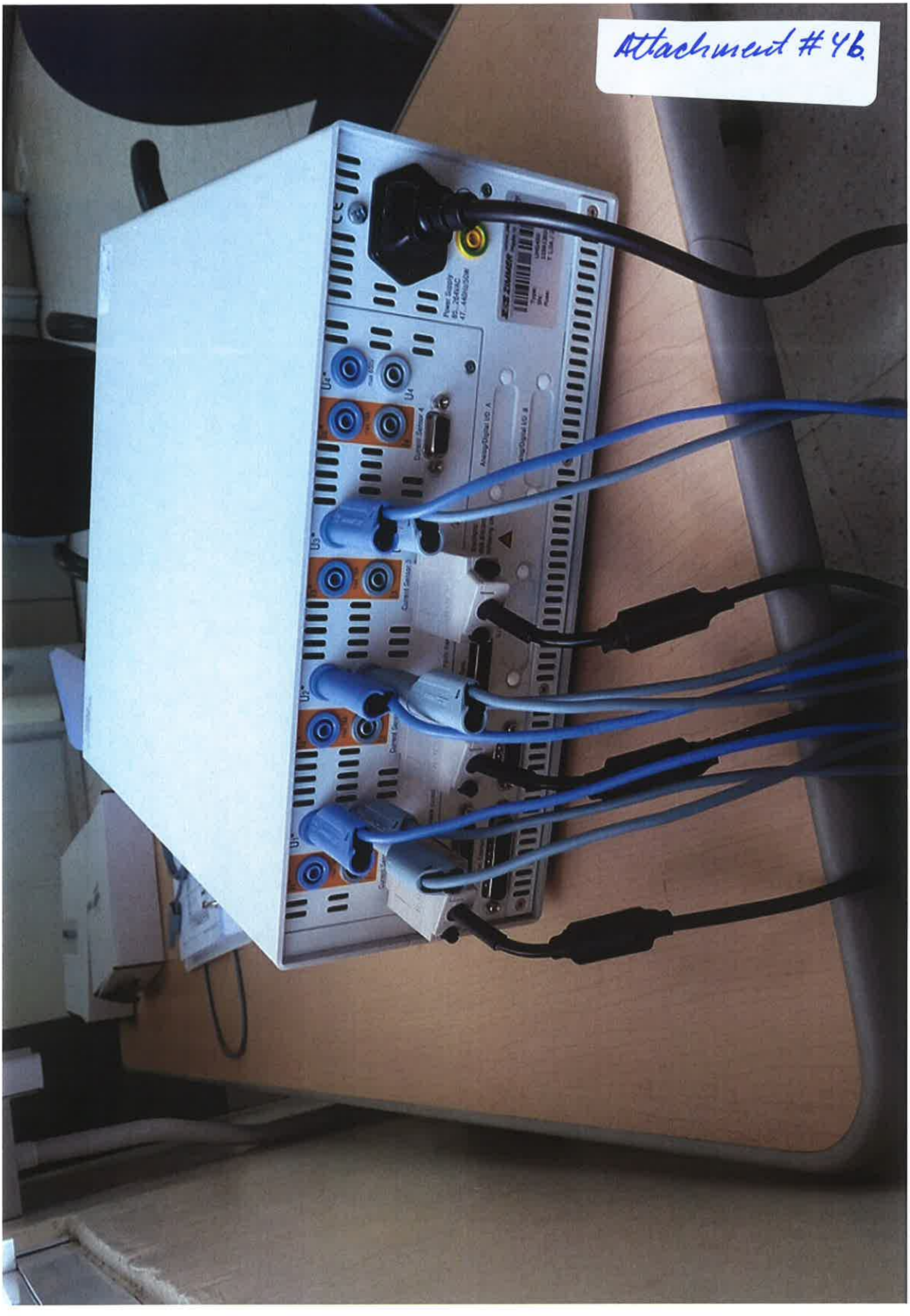
6285-05 KRAL VolumOMG 8s+2 en.in10 10 28.11.2006 10:00:24 Uhr

Attachment #3



Attachment #4a

Attachment #46.



