



**Direktverbindung** GmbH

***environmental.measurement***

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# **Operating manual & Maintenance instructions OMS-1 and PW-2**

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**source:**

**dvb** Direktverbindung GmbH  
Karpfangerstrasse 6  
20459 Hamburg  
Germany

phone: + 49 40 360 900 78  
fax: + 49 40 360 900 86  
email: [info@dvb-env.com](mailto:info@dvb-env.com)  
web: <http://www.dvb-env.com>

subject to alternations



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## 1 INTRODUCTION

### 1.1 PREFACE

The steadily increasing demand on mineral oil products and their multiple use result in a steadily increasing danger of oil contamination of surface and ground water.

Hydrocarbons like for example petrol, diesel fuel, heating and lubrication oils prevent the biological self-cleaning of waters by impairing or even preventing the necessary functions of metabolism.

The oil contamination is an acute danger for our drinking water. Even very low quantities of mineral oil, for example - 1 liter oil in 1 million liter of water - renders drinking water undrinkable.

Hydrocarbons are used in so many ways that we can say: There is hardly any technical field that is free of the danger of pollution through hydrocarbons (for example leakages in heating fuel oil tanks, transport accidents in zones for the protection of water etc.). For this reason in the German DIN standards certain oil-in-water regulations are prescribed.

The minimum requirements of the joint committee of water in Germany -LAWA- determines the limiting values for sewage ingredients. These limiting values follow the "present state of technology", also in the future they will be adapted to the technical progresses. The water authorities usually follow these limits when they set up the sewage discharge and authorization decisions.

Each user is obliged to remove from his sewage oil up to prescribed value according to the authorization decision. Excerpt from the degree for self-control of sewage treatment plants -EKVO- for the Federal State of Hessen, Germany November 24, 1982:

The scope of self-control of other sewage treatment plants with special sewage ingredients of industrial origin results from the sewage discharge or authorization decision.

The DIN standard 38 409 Part 18 describes an infrared laboratory method by which the use of a two-beam IR (Infrared-) grating spectrometer with subsequent evaluation of the CH-, CH<sub>2</sub>-, CH<sub>3</sub>-bands is assumed as basis when checking the hydrocarbon content of sewage.

Due to its size and its price the use of a spectrometer in a portable oil measuring device is not advisable.

As an alternative the DIN standard 38 409 Part 18 permits the use of a non-dispersive IR-analyser, noting that it can be also used for measuring by according calibration. Such an analyser is integrated in the oil measuring systems OMS-1 and PW-2.



## 1.2 APPLICATIONS

The oil measuring systems OMS-1 and PW-2 allow fast and reliable measuring of hydrocarbon contents. Because of their good handling these devices are especially suitable for the individual determination of hydrocarbons in the laboratory as well as at site, for example:

- in rain water sewers or sewage systems in refineries, airports or tank depots;
- for the self-control in the field of analysing technology in laboratories;
- for random samples for the control of wells or water reservoirs for drinking water recovery in case of damage;
- for the analysis of soil samples in case of oil accidents along with the necessary dislocation and destruction of the oil-contaminated soil;
- for the measuring of oil concentrations in emulsions for example from cutting oil, drilling oils, etc.;
- for the measuring of thickness of coat wax (on mineral oil basis) on metal surfaces or for measuring the residual hydrocarbon content in electrolyte solutions at the metal surface treatment.

**The following analysis are possible with the OMS-1 and PW-2:**

1. Direct measuring of water samples (diluted or indiluted)
2. Measuring of mud after corresponding pretreatment
3. Measuring of solid substances after corresponding pretreatment
4. Measuring of difficult to extract water samples after corresponding pretreatment
5. Measuring of residual hydrocarbons after separation of polar substances (see DIN 38 409 Part 18)
6. Measuring of low hydrocarbon concentrations
7. Direct measuring of a solvent which is contaminated with oil (only OMS-1)

For the application 1 to 7 our working instructions "Determination of oil in water and soil" have been formulated.



### 1.3 TECHNICAL DATA

Method of operation:	Solvent extraction with subsequent nondispersive infrared spectroscopy (detection according to DIN standard 38 409 Part 18)
Solvent:	1,1,2 trichlorotrifluoroethane for the spectroscopy (others on request)
Separating filter:	Material: Teflon Size: Diameter 50 mm Pore size: 5 micrometer
Function:	Microprocessor-controlled analysing process; automatic filling level control
Spectral region:	3.2 - 3.6 micrometer wave length
Measuring range:	0,0 - 20 ppm (mg/l) resolution 0,1 ppm (mg/l) 0 – 200 ppm (mg/l) with the error limits written on page 10 200 - 250 ppm (mg/l) with higher error limits (other measuring ranges on request)
Measuring range display:	switchable (for tenfold sample volume)
Sample volume:	Waste water: 25 ml for measuring range 0-250 ppm (other sample water volumes result in other corresponding measuring ranges) 250 ml for measuring value display 0,0 – 25,0 ppm  Solvent: 25 ml for both measuring ranges  Additional water: (tap water) 225 ml for measuring range 0-250 ppm 0 ml for measuring range display 0,0 – 25,0 ppm



Error limit of shortterm reproducibility:	$\pm 2 \%$ of the measuring range final value
Error limit of longterm reproducibility:	$\pm 3 \%$ (when the final calibration is performed weekly)
Linearity:	$\pm 2 \%$ (related to the IR-spectrometer Perkin Elmer Type 1320)
Calibration:	Automatic zero calibration with zero solution, final value calibration with oil-standard solutions (manually)
Variable extraction time:	0 1 2 4 8 12 16 min
Settling time: (automatically with selection of the extraction time)	30 30 30 60 60 120 120 s OMS-1: At operation mode "C" the settling time is 1 minute longer. At operation mode "D" any settling time can be selected.
Analysing time:	2 to 20 minutes (according to the preselected extraction time)
Sample-, additional-, zero water temperature:	5 to 25 °C
Ambient temperature:	5 to 30 °C
Particle size:	approx. 250 micrometer
Measuring value display:	digital (3-digit)
Power supply:	230 V / 50/60 Hz (others on request)
Power consumption:	75 Watt
Fuse:	M1A
Protection: (according to DIN 40050)	IP 21
Dimensions:	Overall height: 430 mm Width: 240 mm Depth: 240 mm
Weight:	approx. 10 kg





The OMS-1 is additionally equipped with a selection switch for different operation modes.

