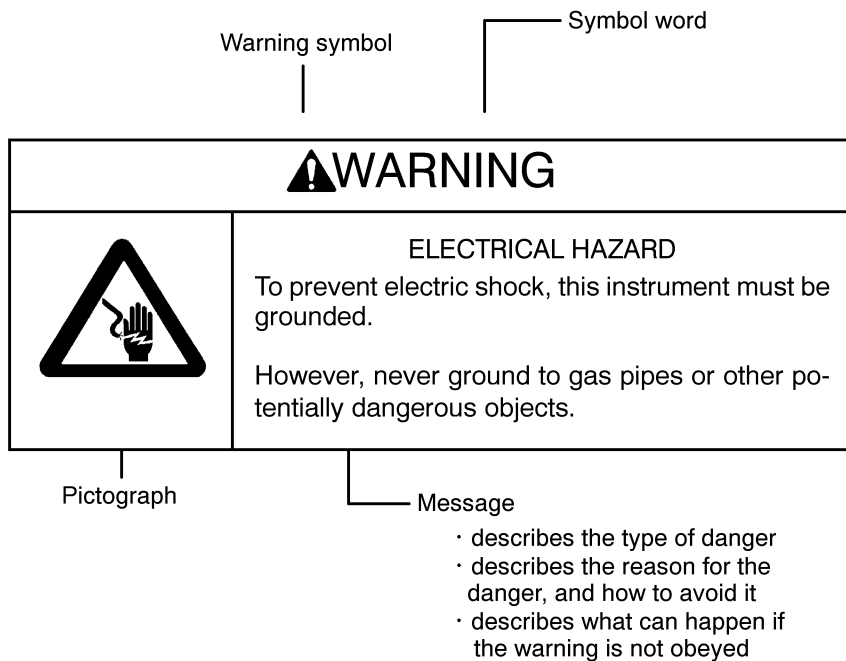


Safety Notice

■ The Safety Messages Used in Manual and their Meanings

- The safety alerts that are used in this manual consist of a warning symbol, symbol word, and a pictograph. You must obey these safety alerts.



- Signal words and their meanings.

WARNING Indicates latent danger. If the danger is not avoided death or serious injury may result.

CAUTION Indicates latent danger. If the danger is not avoided personal injury may result. This alert is also used to indicate unsafe behaviour.

■ Introduction

- This manual is intended for operators of the OCMA-350 Oil Content Analyzer.
- Be certain to read it carefully before operation, and to store it carefully for future reference.
- The specifications and design of this equipment are subject to change for improvement without prior notice. The contents of this manual are subject to change for improvement without prior notice.

■ Scope of warranty and responsibility

- Horiba warrants this product with regard to materials and workmanship for a period of one year from the date of purchase. Should the product fail during this period, Horiba will repair the product free of charge.

This warranty is void in the following situations:

- Failure due to incorrect operation
- Failure due to unauthorized modification or repair
- Failure due to operation in an inappropriate environment
- Failure due to events outside the responsibility of Horiba Inc
- Failure due to fire or natural disaster
- This warranty does not cover replacement of the following parts or consumables
 - B-heavy oil after opening Cell
- In no event will Horiba be liable for any direct, indirect, consequential or incidental damages arising out of the use, results of use or inability to use this product or its software.

■ Reprinting or reproducing this manual is prohibited

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Miyano Higashi, Kisshoin, Minami-ku, Kyoto, Japan 601
Horiba, Ltd.
TEL: (075)-313-8121

Safety Notice(continued)

■ General Points to Note Regarding the OCMA-350

- The OCMA-350 allows only the following solvents in its specification.
Measurement should be done by using only the following solvents.
 - S-316
 - CFC-113
- The OCMA-350 must be grounded to minimize the danger of electrical shock, but the ground wire must not be connected to gas pipes.
- Check that the power supply voltage is correct for the OCMA-350 before switching the power on.
- Test samples may be dangerous. Fully understand the nature of the samples that you plan to measure, and handle them appropriately.
- Carefully read the check and maintenance section in this manual before attempting maintenance work.
- To avoid risk of electric shock, never remove any covers from the OCMA-350 unless specified in this manual.
- Horiba, Ltd. accepts no responsibility for damage or injury resulting from non-compliance with the alert messages in this manual.

■ If you do not follow the procedures and cautions

- HORIBA assumes no responsibility for matters which occur due to a failure to follow the instructions and WARNINGS described in this manual.

HOW TO USE THIS MANUAL

■ STRUCTURE OF THIS MANUAL

- This manual is composed of the 10 chapters listed below.

Chapter 1. Parts Description

Gives an outline of the OCMA-350, and explains its simple functions.

Chapter 2. Measurement Preparations

Explains the preparations required before measurement and how to prepare calibration solution.

Chapter 3. Measurement

Measurement—Explains the calibration and measurement procedures.

Chapter 4. After Measurement

After Measurement—Explains post-operation procedures.

Chapter 5. Settings

Describes the setting of the OCMA-350.

Chapter 6. Connecting the Printer

Explains how to connect the printer and gives printout examples.

Chapter 7. RS-232C Communication Specifications

Describes the RS-232C communication protocol and commands.

Chapter 8. Regular Maintenance

Describes the daily maintenance procedures for the OCMA-350.

Chapter 9. Troubleshooting

Describes the troubleshooting procedures for the OCMA-350.

Chapter 10. Technical Reference

Introduction

Thank you for purchasing the OCMA-350 Oil Content Analyzer.

This instruction manual describes the operation of the OCMA-350 in order from preparation before operation to actual measurement. In addition, each function is described independently to facilitate reference.

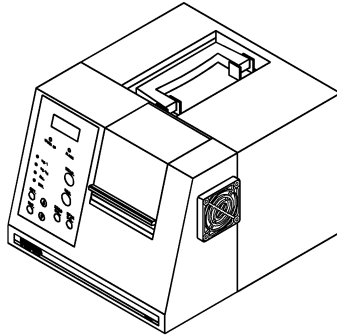
Handling Cautions

- Take care not to spill samples onto the OCMA-350.
This can result in equipment failure.
- Avoid operating or storing the OCMA-350 in the following locations or situations:
 - Where the humidity is above 80%.
 - Where the temperature is below 0°C or above 40°C.
 - Where it will be exposed to direct sunlight.
 - Dusty locations.
 - Vibration.
 - Poor ventilation.
 - Close proximity to large electric motors or voltage transformers.
 - Presence of corrosive gases.
 - Sudden temperature and humidity changes.
- Never strike or drop the instrument.
- Never attempt to operate the keys using sharply pointed objects.
- Ensure that the instrument is grounded.
- Unplug the instrument from the power outlet during long periods of idleness.
- Use a protective mask and polyethylene gloves when handling solvents.
- Background readings may differ slightly depending on the solvents manufacturing lot. When using solvents from different manufacturing lots or reprocessed solvent, match the backgrounds by mixing the amount of solvent that you plan to use in a glass container before using it.
- Use solvents with the same backgrounds for span and zero calibration, and measurement.
- For an accurate measuring, no other solvents but the designated solvents should be used.

Checking Contents

The package includes the following main unit and accessories. Check that none of the items listed below is missing or damaged.