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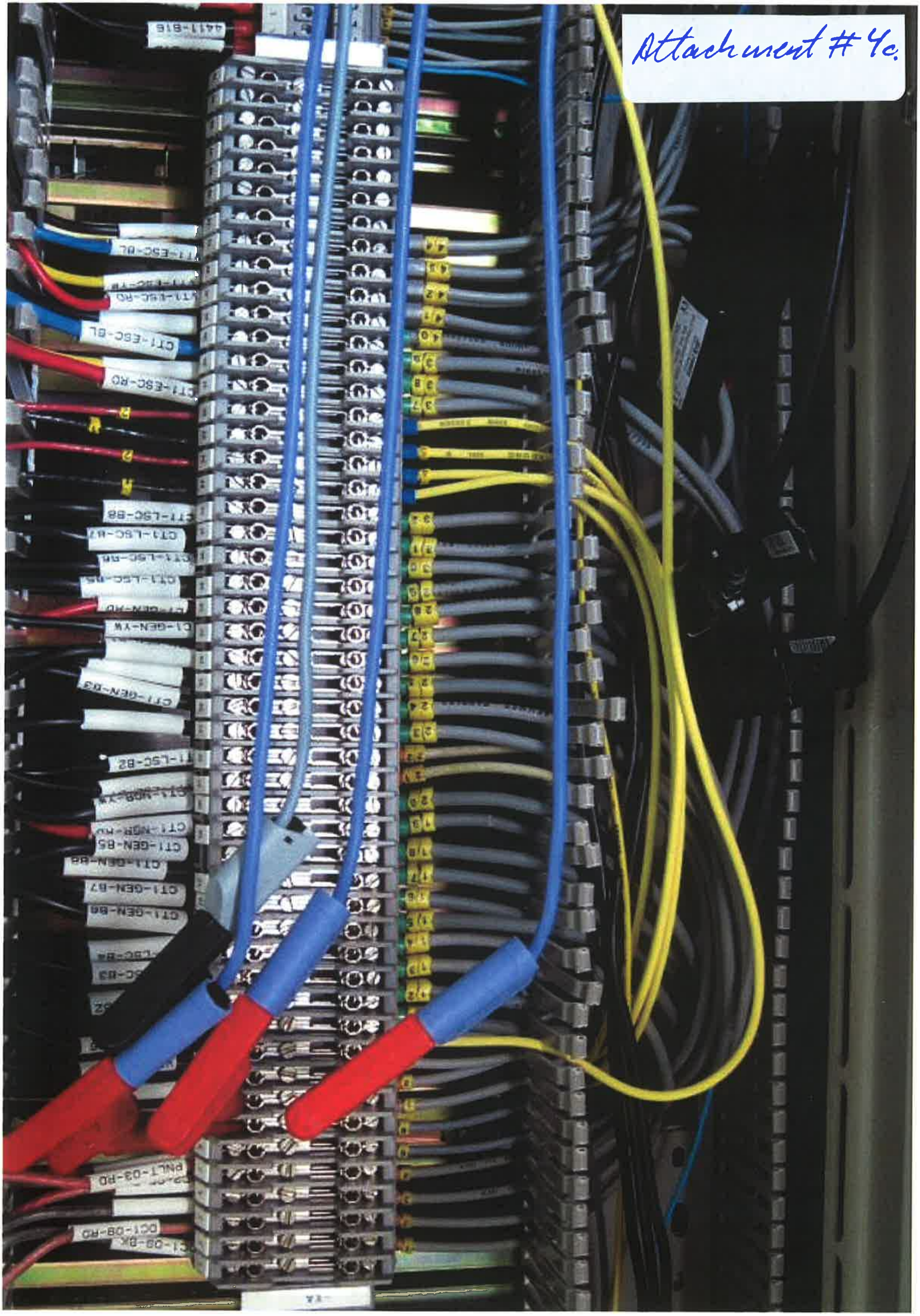
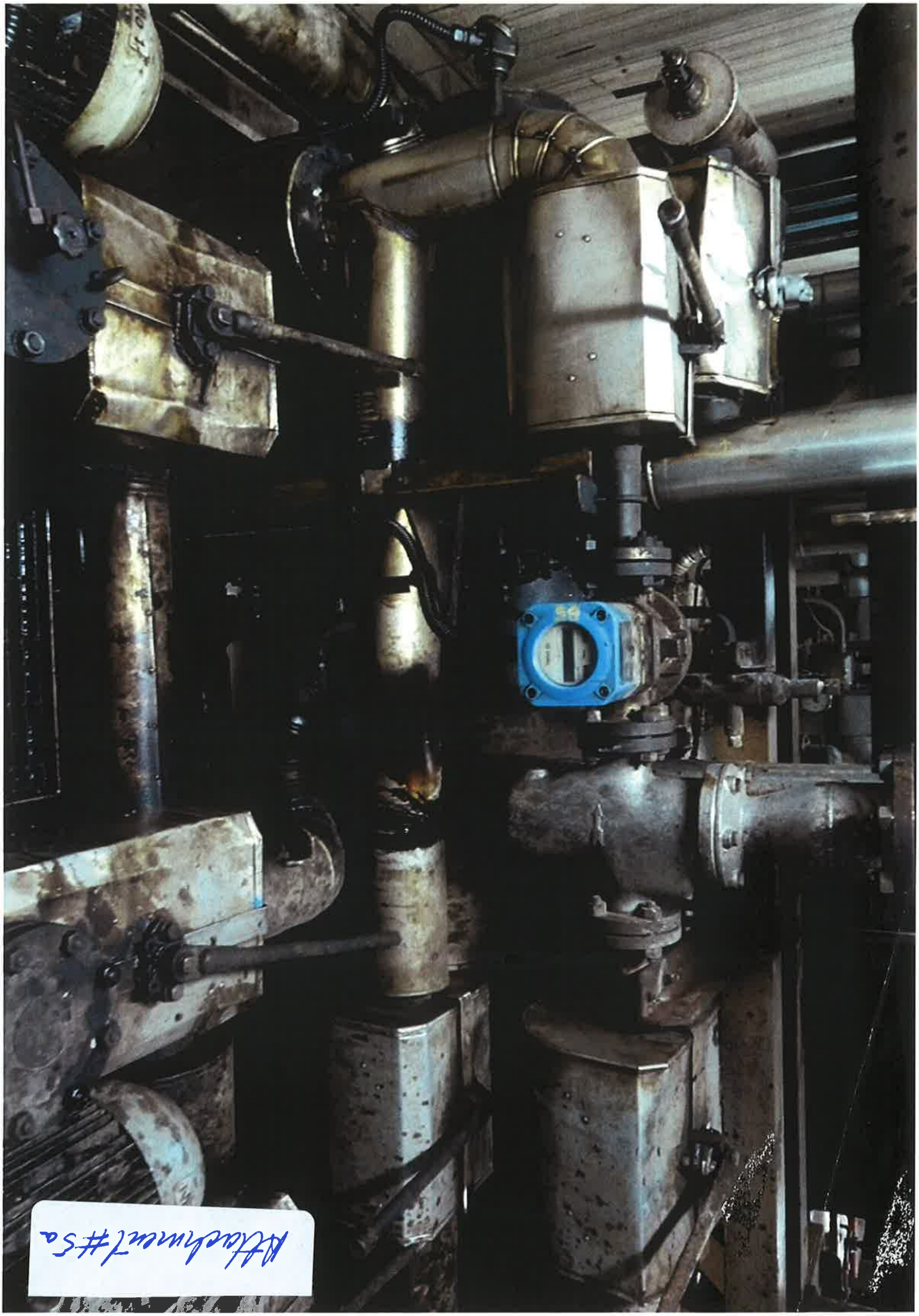
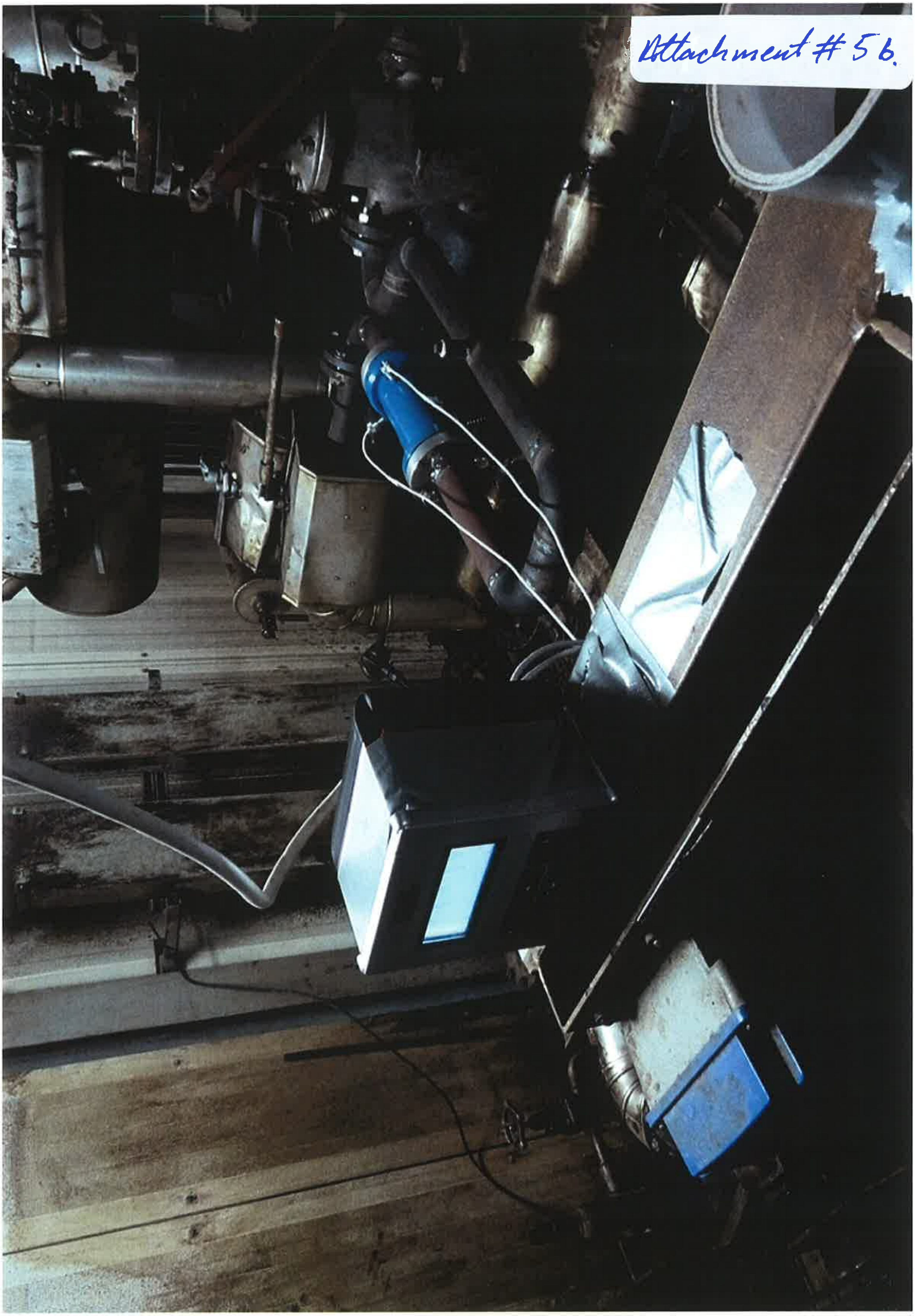




Attachment #5a

Attachment #5b.