Operation mode A: Filling from the top (funnel tube).  
Extraction and settling times as described in "Technical data". See variable extraction/ settling time. After pressing the "Auto Start"-key button the extraction, phase separation, rinsing processes and measuring up to draining of the system run fully automatically.

**ATTENTION:**

For this the selector valve beneath the measuring cell must be switched to passage from extractor glass to measuring cell.

Operation mode B: Direct injection. A solvent-oil mixture can directly be injected into the measuring cell. After pressing the "Auto Start"-key button the measuring starts immediately (extraction-, settling- and rinsing processes are dropped).

**ATTENTION:**

Switch selector valve to passage from inlet front panel (for the direct injection) to measuring cell

Operation mode C: Measuring process same as at position A, only the settling time is 1 minute longer.

Operation mode D: After the set extraction time the device stops. The key buttons "Zero Cal." and "Auto Start" flash, which means, that you have now two possibilities to continue:

1st possibility: When pressing the key button "Zero Cal." solenoid valve SV 1 and SV 2 open and the solvent is drained off through the solvent outlet. The display shows "ABL". The draining must be stopped with the key button "Stop", at the latest then, when the water phase (visible in the extractor glass) gets closer to the extractor glass outlet.

After pressing the key button "Stop" the solenoid valves SV 1 and SV 2 close and the solenoid valve 4 opens for draining off the sample water and the residual solvent. The display still shows "ABL" and the key button "Auto Start" or "Zero Cal." flash, depending in which measuring mode the function "D" has been started before.

2nd possibility: By pressing the key button "AutoStart" the further measuring process after the settling time is activated, that means: rinsing processes and measuring.



**ATTENTION:**

At the operation modes "C" or "D" take care that the selector valve has been switched to passage from the extractor to the measuring cell.

Operation mode E: This mode is free and can be individually filled against additional charges.

**1.4 SUPPLY SPECIFICATION**

Upon receipt of the device please check the delivery for completeness. In case of missing parts or damages please contact immediately the responsible DVB ENVIRONMENTAL MEASUREMENT-office to keep the guarantee claims.

For checking the device on transport damages remove the cross slit screws ("CAMLOC"-screwings), which are marked in section 6, on the right side panel and take it off.

Now the extractor glass, plug connections on the circuit boards and connecting tubes can be checked for damages or correct fitting.

Please check also whether the separating filter (Teflonfilter) has been inserted properly in the filter casing.



Q'ty	Description	Order no.
1	OMS-1	-
1	PW-2	-
1	Funnel lid out of PA 6	OMS-11810
1	Power cord	OMS-11725
1	Sample syringe (only OMS-1)	OMS-10251
1	Small screw driver	OMS-00050
1	Teflonfilter	OMS-10101e

## 2 DESCRIPTION

### 2.1 FUNCTION

The drawings 2/1 and 2/2 show the front views of the measuring devices OMS-1 and PW-2.

The analysing part consists mainly of the extractor the separating filter and the infra-red analyzer.

In the extraction receptacle the hydrocarbons are converted from the water sample into the solvent by intensive stirring.

The purpose of the separating filter is the retaining of water traces, which might be still in the solvent.

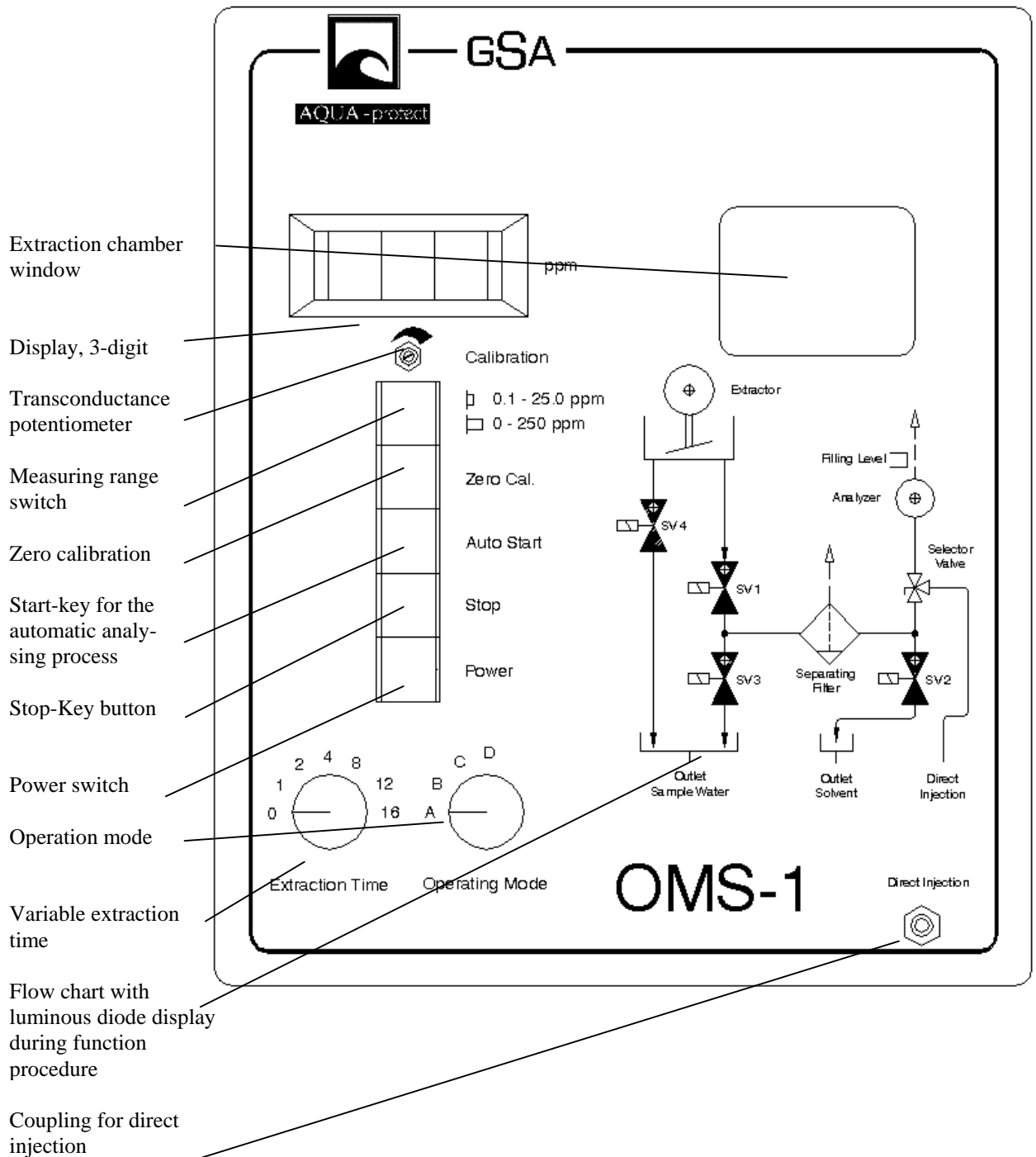
The principal item of the device is the Solid-State-Infrared-Analyser (optical bench). Its structure is shown schematically in drawing 2/3 of the enclosures.