Main unit – 1 set



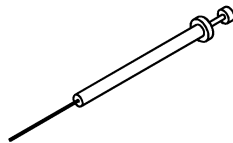
Cell – 1 pc



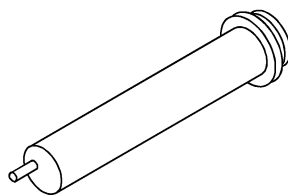
Cell cap – 1 pc



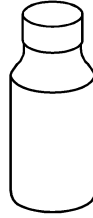
Microsyringe (100 μ l) – 1 pc



Syringe(10ml) – 1pc



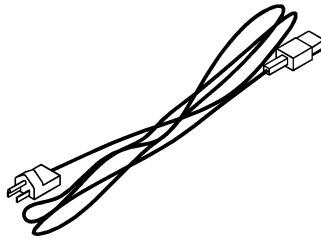
B-heavy oil (contains 10 ml) – 1 bottle



Fuse (2A) – 1 pc



Power supply cable – 1 pc



Indication label 1 sheets

Instruction manual – 1 copy

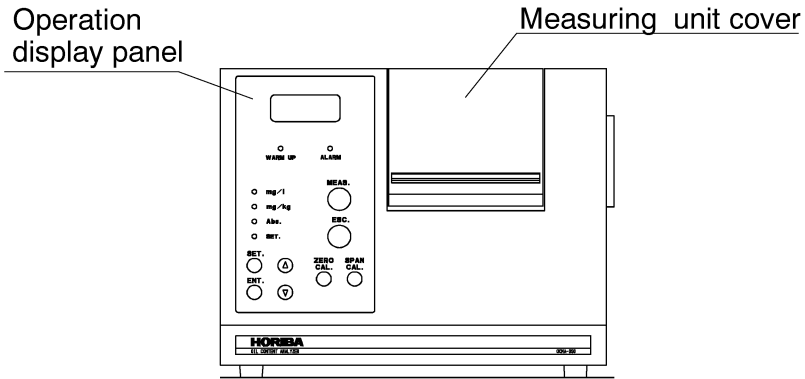
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Handling Cautions
Checking Contents

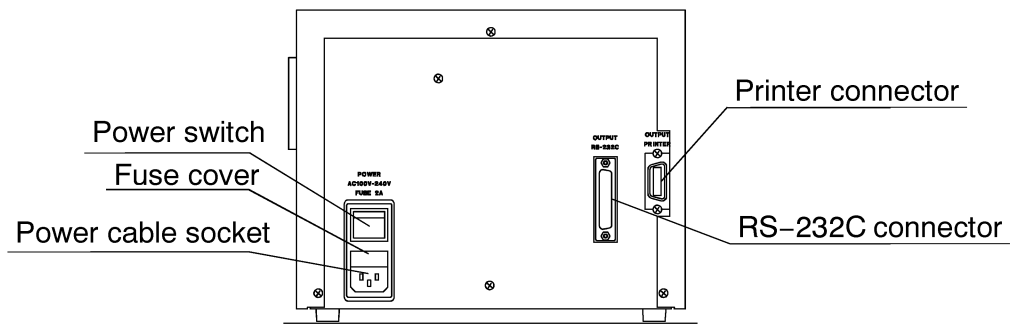
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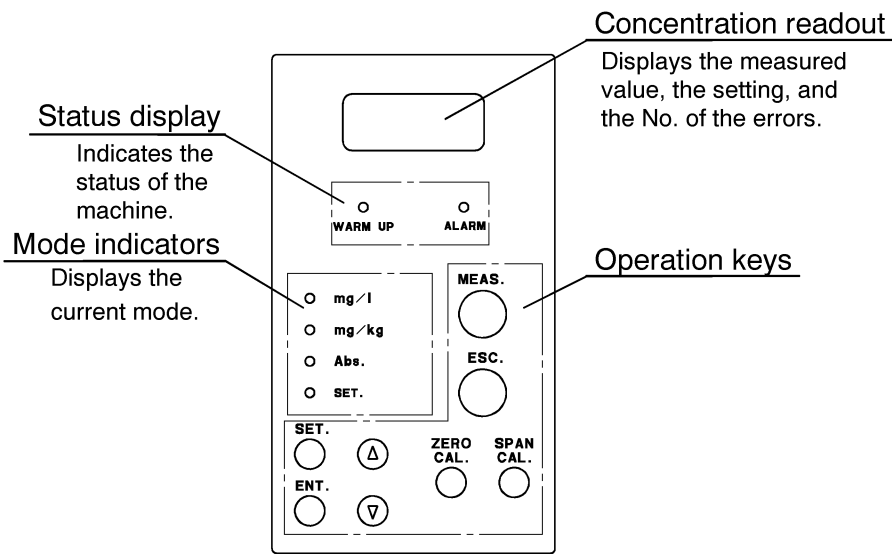
Chapter1 Parts Description



Front view



Rear view



Operation display panel

1. Parts Description

● Description of the operation keys

1

MEAS.



① Press this key to start the stability judgement of the measured value.

ESC.



② Press this key to cancel the stability judgement, and to exit from the error / setting mode display.

SET.



③ Press this key to switch into the setting mode.

ENT.



④ Press this key to enter the setting value at the setting mode.



⑤ Press this key to change the unit, the setting items, and the setting value.

SPAN
CAL.



⑥ Press this key to execute the span calibration.

ZERO
CAL.



⑦ Press this key to execute the zero calibration.

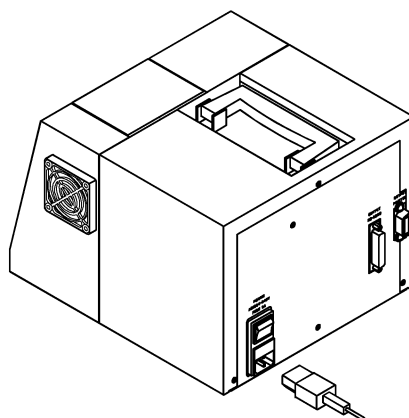
Chapter2 Measurement Preparations



2.1 Preparations

2.1.1 Connect the power cable

Insert the power cable included in the package into the socket in the rear of the machine.

2



 WARNING	
	<p style="text-align: center;">ELECTRICAL HAZARD</p> <p>To prevent electric shock, this instrument must be grounded.</p> <p>However, never ground to gas pipes or other potentially dangerous objects.</p>

2.1.2 Turn on the power

Turn on the power switch. The operation display panel will light.

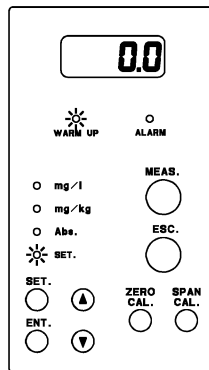
2. Measurement Preparations

2.2 Initial state at power on

2.2.1 Display

When the power is first turned on, the display will be as follows:

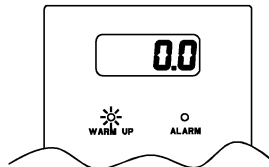
2



2.2.2 Warmup period

The "WARM UP" lamp will remain lit for 30 minutes after the power is turned on. This is the time required for the main unit of the oil content analyzer to become stabilized.

For an accurate measuring result, every calibration or measurement should be started after the "WARM UP" lamp is off.



2.2.3 Initial settings

The OCMA-350 is preset for standard measurement conditions, so you can begin taking measurements as soon as the "WARM UP" lamp goes out. The following table shows the default settings.

Setting	Value
Span calibration value	200mg/l
Zero shift volume	0.0mg/l
Solvent consumption	0.001L
Sample amount	0.001kg

2

Reference · To change the settings → Refer to Chapter 5. Settings.

2.3 Calendar settings

The OCMA-350 contains the calendar settings function. When first installing or the power is off for more than a week, set the calendar again. Internal memory might be cleared.

Reference · Calendar settings → 5.6 Setting year, month, day
5.7 Setting (internal) clock

2.4 Preparation of zero liquid for the calibrations

Prepare pure solvent for the OCMA-350.



2. Measurement Preparations

2.5 Preparation of span liquid for the calibrations

2.5.1 Using B-heavy oil (accessory)

Use B-heavy oil (specific gravity 0.895 at 20 °C) as span adjustment solution for the OCMA-350. When the type of oil (and its specific gravity) is known, that type of oil may be used as the calibration oil.

- Items required
 - solvent
 - B-heavy oil (accessory)
 - Microsyringe (accessory)
 - Flask (250 ml)

Note Clean the glass utensils with pure solvent and let them air dry. If they are not completely dry, purge them 3 to 4 times with the solvent.

● Preparation method

- ① Draw out 56 μ l of the B-heavy oil using the microsyringe.
- ② Transfer the B-heavy oil to the flask.
- ③ Fill the flask to the 250 ml line with solvent.

CAUTION
CHEMICAL HAZARD (SOLVENT) Solvent can be absorbed through the skin, and a large amount can cause poisoning. Wear gloves when handling it, and take precautions to ensure that you never ingest it accidentally.

- ④ Seal the flask with the stopper and mix the contents well.

Span compensation value	B-heavy oil quantity	Span liquid concentration	Span preparation value
200mg/l	56 μ l	200mg/l	200mg/l
20mg/l	6 μ l	20mg/l	20mg/l

Note

- After using a microsyringe, clean it and dry it thoroughly to remove any residual solvents.
- The units for the OCMA-350 are mg/l. Be sure to use the correct quantities when preparing the span liquid.