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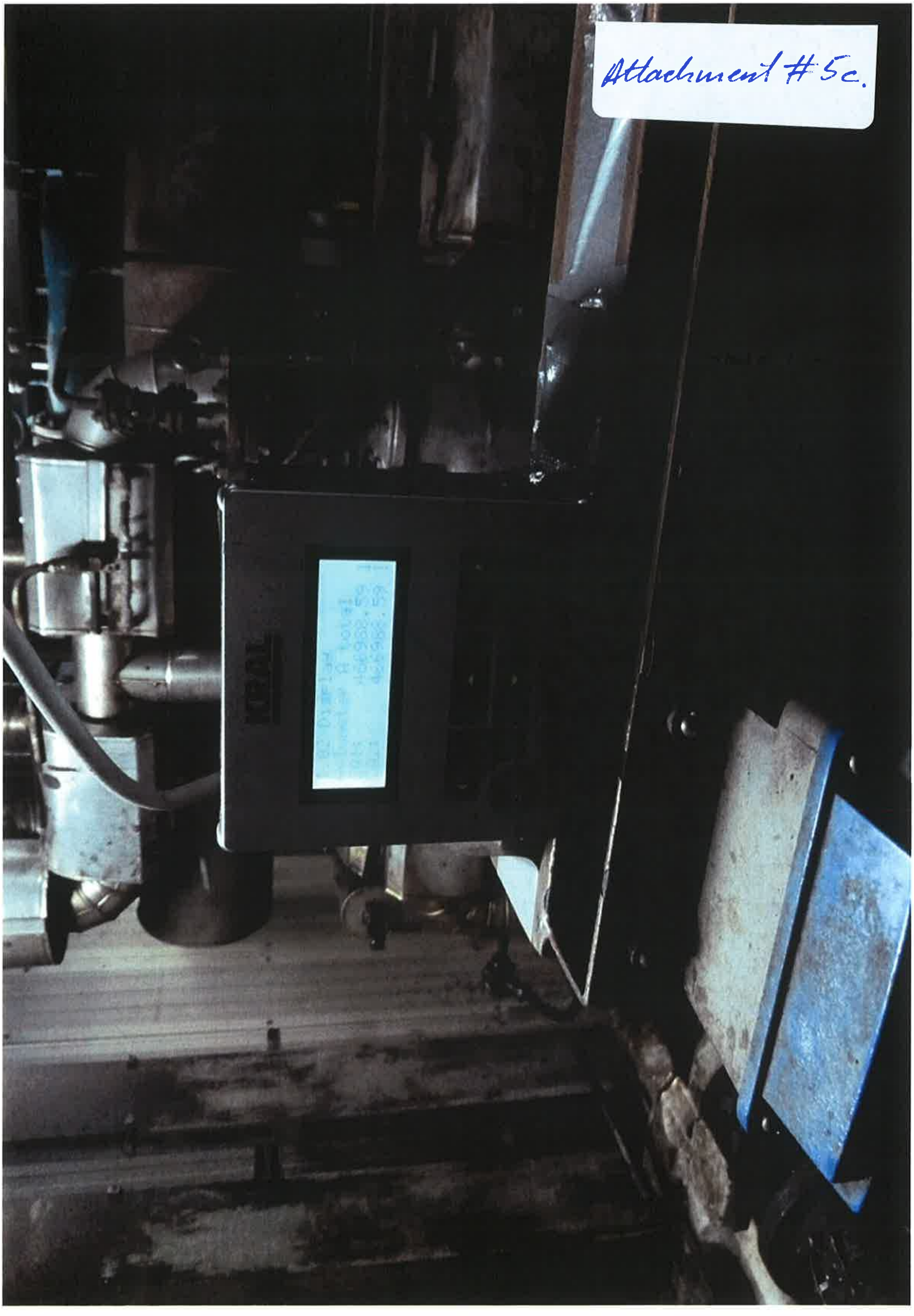
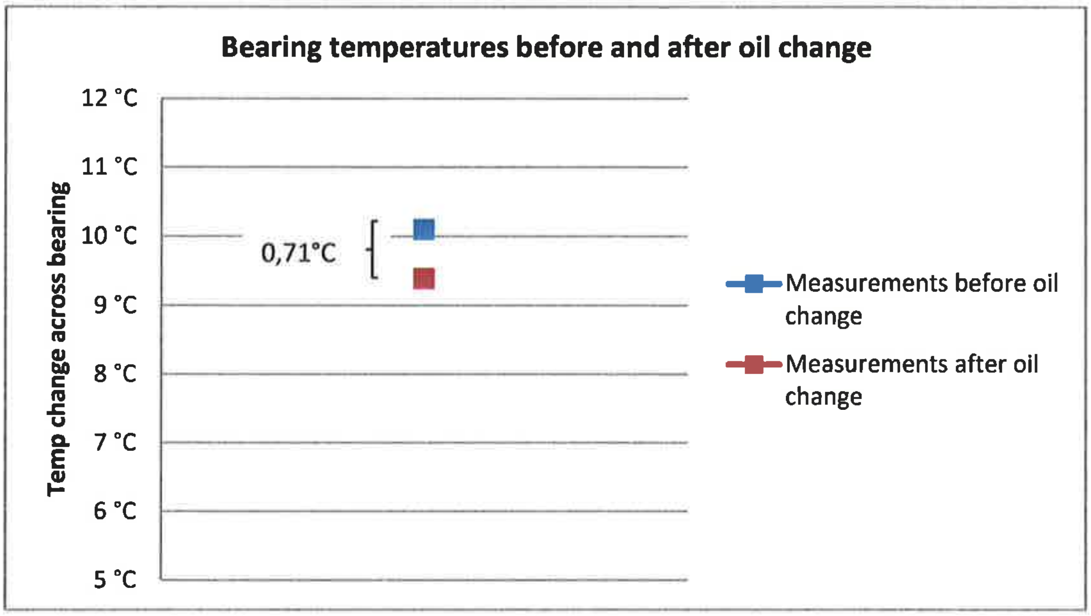


Measurements of bearing temperatures before and after oil change



Measurements before oil change ΔT average: 10,10 °C

10-apr	Temp before	Temp after	ΔT (°C)
cyl 1	41,7	50,4	8,7
cyl 2	41,7	52,7	11
cyl 3	41,7	52,7	11
cyl 4	41,7	46,6	4,9
cyl 5	41,7	51,8	10,1
cyl 6	41,7	53,9	12,2
cyl 7	41,7	52,8	11,1
cyl 8	41,7	53,5	11,8
cyl 9	41,7	52,1	10,4
Average	41,70	51,83	10,13

12-apr	Temp before	Temp after	ΔT (°C)
cyl 1	42,0	50,5	8,5
cyl 2	42,0	53,8	11,8
cyl 3	42,0	52,9	10,9
cyl 4	42,0	46,8	4,8
cyl 5	42,0	51,7	9,7
cyl 6	42,0	54,1	12,1
cyl 7	42,0	52,7	10,7
cyl 8	42,0	53,8	11,8
cyl 9	42,0	52,3	10,3
Average	42,00	52,07	10,07

Measurements after oil change ΔT average: 9,39 °C

15-apr	Temp before	Temp after	ΔT (°C)
cyl 1	42,2	50,2	8
cyl 2	42,2	53,3	11,1
cyl 3	42,2	52,8	10,6
cyl 4	42,2	47,3	5,1
cyl 5	42,2	51	8,8
cyl 6	42,2	53	10,8
cyl 7	42,2	52,3	10,1
cyl 8	42,2	53,8	11,6
cyl 9	42,2	52,3	10,1
Average	42,20	51,78	9,58