The optical bench consists of a bandwidth infra-red lamp, a range spacer, the measuring cell (with a thickness of layer of 10 mm) and a Solid-State-Detector, which is designed as a pyro-electrical sensor.

For the chopping of the IR-radiation a chopper disc driven by a synchro-motor is mounted between measuring cell and detector.

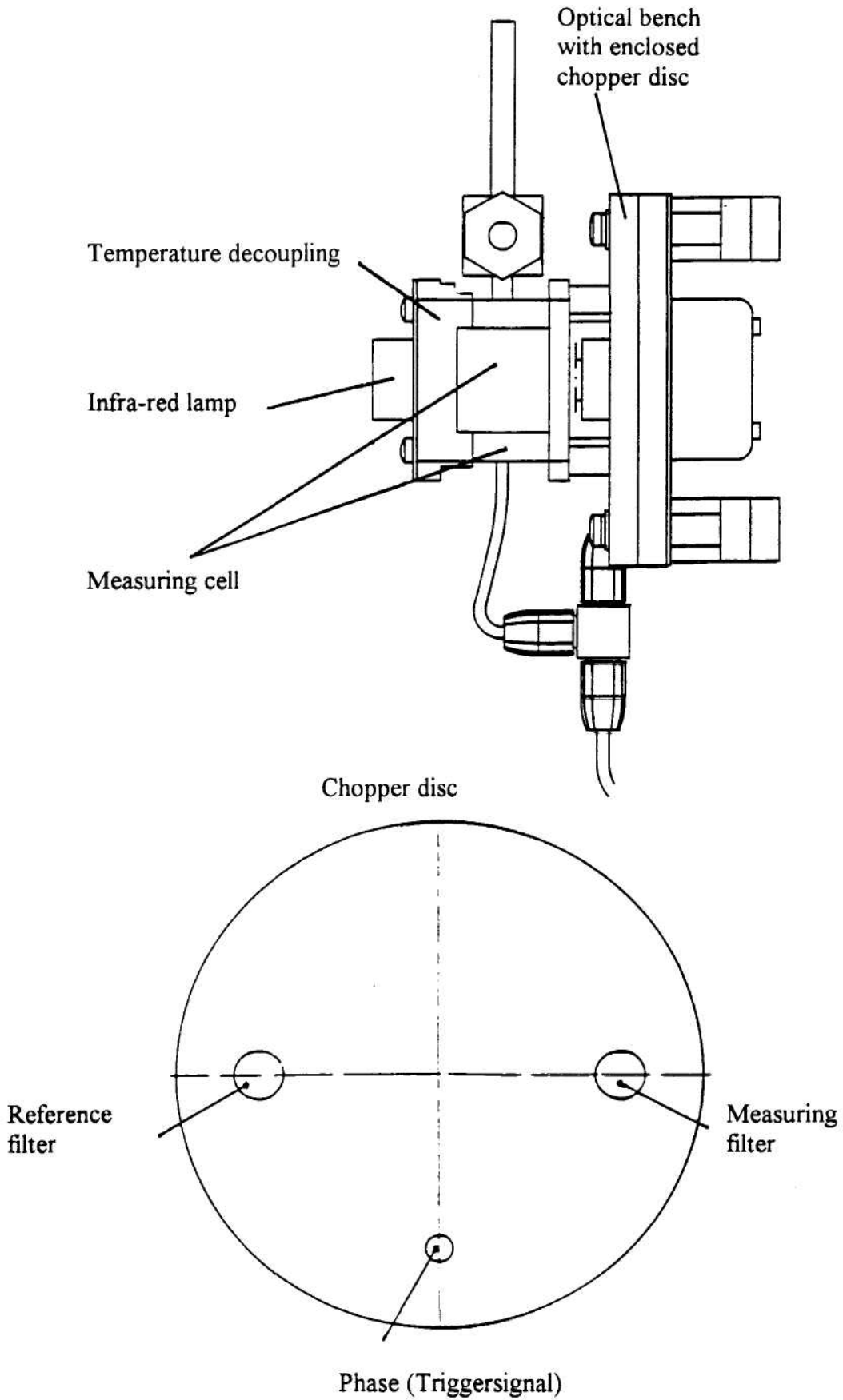
Additionally the device has two separate outlets, one for the sample water and one for the solvent, which makes a recycling of the solvent easier (**↔ Solvent Recycling Service DVB ENVIRONMENTAL MEASUREMENT !**).