Density (ul/l) = Display density (mg/l) \div Specific gravity



2.5.2 To condition the span liquid

Solve the "mixed standard liquid" to the specific amount of extracted solvents. This requires the accurate weighing of mixed standard liquid, which is very difficult because mixed standard liquid is made of a material which is easy to evaporate. Take the following procedure to conduct the conditioning.

2

● Prepare the followings

- Solvents
- 2,2,4-Trimethylpentane(isooctane) (Guaranteed reagent or equivalents)
About 100ml
- Hexadecane (Cetane) (Guaranteed reagent or equivalents)
About 100ml
- Chlorobenzene (Mono) (Guaranteed reagent or equivalents)
About 100ml
- Measuring flask (100ml,250ml)
- A bottle with cock (50ml), or airtight bottle
- Pipet with 10ml hole (1 pc)
- Pipet with 15ml hole (2 pc)

Note Clean the glass utensils with pure solvent and let them air dry. If they are not completely dry, purge them 3 to 4 times with the solvent.

● Conditioning the mixed standard solution

① Conditioning the mixed standard liquid

Collect 15ml of isooctane, 15ml of cetane, and 10ml of chlorobenzene by the hole pipets. Put them to the airtight bottle and mix well.

Note Store the conditioned liquid in a dark place. High temperature, high humidity will cause errors in the measurement.

② Measuring a specific gravity of the mixed standard liquid



Put 1ml of mixed standard liquid measured by a hole pipets in the tared measuring cylinder (100ml). Put a lid on the cylinder immediately and measure the weight. Obtain a specific gravity by the following expression.

$$\text{Specific gravity (g/ml)} = \text{Weight (g)} \div \text{Volume (ml)}$$

Note The specific gravity can fluctuate depending on the temperature.

2. Measurement Preparations

2

 CAUTION	
	NOXIOUS GAS Inhalation of the vapor of OCB mixed standard solution may cause a toxic symptoms. Provide a ventilation in the working place and use a gas mask if necessary.

③ Collecting the mixed standard liquid


Collect the mixed standard liquid using a microsyringe. Do not miss to wipe out the extra residue of liquid on the needle of microsyringe before pouring those into a flask. Also after pouring the solution into the flask, shake off any residual liquid on the needle of syringe in the flask.

Note After using the microsyringe, clean it and dry it thoroughly to remove any residual solvents.

To obtain the amount of the mixed standard liquid (per 1000ml) to be collected, use the following expression.

$$\text{The amount of M.S.L. } (\mu\text{l}) = \frac{\text{Span calibration value (mg/l)}}{\text{Specific gravity (g/ml)}}$$

④ Fill the flask to the 250ml line with solvent.

 CAUTION	
CHEMICAL HAZARD (SOLVENT) Solvent can be absorbed through the skin, and a large amount can cause poisoning. Wear gloves when handling it, and take precautions to ensure that you never ingest it accidentally.	

⑤ Seal the flask with the stopper and mix the contents well.

Chapter3 Measurement

3.1 For the accurate measurements

The OCMA-350 has very high sensitivity using NDIR system.

A slight dirt on the cell or gap in position, because of free-attachment / detachment of the cell, will greatly affect the accuracy in measurement. Follow these advices firmly in making a measurement.

3.1.1 1.Cell

3

- Use HORIBA's exclsinsine cell only.
- Do not touch both ends of the cell. When you find any damage on the cell, do not use that cell.
- Clean the cell by the solvent to use completely.
- Use the same cell as the one used in the zero / span calibration.
- In filling the cell with the solvent, avoid any bubbles from coming into the cell. The surfau of the cell should be dry, and free from the solvent.
- The cell has the front side and the rear side. The front side is the one that has the v-shaped edge.
- Unappropriate setting will cause the errors in the measurement.

3.1.2 2.Calibration

- The zero and span calibration before the measurement is necessary when the measuring background has any changes as below.
 - Replacing the measuring cell.
 - Changing the lot No. of the solvent.
 - When the power is off for more than 1 week.
 - Changing the calibration liquid.
- The zero calibration before the measurement is necessary when the measuring background has any changes as below.
 - When the power is off for a week.
 - When the resistance welding time is over 4 hours.
 - Moving the equipment to another place.
 - When the temperature and the humidity has a drastic change(over 5°C for the temperature, over 10% for the humidity).
 - examples : by air conditioner
 - by weather
 - by winds

3. Measurement

3.2 Measuring procedure

To make a sample measurement, the calibration by the solvent to use is necessary.

- Wait until the "WARM UP" sign disappears.
- When the "ALARM" sign is lit, make sure what kinds of error is occurring, and clear those alarms.



- ① Select a unit for measurement using [▲][▼].

3

- Reference
- The unit for the measurement is as follows.
 - mg/l :The value of the oily content of the liquid.
 - mg/kg:The value of the oily content of the solidity.
 - Abs. :The value to show the absorbance. (for reference)

Note When "SET" is lit to show the setting mode, press [ESC.] to change to the measuring mode.

- ② Open the cover of the measuring unit.
- ③ Wash the cell with a clean solvent.

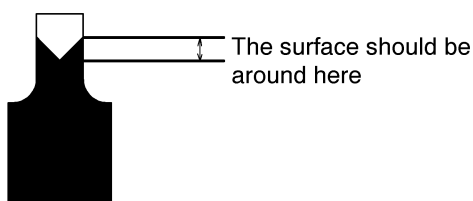


CAUTION

CHEMICAL HAZARD (SOLVENT)

Solvent can be absorbed through the skin, and a large amount can cause poisoning. Wear gloves when handling it, and take precautions to ensure that you never ingest it accidentally.

- ④ Fill the cell with the solvent until the designated area above by attached pipet. (about 6.5ml)

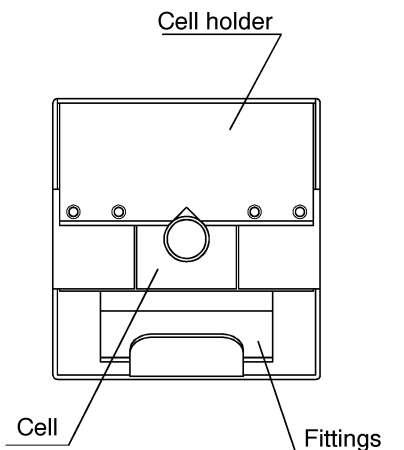


Note When pouring the solvent into the cell, be sure not to put any bubbles in the cell. If the cell should include any bubbles, shake the cell slowly to remove those bubbles. Also take care not to wet the outside of the cell by the solvent.

If the cell outside should get wet, wipe out by a towel and make it dry before the setting.

3. Measurement

- ⑤ Set the cell tightly until the end of cell holder, and set the fittings by pushing the cell slowly .



Top view from the cell upper part

3

- Note
- The cell has the front side and the rear side. The front side is the one that has the v-shaped edge.
 - Do not touch the both ends of the cell.
 - Unappropriate setting will cause the errors in the measurement.
 - Do not spill the solvent at the measuring unit when setting the cell. This will cause the breakage.

- ⑥ Close the cover of the measuring unit.
- ⑦ The measuring unit gets ready and the measured value is displayed at the LCD.

- Note
- When the cell is set, the temperature of the solvent increases by the light source, to make the measuring value fluctuated. Accordingly, take a certain time (1-3 min) after setting the cell to make the measurement.

MEAS.




- ⑧ Press the [MEAS.] to start the stability judgement.

- Note
- During the stability judgement the LCD continues to display the measuring value. Also the "←" mark blinks at the upper left part in the LCD, until the stability judgement is completed. (When the stability judgement is over, "←" mark stops blinking but is not disappeared.)



3. Measurement

- To cancel the stability judgement

ESC.
 ① Press [ESC.] during the stability judgement to stop the judgement and display the measuring value.

Reference · 10.3 The stability judgement function

- When the sample is out of the measurable range
 - If the measured value is under the following values, the LCD will display "U.F."

u.F.

Unit	Value
mg/l	-20.0
mg/kg	-20.0
Abs.	-0.200

- If the measured value is over the following values, the LCD will display "O.F."

o.F.

Unit	Value
mg/l	220
mg/kg	1000
Abs.	1.000

3

3.3 Calibration

Be sure to perform a span calibration after performing a zero calibration.

3.3.1 Zero calibration

- Preparation: Clean solvent, which is the same kind of the extracted solvent.



- ① Select the unit of "mg/l" using [▲] and [▼].