15-apr	Temp before	Temp after	ΔT (°C)
cyl 1	41,8	49,5	7,7
cyl 2	41,8	52,6	10,8
cyl 3	41,8	51,9	10,1
cyl 4	41,8	46,3	4,5
cyl 5	41,8	50,1	8,3
cyl 6	41,8	52,8	11
cyl 7	41,8	51,6	9,8
cyl 8	41,8	52,7	10,9
cyl 9	41,8	51,6	9,8
Average	41,80	51,01	9,21

Finn Hansson Attachment # 7

From: GT4000@dnvps.com
Sent: 4. maj 2013 15:41
To: Henrik.Bak.Weimar@maerskfluid.com
Subject: SPRING GARDEN GENERATION, BARBADOS, SAMPLE : ROT1315536

SPRING GARDEN GENERATION, BARBADOS
UNKNOWN
FUEL SPECIFICATION : MET

To: MAERSK FLUID TECHNOLOGY
Attn: HENRIK BAK WEIMAR

DNV Petroleum Services - Fuel Analysis Report dated: 04-May-2013

Installation: **SPRING GARDEN GENERATION, BARBADOS**

Sample Number	ROT1315536
Product Type	(HFO)
Sampling Date	10-APR-2013
Sampling Point	UNKNOWN
Sampling Method	UNKNOWN
Sent From	DENMARK
Date Sent	01-MAY-2013
Arrived at Lab	02-MAY-2013
Seal data	NO SEAL

Tested Parameter	Unit	Result	RMK380
Density @ 15°C	kg/m³	965.7	1010.0
Viscosity @ 50°C	mm²/s	359.7	380.0
Water	% V/V	0.1	0.5
Micro Carbon Residue	% m/m	9	22
Sulfur	% m/m	1.48	3.50
Total Sediment Potential	% m/m	LT 0.01	0.10
Ash	% m/m	0.03	0.15
Vanadium	mg/kg	77	600
Sodium	mg/kg	4	
Aluminium	mg/kg	LT 1	
Silicon	mg/kg	LT 1	
Iron	mg/kg	5	
Nickel	mg/kg	53	
Calcium	mg/kg	7	
Magnesium	mg/kg	LT 1	
Zinc	mg/kg	LT 1	
Phosphorus	mg/kg	LT 1	
Potassium	mg/kg	LT 1	
Pour Point	°C	LT 24	30
Flash Point	°C	GT 70	60

Calculated Values			
Aluminium + Silicon	mg/kg	LT 2	80
Net Specific Energy	MJ/kg	41.02	
CCAI (Ignition Quality)	-	827	

Note:
LT means Less Than, GT means Greater Than.

Operational Advice :

Approximate fuel temperatures:

Injection:
145°C for 10 mm²/s
125°C for 15 mm²/s
115°C for 20 mm²/s
110°C for 25 mm²/s

Transfer :
45°C

The ISO specification has been included for reference only.

The fuel as represented by this sample, marked as 'UNIT D14', is of an acceptable quality.

Best Regards,
On behalf of DNV Petroleum Services Pte Ltd
Bloemen Edwin
Technical Support Engineer

End of Report for SPRING GARDEN GENERATION, BARBADOS

Reference to part(s) of this report which may lead to misinterpretation is prohibited.

For technical or operational advice or further information on this report please contact us your nearest DNVPS office or contact us directly at
Tel : +31 10 2922600
Email : tvpnl155@dnvps.com

Finn Hansson *Attachment # 8*

From: GT4000@dnvps.com
Sent: 4. maj 2013 15:43
To: Henrik.Bak.Weimar@maerskfluid.com
Subject: SPRING GARDEN GENERATION, BARBADOS, SAMPLE : ROT1315537

SPRING GARDEN GENERATION, BARBADOS
UNKNOWN
FUEL SPECIFICATION : MET

To: MAERSK FLUID TECHNOLOGY
Attn: HENRIK BAK WEIMAR

DNV Petroleum Services - Fuel Analysis Report dated: 04-May-2013

Installation: **SPRING GARDEN GENERATION, BARBADOS**

Sample Number	ROT1315537
Product Type	(HFO)
Sampling Date	15-APR-2013
Sampling Point	UNKNOWN
Sampling Method	UNKNOWN
Sent From	DENMARK
Date Sent	01-MAY-2013
Arrived at Lab	02-MAY-2013
Seal data	NO SEAL

Tested Parameter	Unit	Result	RMK380
Density @ 15°C	kg/m³	965.7	1010.0
Viscosity @ 50°C	mm²/s	359.3	380.0
Water	% V/V	0.1	0.5
Micro Carbon Residue	% m/m	9	22
Sulfur	% m/m	1.48	3.50
Total Sediment Potential	% m/m	LT 0.01	0.10
Ash	% m/m	0.03	0.15
Vanadium	mg/kg	80	600
Sodium	mg/kg	4	
Aluminium	mg/kg	LT 1	
Silicon	mg/kg	LT 1	
Iron	mg/kg	5	
Nickel	mg/kg	55	
Calcium	mg/kg	8	
Magnesium	mg/kg	LT 1	
Zinc	mg/kg	LT 1	
Phosphorus	mg/kg	LT 1	
Potassium	mg/kg	LT 1	
Pour Point	°C	LT 24	30
Flash Point	°C	GT 70	60
Calculated Values			
Aluminium + Silicon	mg/kg	LT 2	80
Net Specific Energy	MJ/kg	41.02	
CCAI (Ignition Quality)	-	827	

Note:
LT means Less Than, GT means Greater Than.

Operational Advice :

Approximate fuel temperatures:

Injection:
145°C for 10 mm²/s
125°C for 15 mm²/s
115°C for 20 mm²/s
110°C for 25 mm²/s

Transfer :
45°C

The ISO specification has been included for reference only.

The fuel as represented by this sample, marked as 'UNIT D14' is of an acceptable quality.

Best Regards,
On behalf of DNV Petroleum Services Pte Ltd
Bloemen Edwin
Technical Support Engineer

End of Report for SPRING GARDEN GENERATION, BARBADOS

Reference to part(s) of this report which may lead to misinterpretation is prohibited.

For technical or operational advice or further information on this report please contact your nearest DNVPS office or contact us directly at
Tel : +31 10 2922600
Email : tvpnl155@dnvps.com

Attachment #9

SeaTec U.K. Ltd.
Skypark
8 Elliot Place
Glasgow G3 8EP
Technical Support: Pact-oilanalysis@seatec-services.com

Vessel:	SPRING GARDEN POWER STATION	**Manufacturer:**	MAN
		Model:	9K80MC MARK 6
IMO Number:		**Serial No.**	D14
		Oil Grade:	SHELL MELINA S 30
Machinery:	MAIN ENGINE (used/existing Oil)	**Oil Volume Litres:**	NOT STATED
		Fuel Grade:	--
SAP NO/EQUIP.NO:	--		