**Drawing 2/1 Front view of the OMS-1; Display- and Operating elements**





**Drawing 2/2 Analysing unit**





## 2.2 FUNCTION PROCEDURE

### 2.2.1 Operation mode "A", "C" or "D"

After filling the solvent and the sample water into the extractor receptacle the "oil" is extracted from the sample by intensive stirring, that means the hydrocarbons are dissolved in the solvent. The necessary extraction time (0 - 16 min.) can be preselected with a 7-steps-switch.

During the following stand-by mode the fluid separates into a solvent-oil-phase and an overlaying water phase due to the different densities of solvent and water. In order to avoid an "Oil-Hang-Up" in the system and to prevent a measuring value adulteration the oil measuring system is automatically rinsed three times with the extract and subsequently drained.

During each cycle the solvent - oil phase passes through a separating filter in order to retain existing water traces and that way preventing an "oil simulation". Water also absorbs infrared energy in the wave-lengths, in which also the hydrocarbons-bands absorb. That's why water residues would pretend a higher oil concentration when entering the measuring cell.

In the analyzer the measuring cell is filled with a water-free solvent-oil-mixture by the static inlet pressure of the head of liquid in the extractor.

The hydrocarbons contained in the mixture absorb the infrared radiation in a certain spectral region (at 3.2 to 3.6 micrometer wavelength). The resulting reduction of the infrared intensity in this region is then measured and reflects a value for the concentration of hydrocarbons. As points of reference serve a zero calibration and a final value calibration.

The measuring value is displayed. The displayed value will remain until a new measurement is performed or until the device is switched off. After the measurement the whole system will be automatically drained.

The measuring systems work automatically due to the integrated microprocessor, that means after filling in the necessary solvent and sample water volumes and pressing the "Auto Start"-key button the analysing process runs by itself until displaying a measuring value and subsequently draining of the complete system.

The devices are furnished with an automatic control for the filling level of the cell. If the measuring cell is not sufficiently filled during the calibration or measuring procedure an error message is displayed. Simultaneously the running function will be interrupted and the system is drained. The OMS-1 / PW-2 will return to the previous function.

The "Stop"-function has priority in the process control. In case a mistake has been made when pressing the "Zero Cal." or "Auto Start"-functions (e.g.: It has been forgotten to fill in solvent or wrong samples, wrong sample volumes or wrong solvent volumes have been filled in, it is possible to interrupt the function procedure any time by pressing the "Stop" – key button. If this button is pressed the microprocessor stops the current function and the solenoid valves open. After draining the extractor the OMS-1, PW-2 return to the operation mode before the "Stop" - function.

At the OMS-1 it is also possible to forward the measuring data to peripheral equipment (interface is obtainable as option).



### 2.2.2 Operation mode "B" (direct injection)

The sample is prepared externally. The obtained solvent-oil mixture can be injected directly over the "Luer-lock-coupling" on the front panel (joint for syringe) into the measuring cell after turning the selector valve to the correct position. The measurement starts immediately after the key button "Auto Start" has been pressed (extraction-, settling- and rinsing processes do not take place).

In this mode also the filling level of the measuring cell will be controlled automatically. If the filling of the measuring cell should not be sufficient during the calibration- or measuring process an error message will be displayed. The OMS-1 will then return to the previous function.

### 2.3 Measuring principle

The measuring principle of the OMS-1, PW-2 is based on the NDIR-analysis (non-dispersive-infrared analysis), that means absorption - measuring in a definite spectral region.

The beam emitted by the IR-radiator is bundled in the analysing unit after radiating through the measuring cell and given to the chopper wheel (light (-beam) chopper wheel). The rotating chopper wheel, which is equipped with 2 interference filters, interrupts cyclically the paths of rays and generates a signal sequence on the detector, consisting of trigger-, reference- and measuring signal.

The interference filter for the measuring signal is in the band range of  $2780 - 3125 \text{ cm}^{-1}$  ( $3.2 - 3.6 \text{ }\mu\text{m}$ ). The reference filter is selected that way, that no absorption through the relevant hydrocarbons can occur.

The absorption of the IR-radiation that reflects the hydrocarbon concentration is converted into an intensity-proportional voltage and will be displayed.

The process control and the evaluation of the measuring signal is performed automatically by a microprocessor in both devices.

#### Measuring range

CH	-	band	$3030 \text{ cm}^{-1}$	or	$3.30 \text{ }\mu\text{m}$
CH <sub>2</sub>	-	band	$2924 \text{ cm}^{-1}$	or	$3.42 \text{ }\mu\text{m}$
CH <sub>3</sub>	-	band	$2958 \text{ cm}^{-1}$	or	$3.38 \text{ }\mu\text{m}$

The devices are suitable for the determination of CH<sub>2</sub>/CH<sub>3</sub>. The aromatic group (CH-), which has a very poor absorptive power, is only partly registered.



## 2.4 CONNECTION OF INTERFACE

Optional it is possible to integrate a serial interface RS 232 in the measuring device. Additionally to this interface a computing program will be supplied.

Also it is possible to print out the measuring result directly on a printer with serial interface

For further informations about the interface please refer to our documentation "Program for the oil measuring system OMS-1".

## 2.5 DISPLAY- AND OPERATING ELEMENTS

*Refer to section 2.1 drawings 2/1 and 2/2.*

Drawing 2/1: Shows the front view of the OMS-1 with the corresponding display- and operating elements

Drawing 2/2: Shows the front view of the PW-2 with the corresponding display- and operating elements

### **Possible instrument readings:**

Display	Explanation
E – L	Warm-up of the operating system
C A L	Request for zero calibration
E .C	Extraction in the calibration cycle
S 1.C	1st rinsing in the calibration cycle
S 2.C	2nd rinsing in the calibration cycle
S 3.C	3rd rinsing in the calibration cycle
P .C	Measuring in the calibration cycle
1 2 3	Measuring value display
E	Extraction
S 1	1st rinsing
S 2	2nd rinsing
S 3	3rd rinsing





P	Measuring
A b.L	Drainage of solvent in operation mode "D" (only OMS-1)
A b.C	Breaking off the calibration cycle
A b b	Breaking off the analysing process
d E F	Error message
G – F	Error message
L F	Error message
L F.C	Error message

For explanations to the error messages please refer to section 7.