- ② Make a measurement by zero liquid, referring to 3.1 measuring procedure.

Note For calibration and measurement, be sure to measure for the value certain time (1–3 min.) after setting the cell. If you do not wait for 1–3 min., the measured value may contain gaps of approx. 0.1–0.4 mg/l.

- ③ The stability judgement is available if necessary.



- ④ Press [ZERO CAL.] to make a zero calibration.



3. Measurement

3.3.2 Span calibration

- Preparation: Span liquid conditioned by the same solvent of the extracted solvent.



① Select the unit of "mg/l" using [▲] and [▼].

② Make a measurement by span liquid, referring to 3.1 measuring procedure.

Note For calibration and measurement, be sure to measure the value certain time (1–3 min.) after setting the cell. If you do not wait for 1–3 min., the measured value may contain gaps of approx. 0.1–0.4 mg/l.

③ The stability judgement is available if necessary.



④ Press [SPAN CAL.] to make a span calibration.

200

Reference • Changing the span calibration value. → 5.2 Setting the span calibration value

3

3.4 Measuring the oil content in soil(Example for reference)

As one of the procedures for measuring the oil contents in soil sample, here is the example referring to EPA method 8440,418.1.

This is only one example among many, and might not be the best way for all samples. Consider and select the best way for your specific sample.

● Preparations

- Solvents
- Bottle (100ml, glass-made) with a screwed lid
- Filter paper (Whatman No.40 11cm or the equivalents)
- Silica gel (60–200Mesh, Activity:1)
- Sodium sulfur trioxide (heated for 4hours at 400°C, or washed by methylene chloride)

Note Using sodium sulfur trioxide without any heating or washing treatment may cause errors in measurement, affected by the water and impurities.

● Procedure

- ① Spread the soil sample in a plate and agitate it well.
- ② Remove large stones or trashes.
- ③ Put 30g of the sample, 2g of sodium sulfur trioxide, 5g of silica gel and 50ml of the solvent in the bottle, and put on the lid firmly.
- ④ Shake the bottle strongly by hand for 5 minutes.
- ⑤ Put the bottle on a flat place and wait until the solvent is separated. (approx. 1 minutes.)
- ⑥ Open the lid and collect the solvent layers carefully using a pipet.

Note When the solvent includes the emulsifying layers, do not collect any of this. Measurement of the samples including any emulsifying levels will not be available.

- ⑦ Filtrate the collected solvent with filter.
- ⑧ Set the solvent consumption and sample amount at the setting mode, and switch the unit into "mg/kg". (To be referred to chapter 5, "Setting".)
- ⑨ Measure the filtered solvent by OCMA-350. (To be referred to chapter 3, "Measurement".)

Note The soil sample may not have a repeatability because of the lack of conformity itself, even with an accurate extraction.

3. Measurement

3.5 Measuring the oil content in metal(Example for reference)

As one of the procedures for confirming the cleaning of metal sample, here is the example of extracting the oil content from metal sample.

This is only one example among many, and might not be the best way for all samples. Consider and select the best way for your specific sample.

● Preparations

- Measuring cylinder (To fit your solvent volume)
- Jar with a lid (To fit your sample size / solvent volume)
- Filter paper (Whatman No.40 11cm or the equivalents)
- (Ultrasonic cleaner)

● Procedure

- ① Put the sample in the jar.
- ② Pour the solvent gradually in the jar, until the sample sinks completely in the solvent. After pouring, put a lid on the jar immediately.
- ③ Agitate the entire contents occasionally, and leave it for between several hours and a whole day / night.

Note The procedure using an ultrasonic cleaner is also available, but this may cause errors in the measurement because of the sample elution or the solvent evaporation.

The time for the ultrasonic cleaning is recommended to be between 1 and 3 mins.

- ④ Filtrate the collected solvent with filter.
- ⑤ Measure the solvent using OCMA-350. → Chapter 3, "Measurement".

Note The solvent contains slight moisture at normal temperature. From this, the measuring value may be effected by this moisture. In doing calibration, use the solvent which has treated just the same way as the sample.

Reference · Expression to demand the concentration in the residual oil of the sample is;

$$C=A \times B=1000$$

A: Measured value by OCMA-350(mg/l)

B: Solvent amount for extraction(ml)

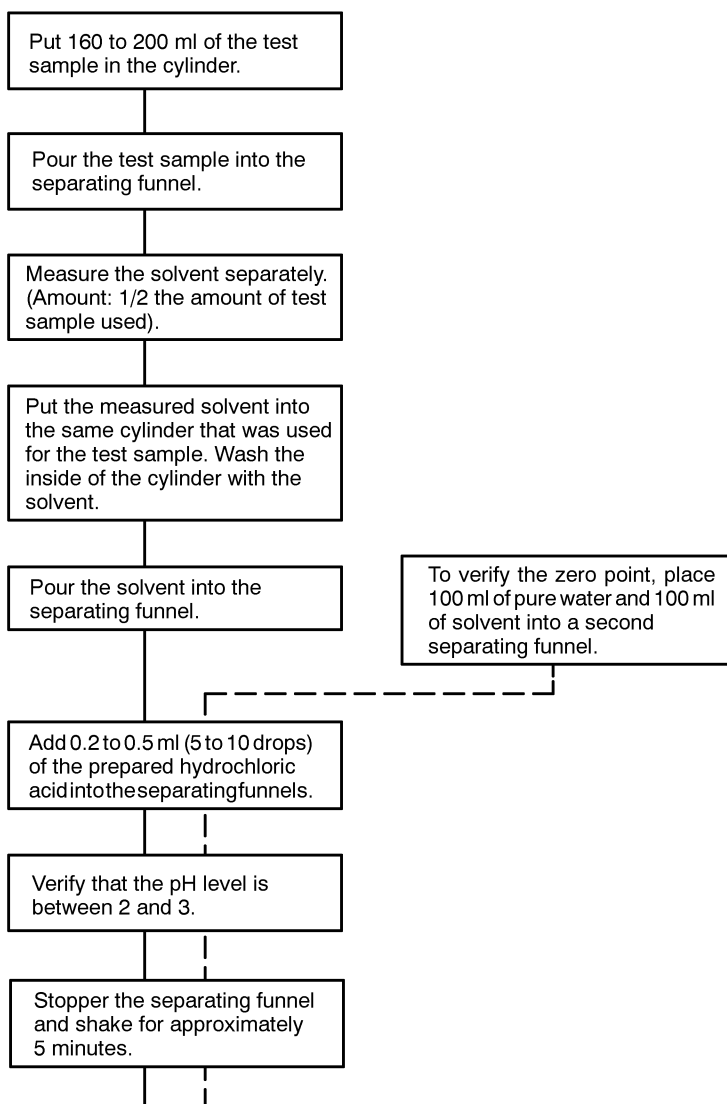
C: The residual oil in the sample(mg)