Sequential Results								**Current**		
Sample Number								4391800		
Date Sampled								10 Apr 13		
Date Dispatched								25 May 13		
Dispatched From								Barbados		
Date Received								30 May 13		
Sampling point								Main sys		
Sampled By								Super		
Unit Service Hours								49950		
Oil Service Hours								2		
Daily Make Up (litres)								Not stated		
Analysis									**New Oil**	**Engine**
Appearance								Opaque		
K Viscosity at 40 °C cSt								164.6	104	40 to -15%
K Viscosity at 100 °C cSt								13.28	11.6	
Flash Point °C								>200	227	
Water % Vol								<0.1		< 0.2%
Soot/Insolubles % wt								<0.1		< 2%
Asphaltenes % Wt								0.09		
Base Number mgKOH/g								17.4	5	100 to -30%
Oxidation abs/cm								14.00		
Acid Number mgKOH/g										
Additive Elemental Analysis ppm										
Barium								<1		
Calcium								8445		
Magnesium								33		
Phosphorus								171		
Zinc								204		
Wear & Contaminant Elemental Analysis ppm										
Boron								<1		
Sodium								6		
Silicon								10		
Sulphur								8162		
Lithium								<1		
Aluminium								2		
Chromium								<1		
Copper								6		
Iron								13		
Lead								<1		
Tin								1		
Molybdenum								<1		
Nickel								12		
Titanium								<1		
Silver								<1		
Manganese								<1		
Vanadium								11		
PQ Index/2ml								<10		
Oil/Unit Rating								C/A		

A = Suitable for Futher Service   B = Alert Level   C = Remedial Action Required   D = Unsuitable Charge

Comments by Interpreter:-

Oil Rating:

The viscosity is significantly higher than the new oil value and above the engine manufacturer's upper limit. This is probably related to the presence of the residual fuel derived elements (Nickel and Vanadium) indicating unburnt/partially burnt residual fuel components in the oil. The reserve of alkalinity (base number) is significantly higher than the new oil value. These increased levels indicate contamination with higher base number oil. It is recommended that the oil is renewed at the earliest opportunity. These parameters will be closely monitored as sampling progresses.

Unit Rating:

Elemental analysis of the wear and contaminant shows these to be at low levels. There is no evidence to indicate that any undue wear is occurring within the system. Nickel and vanadium which are the residual fuel derived elements.

Report Date: 6 June 2013

Attachment #10

SeaTec U.K. Ltd.
Skypark
8 Elliot Place
Glasgow G3 8EP
Technical Support: Pact-oilanalysis@seatec-services.com

Vessel:	SPRING GARDEN POWER STATION	**Manufacturer:**	MAN
		Model:	9K80MC MARK 6
IMO Number:		**Serial No.**	NOT STATED
		Oil Grade:	SHELL MELINA S 30
Machinery:	MAIN ENGINE NEW SYSTEM OIL	**Oil Volume Litres:**	--
		Fuel Grade:	--
SAP NO/EQUIP.NO:	--		

Sequential Results								**Current**		
Sample Number								4391799		
Date Sampled								10 Apr 13		
Date Dispatched								25 May 13		
Dispatched From								Barbados		
Date Received								30 May 13		
Sampling point								Main sys		
Sampled By								Super		
Unit Service Hours								49950		
Oil Service Hours								2		
Daily Make Up (litres)								Not stated		
Analysis									**New Oil**	**Engine**
Appearance								Opaque		
K Viscosity at 40 °C cSt								107.6	104	40 to -15%
K Viscosity at 100 °C cSt								11.82	11.6	
Flash Point °C								>200	227	
Water % Vol								0.74		< 0.2%
Soot/Insolubles % wt								<0.1		< 2%
Asphaltenes % Wt								0		
Base Number mgKOH/g								6.0	5	100 to -30%
Oxidation abs/cm								4.00		
Acid Number mgKOH/g										
Additive Elemental Analysis ppm										
Barium								2		
Calcium								2086		
Magnesium								<1		
Phosphorus								232		
Zinc								294		
Wear & Contaminant Elemental Analysis ppm										
Boron								1		
Sodium								8		
Silicon								4		
Sulphur								5581		
Lithium								<1		
Aluminium								<1		
Chromium								<1		
Copper								2		
Iron								1		
Lead								5		
Tin								<1		
Molybdenum								2		
Nickel								<1		
Titanium								<1		
Silver								<1		
Manganese								<1		
Vanadium								<1		
PQ Index/2ml								<10		
Oil/Unit Rating								C/A		

A = Suitable for Futher Service B = Alert Level C = Remedial Action Required D = Unsuitable Charge

Comments by Interpreter:-

Oil Rating:

The oil shows high levels of water. Since this is a new oil sample, the water could have been introduced due to in correct sampling technique or contaminated oil. Continued intensive purification of the charge at 90-95 degrees should reduce the level of water to a minor level. The oil contains negligible levels of soot/insolubles and the viscosity and the reserve alkalinity (base number), both, are close to the new oil values and satisfactory.

Unit Rating:

Elemental analysis of the wear and contaminant shows these to be remaining at very low levels.

Report Date: 6 June 2013

Attachment # 11a

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT:	Barbados	90065	1	0
		PROJ.	DOC No. SHEET	REV.
DATE:	2013.05.28			
SUBJECT:	MEASURING SHEET			

PERFORMANCE TEST SHEET

UNIT:	14	**DATE:**	10-apr-13
MEAS. No.:	4	**TIME:**	09:00
Load:	27 MW		

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	0	0	295.300,0	kWh
END	58	51	321.950,0	kWh
DIFF.	58,85		26.650,0	kWh
kW			27.170,773	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	9	47	305.270,0	l
END	68	52	320.900,0	l
DIFF.	59,08		15.630,0	l
l/h			15.872,50	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	5	5	9.083.630,0	l
END	63	22	9.093.350,00	l
DIFF.	58,28		9.720,00	l
l/h			10.006,29	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	33,1	34,8	34,7	34,20
Humidity	%RH	51,5	39,8	38,2	43,17
LT Coolant inlet temperature	°C	36,9	37,1	38,3	37,43
Ambient pressure.	mBar	1011	1011	1011	1011,00
Fuel Oil temperature at FO Flowmeter	°C	119,1	119,4	119,2	119,23
Generator Power factor	ρ	0,95	0,95	0,95	0,95
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

BWSC

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **10-apr-13**

MEAS: **4** **TIME:** **09:00**

LOAD: **27 MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27170,77
[4]	Humidity		h	%RH	37,43
[2]	Fuel Oil Consumption		Q	l/h	15872,50
[2A]	Fuel oil drain		Q_{dx}	l/h	10006,29
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	34,20
[5]	LT Cooling Water Temperature	27	t_c	°C	43,17
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	119,23
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,91
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	193,01
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	195,14

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657	
Proportion by mass of water, % (m/m):	0,10	
Proportion by mass of ash, % (m/m):	0,030	
Proportion by mass of sulphur, % (m/m):	1,48	
DNVPS analyse dated 13-01-05	41020	kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment #116.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT:	Barbados		
DATE:	2013.05.28		
SUBJECT:	MEASURING SHEET		

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14

MEAS. No.: 5

Load: 27 MW

DATE: 10-apr-13

TIME: 09:30

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	0	0	309.600,0	kWh
END	60	22	336.950,0	kWh
DIFF.	60,37		27.350,0	kWh
kW			27.183,876	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	8	23	313.260,0	l
END	68	0	329.040,0	l
DIFF.	59,62		15.780,0	l
l/h			15.881,46	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	4	19	9.088.770,0	l
END	64	30	9.098.810,00	l
DIFF.	60,18		10.040,00	l
l/h			10.009,42	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	34,7	34,8	35,7	35,07
Humidity	%RH	38,2	39,8	38,7	38,90
LT Coolant inlet temperature	°C	38,3	37,1	38,2	37,87
Ambient pressure.	mBar	1011	1011	1011	1011,00
Fuel Oil temperature at FO Flowmeter	°C	119,2	119,4	119,8	119,47
Generator Power factor	ρ	0,95	0,95	0,95	0,95
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14**