### **3 INSTALLATION**

#### **3.1 REQUIREMENTS ON LOCATION**

##### **3.1.1 Power supply**

The electric-supply line must fulfill the following conditions:

- 230 V, 50/60 Hz,
- no interference pulses > 50 V,
- no additional high-capacities machines (motors, engines or similiar) on the same electric supply line,
- no photo-static copying machines, telex devices, discharge lamps, radio stations or other devices with extensive or frequent load cycles on the same electric-supply line.



### 3.1.2 Work station

The OMS-1 / PW-2 should be set up that way that they are not exposed to warmth and that they are ventilated sufficiently.

This prevents a possible gasification of the solvent during the analysing process and the resulting measuring value adulteration.

## 3.2 START OF OPERATION

1. First plug in the power cord on the rear panel of the oil measuring system, then connect the device to the electric-supply line.
2. Press the key button "Power".

The display shows "E-L". This display flashes approx. 2 min.. "E-L" is the minimum warming up time, which the device needs.

During the warming up time at the same time all solenoid valves are opened to drain off possible remaining fluid rests.

After the warming up time the solenoid valves close and the display shows "CAL".

Now at first a zero calibration is performed. Then the oil measuring system is ready for operation.

### **ATTENTION:**

The zero- and the final value calibration should be performed with the same extraction time and operation mode as the succeeding sample measurement.



## **4 CALIBRATION OF THE OIL MEASURING SYSTEM**

### **4.1 ZERO CALIBRATION**

#### **4.1.1 Operation mode "A", "C" or "D"**

1. Set operation mode "A", "C" or "D".
2. Set extraction time switch to 4 minutes when using the solvent 1,1,2-trichlorotrifluoroethane.
3. Set selector valve to passage from extraction to measuring cell.
4. Fill the following volumes through the tube (filling) funnel into the extractor glass:
  - \* 25 ml 1,1,2-trichlorotrifluoroethane for spectroscopy  
and
  - \*250 ml tap water (free of hydrocarbons !!)
5. Press the key button "Zero Cal."
6. All further functions proceed fully automatically.

First of all the stirring process is started depending on the set extraction time. The display shows "E.C" = Extraction in the calibration cycle. On the front panel the luminous diode (LED) for the stirrer flashes.

In the following inoperative time the phases separate due to their different densities (display: "E.C" LED darkens).



After the inoperative time the measuring cell is automatically rinsed 3 times. The display shows the following indications:

- "S1.C" = First rinsing process in the calibration cycle
- "S2.C" = Second rinsing process in the calibration cycle
- "S3.C" = Third rinsing process in the calibration cycle

**ATTENTION:**

At operation mode "D" the device stops after the set extraction time, that means the settling time continues as long as wished. The key buttons "Zero Cal." and "Auto Start" flash which results in two possibilities to continue. (*Refer to section 1.3 operation mode "D"*).

During the rinsing processes alternately the solenoid valves 1 and 2 open (distinguishable on the corresponding LED's on the front panel).

Subsequently the actually measuring starts. (The display shows: P.C = Measuring in the calibration cycle).

If the measurement is finished, the display shows "0" (ppm) and the solenoid valve no. 4 opens to drain the sample water off the extractor glass.

After another 30 seconds also the other solenoid valves open to drain the system completely.

If all solenoid valves are closed again (distinguishable on the front panel on the LED's) and the "Auto Start"-key button flashes the device is ready for operation.

The zero calibration is finished now.



#### 4.1.2 Zero calibration at operation mode "B"

1. Select operation mode "B".
2. Detach the right side panel with the CAMLOC-screwing.
3. Set the selector valve to direct injection. Set selector valve to passage from syringe coupling (front panel) to measuring cell.
4. Fill sample syringe for direct injection with approx. 5 ml solvent free of hydrocarbons and rinse the measuring cell over the separation screwing by several injections and drawing ups.

#### **HINT :**

Always inject the solvent extract slowly into the measuring cell. Take care that every time the LED of the measuring cell flashes !

5. Afterwards discard the zero solution and inject slowly new solution until the LED of the measuring cell flashes.
6. Now press the key button "Zero Cal.".
7. Immediately the OMS-1 turns to the mode "P .C" (sample measuring).
8. After the measurement the display shows "0", and the "Auto Start"-key flashes.



## 4.2 FINAL VALUE CALIBRATION

The frequency of the final value calibration depends on the sample quality and on the operation experience of the operator.

The final value must also be calibrated again if a new operation mode and/or extraction time is selected, when using new solvent from another charge (bottle, barrel etc.) or another solvent.

### 4.2.1 Final value calibration with the OMS-1/PW-2 in operation mode "A", "C" or "D"

OMS-1:

Select operation mode !  
Select extraction time !  
Set selector valve to passage  
from extraction to measuring  
cell .

PW-2:

Select extraction time !

1. Fill the following volumes over the funnel tube into the extractor glass:

25 ml standard solution  
250 ml clean oilfree water (tap water)

2. Seal funnel tube with lid and press the key button "Auto Start".

3. The measuring in the device runs fully automatically. The display shows a 3-digit value after 3 rinsings.



**HINT (only OMS-1):**

At the calibration in operation mode "D" it must be proceeded with the "Auto Start" - key button after the extraction time.

4. If the displayed value does not correspond to the nominal value of the standard solution it will be adjusted by a screw driver on the transconductance potentiometer (beneath the display on the front panel).
5. Perform control measuring (refer to point 1 - 4).
6. If the displayed value corresponds to the prepared standard solution the final value has been calibrated.

**4.2.2 Final value calibration in operation mode "B" (only OMS-1)**

1. Select operation mode "B".
2. Detach the side panel with the CAMLOC-screwing and set the selector valve to direct injection.
3. Fill sample syringe (for direct injection) with approx. 5 ml standard solution and rinse the measuring cell over the separation screwing by repeated injections and drawing ups.