3.6 Measuring the oil content in water (reference example)

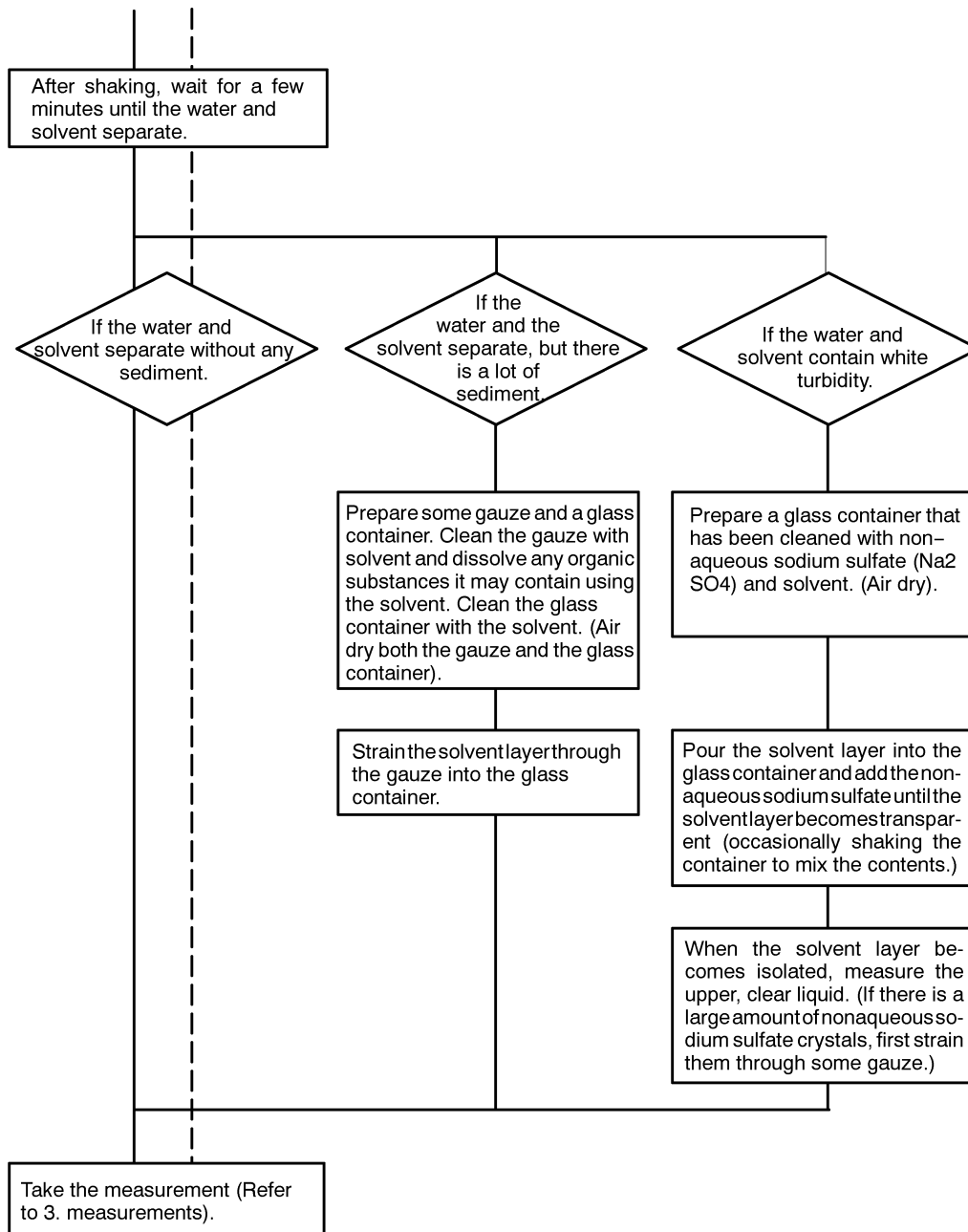
● Items required

- Separating funnel (for 500 ml and 300 ml)
- Cylinder (200 ml, 100 ml)
- Hydrochloric acid
- Solvent
- pH meter
- Other (tissue paper, non-aqueous sodium sulfate or equivalent as required)

● Procedure



3. Measurement



Note The calibration should apply the same extracting procedure.

Chapter4 After Measurement

After measurements have been completed, use the following procedures to store the equipment depending on the length of storage time.

4.1 Short term storage (less than 1 week)

If you will not be taking any measurements for a short period (less than a week):

- ① Discharge the solvent in the cell.
- ② Turn off the power switch.
- ③ Close the cover on the unit.
- ④ Dispose of the discharged liquid → Refer to 10.3.2 Reclamation.

4.2 Long term storage (longer than 1 week)

If you will not be taking any measurements for a long period (more than a week):

- ① Discharge the solvent in the cell and purge the cell with a clean solvent.
→ Refer to 8.1 taking care of the cell.
- ② Turn off the power switch.
- ③ Close the cover on the unit.
- ④ Disconnect the power cable.
- ⑤ Dispose of the discharged liquid → Refer to chapter 10.3.2 "Reclamation".

4. After Measurement

NOTE 

4

4-2

Chapter5 Settings

5.1 Setting items

Display	Item	Range	Function
n.01	Span calibration value	1.0~200mg/l	Setting span calibration value
n.02	Zero shift volume	-100~100mg/l	Setting zero shift volume
n.11	Solvent consumption	0.001~19.99L	Setting solvent consumption
n.12	Sample consumption	0.001~19.99kg	Setting sample consumption
n.21	Year and date	Year:0~99 Month:1~12 Day:1~31	Setting year and date
n.22	Time	Hour:←0~11 Min:0~59	Setting time

5

5.2 Span calibration value

This is the mode to set the span calibration value.

SET.



- ① Press [SET.] in the measuring mode to change to the setting mode.




- ② Select the setting item as No.(n.01) using [▲] and [▼].

ENT.



- ③ Press [ENT.] to let the set value displayed in the LCD.



- ④ Adjust the set value using [▲] and [▼].

ENT.



- ⑤ Press [ENT.] to set the value, and the LCD will displays the setting item of No.(n.01).



ESC.



- ⑥ Press [ESC.] to return to the measuring mode.

5. Settings

● Range

Range	Increments
1.0~200mg/l	0.1mg/l

5.3 Zero shift volume

This is the mode to set the zero shift volume.

SET.



- ① Press [SET.] in the measuring mode to change to the setting mode.



- ② Select the setting item as No.(n.02) using [▲] and [▼].

ENT.



- ③ Press [ENT.] to let the set value displayed in the LCD.



- ④ Adjust the set value using [▲] and [▼].

ENT.



- ⑤ Press [ENT.] to set the value, and the LCD will displays the setting item of No.(n.02).

ESC.



- ⑥ Press [ESC.] to return to the measuring mode.




● Range

Range	Increments
-100~100mg/l	0.1mg/l

Note The values set by the procedure here doesn't affect calibration value.

5.4 Solvent consumption

This is the mode to set the solvent consumption in measuring the oil contents in the soil sample.

- SET.**
 ① Press [SET.] in the measuring mode to change to the setting mode. 
- ▲
 ▼ ② Select the setting item as No.(n.11) using [▲] and [▼]. 
- ENT.**
 ③ Press [ENT.] to let the set value displayed in the LCD.
- ▲
 ▼ ④ Adjust the set value using [▲] and [▼].
- ENT.**
 ⑤ Press [ENT.] to set the value, and the LCD will displays the setting item of No.(n.11). 
- ESC.**
 ⑥ Press [ESC.] to return to the measuring mode.

5

● Range

Range	Increments
0.001~19.99L	0.001L




Reference · The unit of "mg/kg" is obtained by the following expression.

$$\text{Oil concentration (mg/kg)} = \text{Oil concentration (mg/l)} \times \frac{\text{Solvent consumption (L)}}{\text{Sample consumption (kg)}}$$

5. Settings

5.5 Sample consumption

This is the mode to set the solvent consumption in measuring the oil contents in the soil sample.

- SET.**
 ① Press [SET.] in the measuring mode to change to the setting mode. 
- ▲
 ▼ ② Select the setting item as No.(n.12) using [▲] and [▼]. 
- ENT.**
 ③ Press [ENT.] to let the set value displayed in the LCD.
- ▲
 ▼ ④ Adjust the set value using [▲] and [▼].
- ENT.**
 ⑤ Press [ENT.] to set the value, and the LCD will displays the setting item of No.(n.12). 
- ESC.**
 ⑥ Press [ESC.] to return to the measuring mode.





● Range

Range	Increments
0.001~19.99kg	0.001kg

Reference · The unit of "mg/kg" is obtained by the following expression.
$$\text{Oil concentration (mg/kg)} = \text{Oil concentration (mg/l)} \times \frac{\text{Solvent consumption (L)}}{\text{Sample consumption (kg)}}$$

5.6 Year and date

This is the mode to set the year and date.

- SET.**
 ① Press [SET.] in the measuring mode to change to the setting mode. 
- ▲
 ▼ ② Select the setting item as No.(n.21) using [▲] and [▼]. 
- ENT.**
 ③ Press [ENT.] to let the setting year displayed and blinking in the LCD.
 ▲
 ▼ ④ Adjust the "year" using [▲] and [▼].
- ENT.**
 ⑤ Press [ENT.] to set the data of year. Date is displayed next in the LCD, and "month" blinks. 
- ▲
 ▼ ⑥ Adjust the "month" using [▲] and [▼].
- ENT.**
 ⑦ Press [ENT.] to set the data of month. "Day" blinks in the LCD.
 ▲
 ▼ ⑧ Adjust the "day" using [▲] and [▼].
- ENT.**
 ⑨ Press [ENT.] to set the data of day, and the LCD displays the setting item of No.(n.21). 
- ESC.**
 ⑩ Press [ESC.] to return to the measuring mode.