MEAS: **5**

LOAD: **27 MW**

DATE: **10-apr-13**

TIME: **09:30**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27183,88
[4]	Humidity		h	%RH	37,87
[2]	Fuel Oil Consumption		Q	l/h	15881,46
[2A]	Fuel oil drain		Q_{dx}	l/h	10009,42
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	35,07
[5]	LT Cooling Water Temperature	27	t_c	°C	38,90
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	119,47
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,98
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	193,07
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,73

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 11c.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 10-apr-13

MEAS. No.: 6

TIME: 10:00

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	58	51	321.950,0	kWh
END	118	6	348.800,0	kWh
DIFF.	59,25		26.850,0	kWh
kW			27.189,873	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	68	52	320.900,0	l
END	126	45	336.220,0	l
DIFF.	57,88		15.320,0	l
l/h			15.880,22	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	63	22	9.093.350,0	l
END	122	21	9.103.190,00	l
DIFF.	58,98		9.840,00	l
l/h			10.009,61	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	34,7	35,7	34,9	35,10
Humidity	%RH	38,2	38,7	38,2	38,37
LT Coolant inlet temperature	°C	38,3	38,2	38,4	38,30
Ambient pressure.	mBar	1011	1011	1011	1011,00
Fuel Oil temperature at FO Flowmeter	°C	119,2	119,8	119,8	119,60
Generator Power factor	ρ	0,95	0,95	0,95	0,95
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

PROJECT:	Barbados		
DATE:	2013.05.30		
SUBJECT:	FUEL CONSUMPTION CALCULATION SHEET		

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14 **DATE:** 10-apr-13

MEAS: 6 **TIME:** 10:00

LOAD: 27 MW

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27189,87
[4]	Humidity		h	%RH	38,30
[2]	Fuel Oil Consumption		Q	l/h	15880,22
[2A]	Fuel oil drain		Q_{dx}	l/h	10009,61
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	35,10
[5]	LT Cooling Water Temperature	27	t_c	°C	38,37
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	119,60
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,87
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	192,96
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,56

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48
DNVPS analyse dated 13-01-05	41020 kJ/kg

Site references		
Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 11 d.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 10-apr-13

MEAS. No.: 8

TIME: 09:30

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	30	48	310.050,0	kWh
END	90	44	337.200,0	kWh
DIFF.	59,93		27.150,0	kWh
kW			27.180,200	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	38	44	313.400,0	l
END	101	16	329.950,0	l
DIFF.	62,53		16.550,0	l
l/h			15.879,53	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	34	53	9.088.900,0	l
END	94	58	9.098.900,00	l
DIFF.	60,08		10.000,00	l
l/h			9.986,13	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	34,7	34,8	35,7	35,07
Humidity	%RH	38,2	39,8	38,7	38,90
LT Coolant inlet temperature	°C	38,3	37,1	38,2	37,87
Ambient pressure.	mBar	1011	1011	1011	1011,00
Fuel Oil temperature at FO Flowmeter	°C	119,2	119,4	119,8	119,47
Generator Power factor	ρ	0,95	0,95	0,95	0,95
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **10-apr-13**

MEAS: **8** **TIME:** **09:30**

LOAD: **27 MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27180,20
[4]	Humidity		h	%RH	37,87
[2]	Fuel Oil Consumption		Q	l/h	15879,53
[2A]	Fuel oil drain		Q_{dx}	l/h	9986,13
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	35,07
[5]	LT Cooling Water Temperature	27	t_c	°C	38,90
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	119,47
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	193,70
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	193,80
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	195,47

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 11e.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT:	Barbados		
DATE:	2013.05.28		
SUBJECT:	MEASURING SHEET		

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT:	14	**DATE:**	10-apr-13
MEAS. No.:	9	**TIME:**	10:00
Load:	27 MW		

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	58	18	322.500,0	kWh
END	116	59	349.100,0	kWh
DIFF.	58,68		26.600,0	kWh
kW			27.196,819	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	67	39	321.050,0	l
END	125	28	336.350,0	l
DIFF.	57,82		15.300,0	l
l/h			15.877,77	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	63	30	9.093.650,0	l
END	121	18	9.103.290,00	l
DIFF.	57,80		9.640,00	l
l/h			10.006,92	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	34,7	35,7	34,9	35,10
Humidity	%RH	38,2	38,7	38,2	38,37
LT Coolant inlet temperature	°C	38,3	38,2	38,4	38,30
Ambient pressure.	mBar	1011	1011	1011	1011,00
Fuel Oil temperature at FO Flowmeter	°C	119,2	119,8	119,8	119,60
Generator Power factor	ρ	0,95	0,95	0,95	0,95
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **10-apr-13**

MEAS: **9** **TIME:** **10:00**

LOAD: **27 MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27196,82
[4]	Humidity		h	%RH	38,30
[2]	Fuel Oil Consumption		Q	l/h	15877,77
[2A]	Fuel oil drain		Q_{dx}	l/h	10006,92
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	35,10
[5]	LT Cooling Water Temperature	27	t_c	°C	38,37
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	119,60
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,82
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	192,92
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,52

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil

Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 11 f.

BWSC

Burmeister & Wain Scandinavian Contractor A/S

90065	1		0
PROJ.	DOC No.	SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 12-apr-13

MEAS. No.: 3

TIME: 12:00

Load: 27MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	133	57	56.500,0	kWh
END	220	12	95.120,0	kWh
DIFF.	86,25		38.620,0	kWh
kW			26.866,087	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	142	33	1.119.500,0	l
END	228	14	1.142.200,0	l
DIFF.	85,68		22.700,0	l
l/h			15.895,74	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	138	51	9.626.810,0	l
END	225	8	9.641.300,00	l
DIFF.	86,28		14.490,00	l
l/h			10.076,11	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	35,5	35,5		35,50
Humidity	%RH	45	46		45,50
LT Coolant inlet temperature	°C	37,4	37,8		37,60
Ambient pressure.	mBar	1010	1009		1009,50
Fuel Oil temperature at FO Flowmeter	°C	120,7	129,9		125,30
Generator Power factor	ρ	0,939	0,9348		0,94
Generator Voltage	KV	11,1	11,1		11,10
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14 **DATE:** 12-apr-13

MEAS: 3 **TIME:** 12:00

LOAD: 27MW

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	26866,09
[4]	Humidity		h	%RH	37,60
[2]	Fuel Oil Consumption		Q	l/h	15895,74
[2A]	Fuel oil drain		Q_{dx}	l/h	10076,11
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	35,50
[5]	LT Cooling Water Temperature	27	t_c	°C	45,50
[6]	Ambient Pressure	1000	p_{amb}	mBar	1009,50
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	125,30
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,63
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	192,72
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	195,18

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 11g.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065 PROJ. | 1 DOC No. SHEET | 0 REV.