**HINT (only OMS-1):**

Always inject the solvent extract slowly into the measuring cell and take care that every time the LED of the measuring cell flashes on the front panel !

4. Afterwards discard the standard solution and inject new solution into the measuring cell until the LED of the measuring cell flashes.
5. Now press the key button "Auto Start".
6. Immediately the OMS-1 turns to the mode "P" (sample measuring).
7. After the measurement a 3-digit value is displayed.
8. If the displayed value does not correspond to the nominal value of the standard solution it will be adjusted by a screw driver on the transconductance potentiometer for calibration (beneath the display on the front panel).
9. Perform control measurement (points 3 - 7).
10. If the displayed value correspond to the prepared standard solution the final value has been calibrated. 23



**HINT:**

Before each measurement always rinse the measuring cell by repeated slowly injection of the extract !

**4.3 PREPARATION OF THE STANDARD SOLUTION FOR CALIBRATION ON PPM**

You need:	1 microliter syringe	for	25 $\mu$ l
	1 measuring flask with glass stopper	for	100 ml
	Squalane		20 $\mu$ l
	1,1,2-trichlorotrifluoroethane		100 ml

1. Fill up the microliter syringe with 20  $\mu$ l Squalane. Then wipe off the needle of the syringe.
2. Inject the filled up Squalane into a 100 ml measuring flask. Wipe off the last drop on the needle point on the inside of the flask neck.
3. Fill the measuring flask with solvent up to the calibration line.
4. Seal the measuring flask with a glass stopper and mix (shake) well (repeat turning the flask to the top).

**Calibration on ppm (parts per million)**

The such prepared solution corresponds to a standard concentration of 200  $\mu$ l/l (= 200 ppm). When performing the calibration on ppm it is more sensible to prepare a standard on 200 ppm (= 20  $\mu$ l calibration oil on 100 ml solvent), since the linear relation between extinction (absorbance) and concentration at concentrations higher than 200 ppm turns into a non-linear relation.





#### 4.3.1 PREPARATION OF THE STANDARD SOLUTION FOR CALIBRATION ON MG/L

You need:	1 microliter syringe	for	25 $\mu$ l
	1 measuring flask with glass stopper	for	100 ml
	Squalane		25 $\mu$ l
	1,1,2-trichlorotrifluoroethane		100 ml

1. Fill up the microliter syringe with 25  $\mu$ l Squalane. Then wipe off the needle of the syringe.
2. Inject the filled up Squalane into a 100 ml measuring flask. Wipe off the last drop on the needle point on the inside of the flask neck.
3. Fill the measuring flask with solvent up to the calibration line.
4. Seal the measuring flask with a glass stopper and mix (shake) well (repeat turning the flask to the top).

#### Calibration on mg/l

The such prepared solution corresponds to a hydrocarbon concentration of 203 mg/l taking into account the density of Squalane (density = 0.81 kg/l) (*refer to calculation example calibration solution section 4.3.2*).

#### Hint for calibration:

In addition to Squalane also other single hydrocarbons or hydrocarbon mixtures can be used for calibration. Referring to the measuring-, detection- and calculation principle (Lambert-Beer-Law) the obtained measuring value will be as more exact as the to be measured hydrocarbon (or hydrocarbon mixture) is more similiar to the calibration oil.



#### 4.3.2 Calculation example calibration solution

Density of Squalane: 0.81 kg/l

0.81 kg	correspond to a volume of	1 Liter
20.25 g	correspond to a volume of	25 ml
20.25 mg	correspond to a volume of	25 µl

That means:

25 µl dissolved Squalane in 1 liter fluid correspond to a hydrocarbon concentration of 20.25 mg/l, which means that 25 µl Squalane dissolved in 100 ml fluid correspond to a hydrocarbon concentration of 202.5 mg/l.

#### 4.4 CHANGING SOLVENT

Hints for the change of the OMS-1 / PW-2 from trichlorotrifluoroethane to other solvents (or reverse):

When changing to another solvent the Teflonfilter must be changed (refer to section 6.3).

During the start of operation of the device the following is valid then:

- Set extraction time correspondingly
- Zero calibration and
- Final value calibration must be performed with the new solvent



## 5 SWITCHING OFF DEVICE

If the device shall be switched off after measuring it is sensible if necessary to perform a so called rinsing measurement with pure solvent and clean, oilfree water.

That way possible solid substances or other dirt particles will not remain in the solenoid valves or hoses etc. and disturbances can be avoided when the device will be started later again.

Generally the extractor glass should be filled with pure tap water if the device is not in operation for a longer period of time (for example over night) in case of frequent measurements of contaminated sample water (pay attention to max. particle size and quantity of suspended substances). That way "sticking" of dirt particles to the extractor glass will be avoided.

For this switch off the oil measuring system with the key button "Power". Then pour approx. 300 ml tap water into the extractor glass.

### **ATTENTION:**

Before starting the device again by pressing the key button "Power" place a beaker glass beneath.

Please store the OMS-1 / PW-2 as dustfree as possible, at not too low temperature and not too high humidity of air.



## 6 MAINTENANCE

### 6.1 GENERAL

#### 6.1.1 Maintenance intervals

Period of time	Component
every 3 months	Measuring cell of the optical bench, section 6
if necessary	Teflonfilter in the filter casing, section 6
if necessary	Extractor glass, section 6.

We recommend a complete maintenance by the DVB ENVIRONMENTAL MEASUREMENT-protect-service at least once a year. Please contact our DVB ENVIRONMENTAL MEASUREMENT-representative.

#### 6.1.2 Precautions when dealing with electronical components

Electrostatical discharges can cause damages on components. When dealing with electronical components special precautions are necessary:

- 1) Please wear a grounded copper arm band or use a grounded, antistatic working surface.

If this is not possible, please touch a grounded conductor (for example heating, water pipe) before touching the electronical components.

- 2) Keep the components until directly use in the original packing.
- 3) Touch electronical components only on their casing, never on their contactors.

Touch printed circuit boards only on their edges, never touch the components or the circuits.