● Range

Item	Range	Increments
Year	0~99	1
Month	1~12	1
Day	1~31	1

5. Settings

5.7 Calendar

This is the mode to set the calendar(time).

SET.
 ① Press [SET.] in the measuring mode to change to the setting mode.

② Select the setting item as No.(n.22) using [▲] and [▼].

ENT.
 ③ Press [ENT.] to let the clock displayed and "hour" blinking in the LCD.

④ Adjust the "hour" using [▲] and [▼].

Note "←"Mark in the LCD means it is AM.

ENT.
 ⑤ Press [ENT.] to set the data of hour. "Minute" will blink.

⑥ Adjust the "minute" using [▲] and [▼].

ENT.
 ⑦ Press [ENT.] to set the data of minute, and the LCD displays the setting item of No.(n.22).

ESC.
 ⑧ Press [ESC.] to return to the measuring mode.

● Range

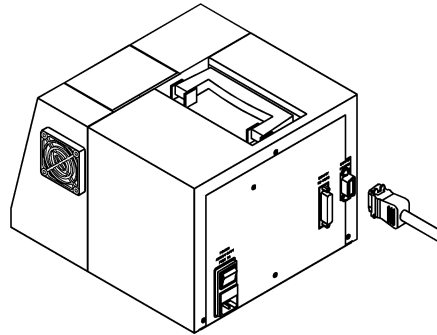
Item	Range	Increments
Hour	←0~11	1 (Indicating "←":AM)
Minute	0~59	1

Chapter6 Connecting the Printer

6.1 Connecting the printer

There is a connector for a printer on the OCMA-350 which you can use to connect a printer and print out the measurement data. The recommended printer is the Seiko Electronics DPU-201G.

The connection method is as follows:



Connecting a printer to the main unit

Note Use a simplified centronics specification printer and printer cable.

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6.2 Printer output timing and sample printout

6.2.1 Measurement value output

The printer output is available in the occasion of power-on, zero / span calibration, and when the stability judgement is over.

The format of the printout is as follows:

POWER ON	1/23	8:30	
	DATE	TIME	CONC
Z	1/1	9:00	0.0 mg/L
S	1/1	9:30	50 mg/L
*	1/1	13:00	3.4 mg/L
	1/2	15:05	-0.1 mg/kg
	1/10	2:50	0.007 Abs.

←A line is printed the first time the power is turned on and after each measurement is completed

Z : Zero calibration printout

S : Span calibration printout

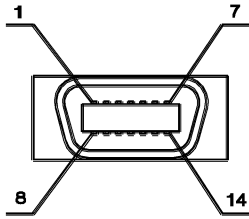
* : Alarm printout

6. Connecting the Printer

6.3 Pin connections for the output connector

The pin connections for the output connector are as follows:

Pin configuration and pin No.



Pin No.	Name
1	STB
2	DB0
3	DB1
4	DB2
5	DB3
6	DB4
7	DB5
8	DB6
9	DB7
10	Not connected
11	BUSY
12	Not connected
13	Not connected
14	GND

6

Reference · Connector : 57-20140 (DDK)
· Suitable connectors : 57-10140 (DDK) or equivalent

Chapter7 RS-232C Communication Specifications

OCMA-350 contains RS-232C as its standard configuration. Using RS-232C, it is available to have a data transmission between OCMA-350 and your PC. We do recommend to use RS-232C in putting the numerous measuring data in order.

7.1 Before usage

Take note of the following when using RS-232C.

- Be sure to match the transmission format between the OCMA-350 and the computer.
If the transmission formats do not match, communication errors may occur, or communications will not be established, and you will not be able to perform normal RS-232C communications. If you change the transmission format, turn off the power to both the OCMA-350 and the computer, and restart them.
- Use a commercially available crossed cable for connecting the OCMA-350 to your computer.

7.2 Transmission data format

SOH + COM + STX + DATA + . . . + DATA + ETX

Code	Name	Meaning	Command Code
SOH	Header command	Transmission start code (1Byte)	Char(01H)
COM	Command code	Indicates the type of transmission processing (1Byte)	Char(20H)~(63H)
STX	Text start code	Code indicating the start of the data (1Byte)	Char(02H)
DATA	Text data	Encoded representation of the transmission data	Char(20H)~(7FH)
ETX	Text end code	Code indicating the end of the transmission (1Byte)	Char(03H)

7. RS-232C Communication Specifications

7.3 Realtime output command

- Description:
Output the measurement data after measurement is completed.
- Execution condition:
Always output after a measurement.

7.3.1 Realtime output

Command transmission format: None (automatically output)

OCMA-350 output (for normal measurement)

SOH + □ + STX + DATA1 +, + DATA2 +, +
DATA3 +, + DATA4 +, + DATA5 +, + DATA6 + ETX

Settings data format (Total data length = 25 bytes)

Data No.	Description	Length	Delimiter	Data Output Range	Comments
DATA1	Measurement / Zero / Span	2	,		□:Measurement Z:Zero S:Span
DATA2	Calendar	8	,	00/01/01~ 99/12/31	Output measurement date
DATA3	Time	5	,	00:00~23:59	Output measurement time
DATA4	Output measurement value	5	,	-20.0~220.	Output in left-adjusted format
DATA5	Unit	1	,	1~3	1:mg/l 2:mg/kg 3:Abs.
DATA6	Error No.	2			Output the error No.

OCMA-350 output (when measurement is interrupted)

SOH + □ + STX + DATA1 + DATA2 + DATA3 +
DATA4 + ETX

Settings data format (Total data length = 16 bytes)

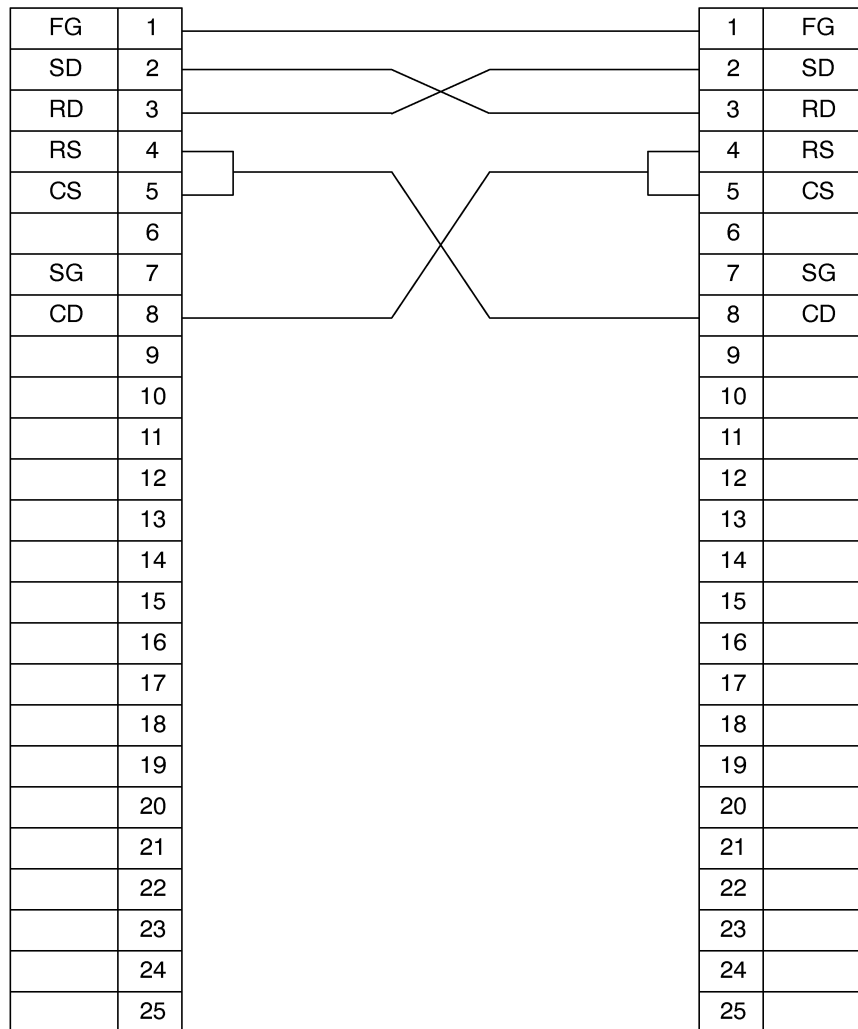
Data No.	Description	Length	Delimiter	Data Output Range	Comments
DATA1	Dummy	3			Output 3 spaces
DATA2	Message	10			
DATA3	Dummy	5	,		Output 3 spaces
DATA6	Error No.	2			Output the error No.