PAGE 1 OF 1

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 12-apr-13

MEAS. No.: 4

TIME: 12:40

Load: 27MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	149	44	63.568,0	kWh
END	220	15	95.120,0	kWh
DIFF.	70,52		31.552,0	kWh
kW			26.846,419	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	142	33	1.119.500,0	l
END	228	14	1.142.200,0	l
DIFF.	85,68		22.700,0	l
l/h			15.895,74	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	153	40	9.629.300,0	l
END	225	6	9.641.300,00	l
DIFF.	71,43		12.000,00	l
l/h			10.079,33	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	35,5	35,5		35,50
Humidity	%RH	45	46		45,50
LT Coolant inlet temperature	°C	37,4	37,8		37,60
Ambient pressure.	mBar	1010	1009		1009,50
Fuel Oil temperature at FO Flowmeter	°C	120,7	129,9		125,30
Generator Power factor	ρ	0,939	0,9348		0,94
Generator Voltage	KV	11,1	11,1		11,10
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **12-apr-13**

MEAS: **4** **TIME:** **12:40**

LOAD: **27MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	26846,42
[4]	Humidity		h	%RH	37,60
[2]	Fuel Oil Consumption		Q	l/h	15895,74
[2A]	Fuel oil drain		Q_{dx}	l/h	10079,33
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	35,50
[5]	LT Cooling Water Temperature	27	t_c	°C	45,50
[6]	Ambient Pressure	1000	p_{amb}	mBar	1009,50
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	125,30
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,66
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	192,76
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	195,22

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48
DNVPS analyse dated 13-01-05	41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment #11 h.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 12-apr-13

MEAS. No.: 5

TIME: 14:20

Load: 27MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	238	12	103.160,0	kWh
END	288	43	125.780,0	kWh
DIFF.	50,52		22.620,0	kWh
kW			26.866,381	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	245	58	1.146.900,0	l
END	296	10	1.160.200,0	l
DIFF.	50,20		13.300,0	l
l/h			15.896,41	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	242	52	9.644.300,0	l
END	292	48	9.652.700,00	l
DIFF.	49,93		8.400,00	l
l/h			10.093,46	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	36	36		36,00
Humidity	%RH	46	46		46,00
LT Coolant inlet temperature	°C	38,7	38,9		38,80
Ambient pressure.	mBar	1008	1111		1059,50
Fuel Oil temperature at FO Flowmeter	°C	120,7	121		120,85
Generator Power factor	p	0,938	0,9385		0,94
Generator Voltage	KV	11,1	11,1		11,10
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

90065	1		0
PROJ.	DOC. No.	SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **12-apr-13**

MEAS: **5** **TIME:** **14:20**

LOAD: **27MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	26866,38
[4]	Humidity		h	%RH	38,80
[2]	Fuel Oil Consumption		Q	l/h	15896,41
[2A]	Fuel oil drain		Q_{dx}	l/h	10093,46
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	36,00
[5]	LT Cooling Water Temperature	27	t_c	°C	46,00
[6]	Ambient Pressure	1000	p_{amb}	mBar	1059,50
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	120,85
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	192,75
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	192,84
[14]	Site Ambient Correction Factor		A_c	%	0,99
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	195,19

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references		
Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment #12 a.

BWSC

Burmeister & Wain Scandinavian Contractor A/S

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 15-apr-13

MEAS. No.: 1

TIME: 11:00

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	0	0	0,0	kWh
END	61	56	27.940,0	kWh
DIFF.	61,93		27.940,0	kWh
kW			27.067,815	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	6	28	1.594.700,0	l
END	68	34	1.610.800,0	l
DIFF.	62,10		16.100,0	l
l/h			15.555,56	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	3	37	9.965.100,0	l
END	65	44	9.975.200,00	l
DIFF.	62,12		10.100,00	l
l/h			9.755,84	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	34,7	35		34,85
Humidity	%RH	50	50		50,00
LT Coolant inlet temperature	°C	38,3	38,6		38,45
Ambient pressure.	mBar	1011	1011		1011,00
Fuel Oil temperature at FO Flowmeter	°C	121	121		121,00
Generator Power factor	ρ	0,9375	0,93		0,94
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **15-apr-13**

MEAS: **1** **TIME:** **11:00**

LOAD: **27 MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27067,81
[4]	Humidity		h	%RH	38,45
[2]	Fuel Oil Consumption		Q	l/h	15555,56
[2A]	Fuel oil drain		Q_{dx}	l/h	9755,84
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	34,85
[5]	LT Cooling Water Temperature	27	t_c	°C	50,00
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	121,00
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	191,19
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	191,28
[14]	Site Ambient Correction Factor		A_c	%	0,98
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,22

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references		
Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment #12 b.

BWSC

Burmeister & Wain Scandinavian Contractor A/S

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14 **DATE:** 15-apr-13

MEAS. No.: 2 **TIME:** 11:00

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	15	28	6.977,0	kWh
END	98	30	44.447,0	kWh
DIFF.	83,03		37.470,0	kWh
kW			27.075,873	

FUEL OIL CONSUMPTION (Q)				
	TIME: MIN	SEC	READING	
START	25	45	1.599.700,0	l
END	100	59	1.619.200,0	l
DIFF.	75,23		19.500,0	l
l/h			15.551,62	

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	22	27	9.968.150,0	l
END	94	59	9.979.950,00	l
DIFF.	72,53		11.800,00	l
l/h			9.761,03	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	34,7	35		34,85
Humidity	%RH	52	52		52,00
LT Coolant inlet temperature	°C	38,3	38,6		38,45
Ambient pressure.	mBar	1011	1011		1011,00
Fuel Oil temperature at FO Flowmeter	°C	121	121		121,00
Generator Power factor	ρ	0,9375	0,93		0,93
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14**

MEAS: **2**

LOAD: **27 MW**

DATE: **15-apr-13**

TIME: **11:00**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	27075,87
[4]	Humidity		h	%RH	38,45
[2]	Fuel Oil Consumption		Q	l/h	15551,62
[2A]	Fuel oil drain		Q_{dx}	l/h	9761,03
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	34,85
[5]	LT Cooling Water Temperature	27	t_c	°C	52,00
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	121,00
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	190,83
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	190,92
[14]	Site Ambient Correction Factor		A_c	%	0,98
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,09

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil

Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48
DNVPS analyse dated 13-01-05	41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment #12 c.

BWSC

Burmeister & Wain Scandinavian Contractor A/S

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065 PROJ. 1 DOC No. SHEET

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 15-apr-13

MEAS. No.: 4

TIME: 14:00

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	190	54	86.079,0	kWh
END	245	56	110.700,0	kWh
DIFF.	55,03		24.621,0	kWh
kW			26.843,004	

FUEL OIL CONSUMPTION (Q)			
	TIME: MIN	SEC	READING
START	183	55	1.640.700,0
END	238	5	1.654.700,0
DIFF.	54,17		14.000,0
l/h			15.507,69

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	186	30	9.994.830,0	l
END	241	0	10.003.700,00	l
DIFF.	54,50		8.870,00	l
l/h			9.765,14	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	36,3	36,3		36,30
Humidity	%RH	52	52		52,00
LT Coolant inlet temperature	°C	39,5	39,5		39,50
Ambient pressure.	mBar	1011	1011		1011,00
Fuel Oil temperature at FO Flowmeter	°C	121	121		121,00
Generator Power factor	ρ	0,9375	0,93		0,94
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

BWSC

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14**

MEAS: **4**

LOAD: **27 MW**

DATE: **15-apr-13**

TIME: **14:00**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	26843,00
[4]	Humidity		h	%RH	39,50
[2]	Fuel Oil Consumption		Q	l/h	15507,69
[2A]	Fuel oil drain		Q_{dx}	l/h	9765,14
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	36,30
[5]	LT Cooling Water Temperature	27	t_c	°C	52,00
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	121,00
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	190,89
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	190,98
[14]	Site Ambient Correction Factor		A_c	%	0,98
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,21

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil
Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references		
Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment #12 d.