- 4) Keep away the components and printed circuit boards from statical loaded surfaces as for example from PVC-plastics, plastic bags, etc..



## 6.2 OPENING OF THE DEVICE CASING

### **WARNING:**

Before opening the device pull out the power-supply plug to avoid injuries caused by electrical circuit.

- 1) Pull out the power-supply plug.
- 2) Loosen the CAMLOC-screwing on the right side of the device and take off the side panel.

## 6.3 CHANGING OF THE TEFLONFILTER

The Teflonfilter must be changed regularly depending on the frequency of the sample measurements and on the quantity of suspended matter. If it has been failed to change the filter, it might break and then water will reach the measuring cell.

Result:

Simulation of a high oil concentration, possible display: "DEF".

Also the filter might become clogged.

Result:

The measuring cell will not be filled with solvent, display "LF" or "LF.C" in the display.

### **HINT:**

The interval for changing the Teflonfilter depends on the sample quality and on the operation experience of the operator.

- 1) Pull out the power-supply plug.
- 2) Remove the CAMLOC-screwings on the right side panel and take off the side panel.
- 3) Loosen the knurled screws on the filter casing and hinge down the filter front piece.
- 4) Take out the used Teflonfilter and replace through a new one.



**ATTENTION:**

Please take care that the Teflonfilter is inserted correctly since otherwise water can enter the measuring cell and this will result in measuring value adulterations. Furthermore it must be taken care that when changing the filter no water will contaminate the filter rear panel (which points to the measuring cell).

**6.4 CLEANING OF THE EXTRACTOR GLASS**

The extractor glass must be cleaned depending on the contamination and from that resulting bad phase separation.

**HINT:**

The interval of cleaning the extractor glass depends on the operation experience of the operator.

1. Switch on the device by pressing the key button "Power".
2. Set extraction time switch to 16 minutes.
3. Select operation mode "D" (only OMS-1).
4. Wait for the display "CAL".
5. Fill 300 ml acidified tap water into the extractor glass.
  - \* sulphuric acid (diluted)  
pH-value-setting: 2 - 3
6. Press the key button "Auto Start".
7. When the stirring motor has stopped after 16 minutes press the key button "Stop".
8. The extraction unit will be automatically drained and the extraction glass will be rinsed.

This rinsing process can be repeated as often as wished.



## 6.5 CLEANING OF THE MEASURING CELL

The cell must be cleaned regularly (approx. every 3 months).

### ATTENTION:

When reassembling the cell please take care that the infrasil glasses (measuring cell glasses) are not canted (risk of breakage !).

1. Pull out the power-supply plug.
2. Remove the "CAMLOC"-screwing on the right side panel and take off the side panel.
3. Remove the Teflon block from the measuring cell.
4. Unscrew the selector valve on the top (only OMS-1). Pull the Teflon hose out of the measuring cell below (only PW-2).
5. Unscrew the two holding screws of the measuring cell with a screwdriver with hexagonal recessed hole, size 2.5.
6. Carefully put the infrared lamp and the distance holder aside and take out the measuring cell.
7. Loosen the two brass screwings with the cell wrench (order no.: OMS-11668).
8. Take out the O-rings, the infrasil glasses and the flat gasket rings.
9. Clean the two infrasil glasses with water and soap, afterwards dry with a fabric free of fluffs which is moistened with Aceton. Then rinse them with the solvent which will be used for the measuring.
10. The cell turned piece must also be cleaned inside with a fabric moistened with Aceton. Also rinse with solvent afterwards.  
  
Then reassemble the measuring cell (1. flat gasket ring, 2. infrasil glass, 3. O-ring, 4. brass screwing). When fixing the brass screwing take care that the O-ring of the brass screwing is equally pressed on the measuring cell window.
11. Fasten measuring cell, distance holder and infrared radiator with the two holding screws again. When reassembling the measuring cell screw down the holding screws only sturdily. If they are screwed down too tightly the glass of the infrared radiator may break.
12. Put up the Teflon block ( holding for the filling level sensor) again and screw up the hose of the measuring cell inlet again on the selector valve.
13. Fix the side panel again.



14.

## 7 ERROR MESSAGES

The following error messages may occur and are displayed:

Display	Explanation
-----	
d E F	Defect
G – F	Limiting value error
L F	Cell not filled
L F.C	Cell not filled in the calibration cycle

### 7.1 CAUSES OF THE ERROR MESSAGES

Display	Cause
-----	
d E F	Plug to optical bench loose, detector defective, variations of frequency, radiator defective, cell heavily contaminated, Teflonfilter is broken or is missing, too heavily contaminated sample has been filled into the device, chopper motor rotates too slowly or not at all.
G – F	Measuring value > 250 ppm, potentiometer defective, cell contaminated.
L F	Bad phase separation, not enough solvent has been poured into the extractor glass, leakage, clogging, filling level sensor is defective or plug (filling level sensor) is loose or selector valve is in wrong position.
L F.C	Refer to "L F".





## 7.2 ELIMINATION OF ERROR

Error	Measures
d E F	<ul style="list-style-type: none"><li>* Clean measuring cell.</li><li>* Dilute sample highly.</li><li>* Check plug (for this detach the left side panel).</li><li>* Check the Teflonfilter for correct position.</li><li>* In case of stoppage of the the chopper motor start the device and thus also the chopper motor with Power-key button again.</li></ul>
G – F	<ul style="list-style-type: none"><li>* Dilute sample.</li></ul>
L F	<ul style="list-style-type: none"><li>* Watch phase separation, if necessary work with sample preparation.</li><li>* Check if selector valve is in the correct position</li><li>* Check if the right volumes have been given to the oil measuring system.</li><li>* Check plug of filling level sensor (for this remove the left side panel).</li><li>* Check filling level sensor for damage.</li><li>* Check the tubes and the connections for leakage</li></ul>
L F.C	<ul style="list-style-type: none"><li>* Refer to "L F".</li></ul>

### **ATTENTION:**

If the error cannot be eliminated despite the previous actions please contact the responsible service of DVB ENVIRONMENTAL MEASUREMENT !