□ : Space

7. RS-232C Communication Specifications

7.4 RS-232C specifications

- Conforms to JIS-C6361
- Transmission format:
 - Baud rate : 2400(BPS)
 - Character length : 8 bits
 - Parity : None
 - Stop bit : 1 bits
 - Communication method : Full duplex
- Cable specification:



7. RS-232C Communication Specifications

7.5 Sample program

```
10 'SAVE "A:\RS_OCM.BAS",A
20 '*****
30 ' OCMA-350 RS-232C SAMPLE PROGRAM(N88BASIC)
40 '*****
50 '
100 CLS
110 OPEN "COM:N81NN" AS #1
120 *RSNEXT
130 B$=INPUT$(1,#1)
140 C$=C$+B$
150 IF B$=CHR$(&H3) THEN GOTO *REND ELSE GOTO *RSNEXT
160 *REND
170 PRINT C$
180 CLOSE #1
190 END
```

Comment lines

←Open RS-232C communications

←Data received (1 byte)

←Check whether end of data

←Display data received

←Close RS-232C communications

7

This sample program is written in NEC N88BASIC (V6.0). The baud rate, parity check, and stop bits settings are given below:

Baud rate : 2400 bit
No. of data bits : 8 bits
Parity check : None
Stop bit : 1 bit

Chapter8 Regular Maintenance

8.1 Taking care of the cell

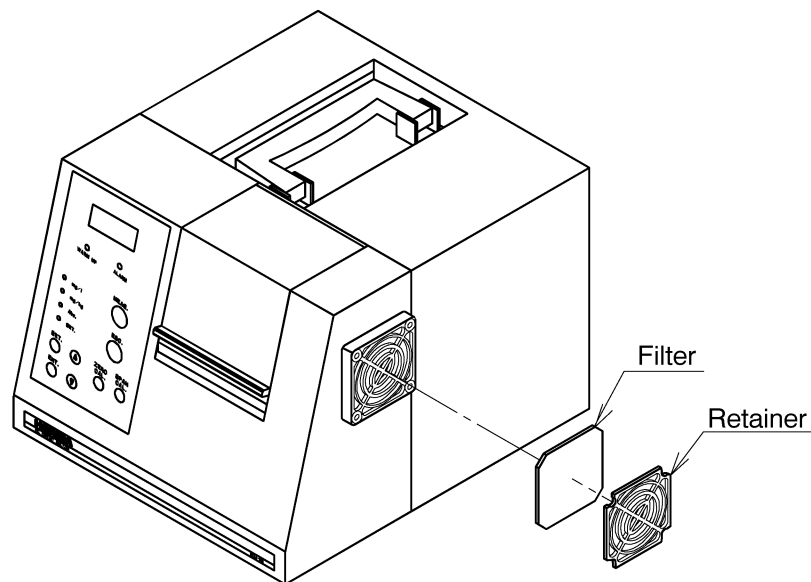
- When the measurement is over, wash the cell with a clean solvent, dry it well by air and store to avoid any damage.
- The other procedure for storage is also available; to sink the cell in alcohol for the storage, and clean it with a pure water, and dry it well with air.
- When the cell is extremely dirty, immerse the cell into the water with a little amount of newtral detergent. Clean the cell with the ultrasonic first, and after that with water, then dry it well with the air.

Note In cleaning the cell, do not use any brushes, which can easily damage the cell. Once the cell gets damaged, it may lose the accuracy in measurement. Any damaged cells are not to be used.

8.2 Cleaning the fan filter

In order to preserve the efficiency of the light source, clean the fan filter about once a month.

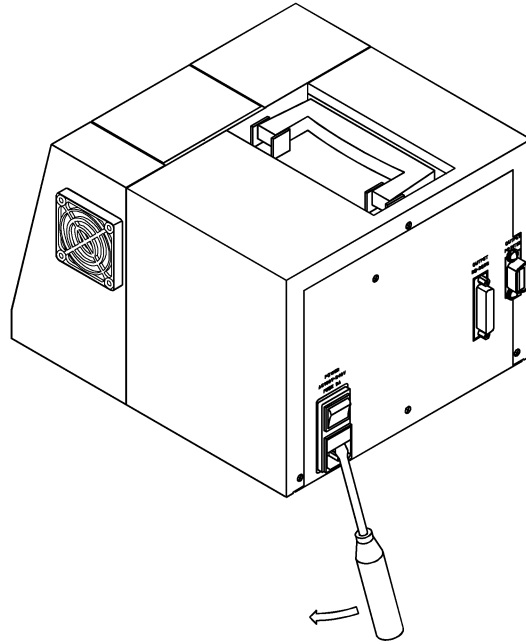
- ① Remove the retainer.
- ② Clean the filter.
- ③ Mount as it was originally.



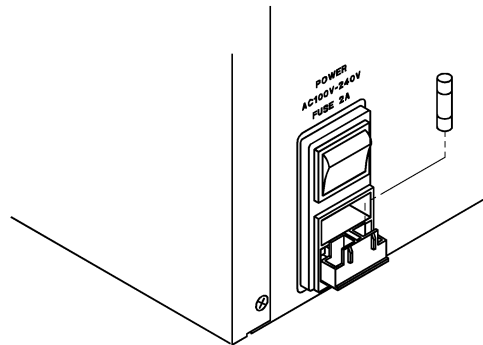
8. Regular Maintenance

8.3 Replacing the fuse

- ① Use a screwdriver to pull out the fuse cover located near the power cable socket on the rear panel.



- ② Mount a new fuse and push the fuse cover back in.
(Fuse used: AC250V 2A, 1 pc)



8.4 Supplementary parts list

Part Name	Part Number	Specifications
Cell	9039002000	Quartz (20mm)
Cell cap	9039002100	For cell
Syringe	9039002300	10ml
Microsyringe	9039002200	100 μ l
B-heavy oil	9018000600	10 ml

These supplies may be ordered by part name and part number from your retailer.

8. Regular Maintenance

NOTE 

Chapter9 Troubleshooting

9.1 Errors

OCMA-350 has the function of indicating the error No. in the LCD and light the "ALARM".

Error No.	Error Name	Description of Error
E.01	EEPROM ERROR	Malfunction in the internal memory (EEPROM).
E.02	RAM ERROR	Malfunction in the internal memory (RAM).
E.07	Light source ERROR	Light source output degradation.
E.09	Unstable data	Measurement (value) instability.
E.11	Calibration liquid ERROR	Calibration value falls outside the calibration value range.
	WARM UP	Measurement or calibration performed during warmup.

- Note
- When any error occurs, the error No. is indicated in the LCD and "ALARM" gets lit.
 - When multiple errors occur simultaneously, those errors are repeatedly displayed one error message by one.

9. Troubleshooting

9.2 Error handling

● Error No. 1: EEPROM ERROR

Definition: Data in the internal EEPROM memory was erased.

Error cancellation method: Turn the power on again.

Causes	Countermeasures
This is a malfunction in the internal EEPROM memory.	Contact your nearest retail outlet or a HORIBA service station for repairs.

● Error No. 2: RAM ERROR

Definition: Data in the internal RAM memory was erased.

Error cancellation method: Press the [ESC] key.

Causes	Countermeasures
The back-up battery has run out. (The lifetime is approx. 1week when power is off.)	Error can be cancelled by ESC key. Re-set the calendar again.
This is a malfunction in the internal RAM memory.	Contact your nearest retail outlet or a HORIBA service station for repairs.

● Error No. 7: Light source ERROR

Definition: During measurement, the output from the light source is less than 40% of the output at time of shipment from the factory.

Error cancellation method: Press the [ESC] key.

Causes	Countermeasures
The window in the measurement cell is dirty.	Purge several times with the zero liquid.
A foreign substance has entered the measurement cell.	Purge several times with the zero liquid.
The light source has degraded.	Contact your nearest retail outlet or a HORIBA service station for repairs.
A wire is broken in the light source.	

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● Error No. 9: Unstable data

Definition: The measurement value does not stabilize during measurement and the results cannot be output after 5 minutes.

Error cancellation method: Press the [ESC] key.