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065 PROJ. 1 DOC No. SHEET

PAGE 1 OF 1

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 15-apr-13

MEAS. No.: 5

TIME: 16:00

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	0	0	0,0	kWh
END	108	56	47.551,0	kWh
DIFF.	108,93		47.551,0	kWh
kW			26.190,881	

FUEL OIL CONSUMPTION (Q)			
	TIME: MIN	SEC	READING
START	10	11	1.674.650,0
END	117	7	1.702.340,0
DIFF.	106,93		27.690,0
l/h			15.536,78

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	6	28	14.900,0	l
END	113	56	32.700,00	l
DIFF.	107,47		17.800,00	l
l/h			9.937,97	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	36,3	36,3		36,30
Humidity	%RH	52	52		52,00
LT Coolant inlet temperature	°C	39,5	39,5		39,50
Ambient pressure.	mBar	1011	1011		1011,00
Fuel Oil temperature at FO Flowmeter	°C	121	121		121,00
Generator Power factor	ρ	0,9375	0,93		0,94
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

BWSC

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

PERFORMANCE TEST SHEET

UNIT: **14** **DATE:** **15-apr-13**

MEAS: **5** **TIME:** **16:00**

LOAD: **27 MW**

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	26190,88
[4]	Humidity		h	%RH	39,50
[2]	Fuel Oil Consumption		Q	l/h	15536,78
[2A]	Fuel oil drain		Q_{dx}	l/h	9937,97
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	36,30
[5]	LT Cooling Water Temperature	27	t_c	°C	52,00
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	121,00
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	190,74
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	190,84
[14]	Site Ambient Correction Factor		A_c	%	0,98
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,06

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil

Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48

DNVPS analyse dated 13-01-05 41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 12 e.

BWSC

Burmeister & Wain Scandinavian Contractor A/S

PROJECT: **Barbados**

DATE: **2013.05.28**

SUBJECT: **MEASURING SHEET**

90065 PROJ. 1 DOC No. SHEET

PERFORMANCE TEST SHEET

UNIT: 14

DATE: 15-apr-13

MEAS. No.: 6

TIME: 16:00

Load: 27 MW

Unit Gross Electrical Power (Punit)				
	TIME: MIN	SEC	READING	
START	16	27	7.547,0	kWh
END	108	56	47.511,0	kWh
DIFF.	92,48		39.964,0	kWh
kW			25.927,266	

FUEL OIL CONSUMPTION (Q)			
	TIME: MIN	SEC	READING
START	24	15	1.678.300,0
END	104	21	1.699.040,0
DIFF.	80,10		20.740,0
l/h			15.535,58

FO DRAIN (Q_d)				
	TIME: MIN	SEC	READING	
START	20	37	17.200,0	l
END	101	23	30.650,00	l
DIFF.	80,77		13.450,00	l
l/h			9.991,75	

Readings		Read. #1	Read. #2	Read. #3	Average
Ambient Air Intake temperature	°C	36,3	36,3		36,30
Humidity	%RH	52	52		52,00
LT Coolant inlet temperature	°C	39,5	39,5		39,50
Ambient pressure.	mBar	1011	1011		1011,00
Fuel Oil temperature at FO Flowmeter	°C	121	121		121,00
Generator Power factor	ρ	0,9375	0,93		0,94
Generator Voltage	KV	11,1	11,1	11,2	11,13
Gen.Cooling Air Temp inlet	°C				
Gen.Cooling Air Temp outlet	°C				
Gen. Winding Temp Phase U	°C				
Gen. Winding Temp Phase V	°C				
Gen. Winding Temp Phase W	°C				

Date/Signature - BWSC

Date/Signature _ CLIENT

Burmeister & Wain Scandinavian Contractor A/S

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **FUEL CONSUMPTION CALCULATION SHEET**

90065	1	0
PROJ.	DOC. No. SHEET	REV.

PERFORMANCE TEST SHEET

UNIT: 14 **DATE:** 15-apr-13

MEAS: 6 **TIME:** 16:00

LOAD: 27 MW

Ref.	Item:	Ref	Abb.	Unit	Value
[1]	Unit Generator Terminal Power		P_{unit}	kW	25927,27
[4]	Humidity		h	%RH	39,50
[2]	Fuel Oil Consumption		Q	l/h	15535,58
[2A]	Fuel oil drain		Q_{dx}	l/h	9991,75
[3]	Ambient Air Intake Temperature	27	t_{amb}	°C	36,30
[5]	LT Cooling Water Temperature	27	t_c	°C	52,00
[6]	Ambient Pressure	1000	p_{amb}	mBar	1011,00
[7]	Fuel Oil Temperature at Flowmeter		t_{fuel}	°C	121,00
[8]	Fuel Oil specicific gravity at 15 °C		ρ_{15}	kg/l	0,97
[9]	Fuel Oil specicific gravity Correction at t_{fuel}		ρ_{act}	kg/l	0,89
[10]	Specific Fuel Oil Consumption - uncorrected		VCF	kJ/kWh	190,79
[11]	Fuel Net. Heat Value	41000	H_N	kJ/kg	41020,00
[12]	SFOC corrected to LCV		$SFOC_{LCV}$	kJ/kWh	190,88
[14]	Site Ambient Correction Factor		A_c	%	0,98
[15]	SFOC corrected to MCR ("consumption ref. condition")		$SFOC_{corr}$	g/kWh	194,11

DNVPS analyse No. , Seal

Date/Signature - BWSC

Date/Signature - CLIENT

Calculation of specific energy for fuel oil

Comparison between diff. standard calculations

Given:

Density at 15°C, g/ml:	0,9657
Proportion by mass of water, % (m/m):	0,10
Proportion by mass of ash, % (m/m):	0,030
Proportion by mass of sulphur, % (m/m):	1,48
DNVPS analyse dated 13-01-05	41020 kJ/kg

Site references

Ambient temperature	°C	27
Cooling Water temperature	°C	27
Ambient Pressure	mbar	1.000
Net Heat Value MJ/kg	MJ/kg	41.000

Standard:	Net specific energy, Qnp	Gross specific energy, Qgv
BS MA 100 : 1982 ASTM D 4868-90 (Reappr. 1995)	40,7573 MJ/kg 9734,722 kcal/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
BS MA 100 : 1989 BS 2869 : Part 2 : 1988 BS 2869:1998 ISO 8217:1987 ISO 8217:1996	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,1 Btu/lb
JIS K 2279 Gas Oil, A, B	40,7574 MJ/kg 17522,5 Btu/lb	43,1524 MJ/kg 18552,2 Btu/lb
JIS K 2279 Fuel Oil C	41,0218 MJ/kg 17636,2 Btu/lb	43,4128 MJ/kg 18664,2 Btu/lb
Publ. No. 97 US NBS	40,7040 MJ/kg 17499,6 Btu/lb	43,2262 MJ/kg 18583,9 Btu/lb

1,0550559

Attachment # 13

Burmeister & Wain Scandinavian Contractor A/S

BWSC

PROJECT: **Barbados**

DATE: **2013.05.30**

SUBJECT: **Summary**

90065	1	0
PROJ.	DOC No. SHEET	REV.

PERFORMANCE TEST SHEET

LOAD	27	MW

Preliminary Measurements

Date	Measurement No.	Result [g/kwh]
10-04-2013	4	195,14
10-04-2013	5	194,73
10-04-2013	6	194,56
10-04-2013	8	195,47
10-04-2013	9	194,52
12-04-2013	3	195,18
12-04-2013	4	195,22
12-04-2013	5	195,19
Average Preliminary		195,00

Measurement after Oil Change 1

Date	Measurement No.	Result [g/kwh]
15-04-2013	1	194,22
15-04-2013	2	194,09
15-04-2013	4	194,21
15-04-2013	5	194,06
15-04-2013	6	194,11
Average Measurement 1		194,14

Measurement after Oil Change 2

Date	Measurement No.	Result [g/kwh]
Average Measurement 2		

Measurement after Oil Change 3

Date	Measurement No.	Result [g/kwh]
	1	
	2	
	3	
	4	
	5	
	6	
Average Measurement 3		

Differens Between Preliminary Measurement and Measurement 1	0,86
Differens Between Preliminary Measurement and Measurement 2	#VALUE!
Differens Between Preliminary Measurement and Measurement 3	#VALUE!

Date/Signature - BWSC

Date/Signature _ CLIENT