## 8 SPARE PARTS AND ACCESSORIES

All spares and accessories are obtainable at the company DVB ENVIRONMENTAL MEASUREMENT, for example

solenoid valves, all parts of the measuring cell, extractor glass, filling level sensor, sealings, tubes etc.

Option sets and consumables can also be ordered from DVB ENVIRONMENTAL MEASUREMENT.

### 8.1 OPTION SET NO. 1 (basic equipment)

Order no.	Article	Nos.
OMS-10 201	Beaker, 25 ml	(2)
OMS-10 203	Beaker, 100 ml	(1)
OMS-10 210	Test tube, 18 x 180 mm	(6)
OMS-10 212	Cork stopper (conical) 16/19/22 mm	(6)
OMS-10 211	Test tube rack (wood) for 12 glasses	(1)
OMS-10 220	Burette bottle, NS* 29/32, 1000 ml	(1)
OMS-10 225	Automatic pipettes, NS* 29/32, 25 ml	(1)
OMS-10 231	Glass stopper NS* 29/32	(1)
OMS-10 240	Graduated cylinder, 25 ml	(2)
OMS-10 241	Graduated cylinder, 50 ml	(2)
OMS-10 243	Graduated cylinder, 250 ml	(2)
OMS-10 110	Squalane, approx. 2 ml	(1)
OMS-10 120	Vinyl gloves (1 pack. = 50 pcs.)	(1)
OMS-10 250	Microliter syringe, 25 µl	(1)
OMS-10 209	Crystal bowl, 500 ml	(1)
OMS-10 245	Measuring flask, NS* 12/21 with NS*-PE stopper	(1)
OMS-10 230	Glass stopper, NS* 12/21	(1)



OMS-10 101	Teflonfilter (1 pack. = 50 pcs.)	(1)
OMS-10 252	Steel tweezers, round 18/8	(1)
L-11025	1,1,2-trichlorotrifluoroethane for spectroscopy (1 btl. = 2.5 l)	(1)
	Working instructions "Determination of oil in water and soil"	(1)

## 8.2 OPTION SET NO. 2 (for difficult to extract samples)

Order no.	Article	Nos.
OMS-10 260	Separating funnel, with Teflon stopcock, 1000 ml and NS*-PE-stoppers 29/32	(1)
OMS-10 270	Retort plate 210 x 130 mm	(2)
OMS-10 271	Retort rod 600 mm	(2)
OMS-10 272	Retort ring with bosshead, 130 mm	(1)
OMS-10 273	Retort clamp with bosshead, 40 mm	(2)
OMS-10 253	Chemist spoon 150 mm	(2)
OMS-10 125	Folded filter d. 185 mm (1 pack. = 100 pcs.)	(1)
OMS-10 010	Chromatographic column according to DIN (German Industrial Norm) 38409, part 18, complete with measuring flask 50 ml and NS-PE stopper 12/21	(1)
OMS-10 230	Glassstopper, NS* 12/21	(1)
OMS-10 235	Glass funnel, 100/5 mm	(1)
OMS-10 236	Powder funnel out of PP, 65/16 mm	(1)
OMS-10 130	pH-indicating rods (1 pack. = 100 pcs.)	(1)
OMS-10 117	Magnesiumsulfate heptahydrate (500 g/btl.)	(1)
OMS-10 116	Aluminium oxide 90 active (1000 g/btl.)	(1)
OMS-10 115	Sodiumsulphate anhydrous (1000 g/btl.)	(1)

**8.3 OPTION SET NO. 3 (for the correct analysis of soil samples)**

Order no.	Article	Nos.
OMS-10 270	Retort plate 210 x 130 mm	(1)
OMS-10 271	Retort rod 600 mm	(1)
OMS-10 273	Retort clamp with bosshead, 40 mm	(2)
OMS-10 253	Chemist spoon 150 mm	(2)
OMS-10 125	Folded filter d. 185 mm (1 pack. = 100 pcs.)	(1)
OMS-10 010	Chromatographic column according to DIN (German Industrial Norm) 38409, part 18 complete with measuring flask 50 ml and NS*-PE stopper 12/21	
OMS-10 230	Glass stopper, NS* 12/21	(1)
OMS-10 235	Glass funnel, 100/5 mm	(1)
OMS-10 205	Erlenmeyer flask, NS* 45/40, 250 ml	(1)
OMS-10 232	Glass stopper NS 45/40	(1)
OMS-10 236	Powder funnel, 65/16 mm	(1)
OMS-10 254	Glass rod, 250/6 mm	(1)
OMS-10 116	Aluminium oxide 90 active (1000 g/btl.)	(1)
OMS-10 115	Sodiumsulphate anhydrous (1000 g/btl.)	(1)

NS\* = Wet grinding



## 9 ENCLOSURES

### NOTE:

The instructions in this operating manual are subject to change accordingly to the technical state without previous notice.

Without the previous written agreement of DVB ENVIRONMENTAL MEASUREMENT the complete or partly photostatic copy or reproduction of this manual as well as the translation into another language are not allowed.

### 9.1 DENSITY OF SOM HYDROCARBONS

Product	Indication	Density * kg/l	Temperature °C
Gasoline	Super	0.81	20
Heating oil EL	pertaining to commercial customs	0.86	20
Squalane	Gas-chromatography	0.81	20
Gasoline	Normal	0.765	20
Paraffin oil		0.88	20
Benzene		0.88	20
Mineral oil	high content of aromatics	0.915	20
Mineral oil	paraffin basic	0.85	20
Mineral oil	naphthene basic	0.88	20
Crude oil	Argentina	0.897	15
Crude oil	Mexico	0.924	15
Crude oil	Germany/Hannover Hannover	0.905	15
Crude oil	Iran	0.835	15
Crude oil	Iraque	0.842	15
Crude oil	USA	0.852	15
Petroleum Aviation gasoline	for lamps Kerosene	0.81	15
Oil fuel		0.715	15
		0.87	15

\* Average values

Source: Working file for mineral oil engineers  
VDI-publishing house 1962