9. Troubleshooting

Causes	Countermeasures
The liquid is not completely in the measurement cell.	Pour the liquid into the specified area on the cell.
The warmup cycle has not completed.	Redo the measurement after the warmup cycle has completed.
The machine is vibrating.	Move the machine to a location where it will not vibrate and redo the measurement.

● Error No. 11: Caribration liquid ERROR

Definition: Either the zero calibration value, or the span calibration value does not fall within the calibration range.

Error cancellation method: Press the [ESC] key.

Causes	Countermeasures
The calibration liquid was not clean; it contained some impurities.	Redo the calibration with pure solvent.
The wrong value was used for the span calibration.	Remake the span calibration liquid.
The wrong value was set for the span calibration value.	

● WARM UP ERROR

Definition: A measurement or calibration was performed less than 30 minutes after the power was turned on (while the WARM UP lamp was still lit).

Error cancellation method: Press the [ESC] key.

Note The calibration during the "WARM UP" is lit is not available. Try the calibration again after the "WARM UP" is off.

9. Troubleshooting

9.3 Errors that are not displayed

The following describes ways to handle various symptoms that do not cause an error to be displayed.

For problems that are not described here, contact your nearest retailer or HORIBA service station.

- Nothing is displayed when you turn on the power

Causes	Countermeasures
The power cable is not connected.	Connect the power cable to the machine and to the power outlet.
A fuse has blown.	Replace the fuse.
The power switch is not turned on.	Turn on the power switch.

- The measured value is not an expected value

Causes	Countermeasures
The extraction ratio between the sample and the solvent is wrong.	Confirm and correct the extraction ratio.
The wrong value was used in the calibration.	Redo the zero and span calibrations.
The solvent used for the calibration, and the solvent used for the measurement came from different lots.	Try the zero / span calibration again using the solvents of the same lots.
The liquid is not completely in the measurement cell.	Fill in the liquid fill the designated line of the cell.
The temperature of the surroundings is outside the ambient operating temperature range.	Redo the measurements at a location where the temperature of the surroundings is within the range 0 to 40 °C.
The span liquid value is too small.	Use span liquid that is greater than 10 mg/l.

- The switches do not work/The display is strange

Causes	Countermeasures
The system is locked.	Turn off the power and turn it back on. If this does not fix the problem, contact your nearest retailer or HORIBA service station to request repairs.

9. Troubleshooting

- The indication value goes down to a minus

Causes	Countermeasures
The solvent used for the calibration, and the solvent used for the measurement came from different lots.	Mix each solvents well to make the original concentration the same, and try the calibration and the measurement again.
The measured value is approx. 0~-0.4mg/l	This value is within the repeatability of the analyzer and not abnormal. Regard any value up to -0.4mg/l as 0.0mg/l.
The extraction procedure for the calibration and the extraction procedure for the measurement is different.	The calibration should be made by the same extraction procedure (adding water) with the one for the measurement.

Note When the solvents for the calibration and for the measurement is different in lots or the residual oil concentration, it is available to obtain the original sample concentration by measuring the sample liquid as the zero solvent (Sample concentration (mg/l) = measured value of sample liquid - measured value of zero solvent). Even though the both solvents are the same in lots or the residual oil concentration, sometimes the measured value could be minus, affected by a slight moisture. When this happens, try the procedure for the measurement and the calibration shown in page 3-5, 3-6. Lastly, the measured value can be also down to minus when the solvent is treated by ultrasonic or filtered especially in the measurement of residual oil concentration. When this happens, the solvent for the calibration needs the same treatment, with the solvent for the measurement.

- The printer does not print

Causes	Countermeasures
The power supply for the printer is not turned on.	Turn on the power to the printer.
The printer cable is not connected.	Connect the printer cable.
The printer does not conform to the simplified centronics specification.	Use one of the printers recommended by HORIBA.

- Cannot perform RS-232C communications

Causes	Countermeasures
The communications cable is not connected.	Connect the RS-232C (cross) cable.
The personal computer and the OCMA-300 are using different communications specifications.	Reset the communications specifications on the personal computer or the OCMA-300 and reset the power.

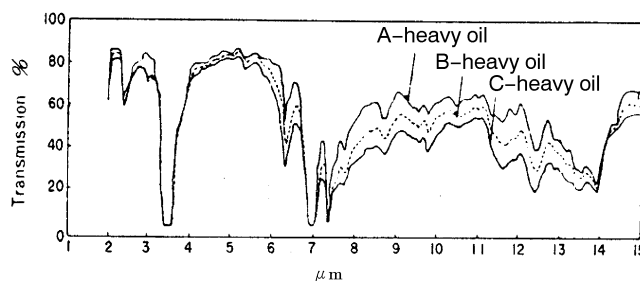
9. Troubleshooting

NOTE 

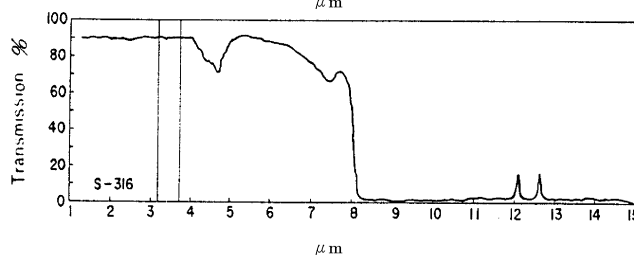
Chapter 10 Technical Reference

10.1 Measurement principles

Although there are many methods that are appropriate for measuring the oils contained in natural water or drainage water, including: the n-hexane extraction method, Soxhlet's extraction method, the soaking method, the emulsification turbidity method, the fluorescence analysis method, and gas chromatography methods using FID and FPD, recently the infrared absorption method is gaining widespread use as a quantitative method for oils. The infrared absorption measurement principle reflects the chemical structure of the molecules well and a characteristic absorption pattern is shown by the chemical structure of the substances. Therefore, the absorption of various wavelengths in the infrared range is measured, and the position and strength of the absorption bands enable us to make a qualitative and quantitative analysis of the substances.



Example absorption spectrum
Figure 1



Flon S-316
absorption spectrum
Figure 2

The HORIBA oil Content Analyzer makes use of the facts described above and the fact that oils are composed of hydrocarbons.

As shown in Figure 1, there is an absorption band that follows the expansion and contraction movements of the radicals in $(-\text{CH}_2-)$, $(-\text{CH}_3)$, etc. that are characteristic of hydrocarbons which are composed of C-H unions near the 3.4 to 3.5 μm ($2,941$ to $2,857\text{ cm}^{-1}$) wavelengths. The wavelength spectrum for this range can be measured at the same sensitivity with almost no dependency on the type of oil (plant oil, animal oil or mineral oil).

On the other hand, as shown in Figure 2, S-316 has no absorption band within this wavelength range. Further, when dissolved in water, the difference in specific gravity is large, so that oil is easily dissolved. Taking advantage of these features, we can measure the oil concentration in test sample water as follows:

10. Technical Reference

after the oil which has been dispersed in water is extracted (dissolved) in S-316, the oil concentration in the sample is measured from the changes in the amount of infrared absorption in the 3.4 to 3.5 μm wavelength range of the extracted liquid.

Infrared analysis meters can be generally divided into "spectral infrared analysis meters" and "non-dispersive infrared analysis meters". The OCMA-350 belongs to the "non-dispersive" family. Because the "non-dispersive" type allows a more sensitive analysis than the "spectral" type, the cell length can be made shorter, so that less test sample is required. It has many other merits such as the ability to take measurements without losing elements with low boiling points, making it currently one of the best quantitative methods for oils.

10.2 Mixed standard liquid

The mixed standard liquid here is defined as a solution mixture of 2,2,4-Isooctane, cetane and chlorobenzene by the volume ratio of 3:3:2.

10.3 The oil measurement solvent (S-316)

S-316 is a double chlorotrifluoroethylene obtained from a dimerization (doubbling) reaction of chlorotrifluoroethylene monomer.

10.3.1 Characteristics

- Almost no infrared absorption in the 3,000 cm^{-1} absorption wavelength of hydrocarbon radicals.
- Because of the high boiling point of +134 $^{\circ}\text{C}$, and the low freezing point of -143 $^{\circ}\text{C}$, measurements can be taken under a wide temperature range.
- Chemically stable in acid, alkali, oil and water.
- Insoluble in water.
- Non-volatile because of low vapor pressure.
- Non-combustible so there is no danger of explosion.
- Highly safe because of extremely low toxicity to people.

Because of the above characteristics, S-316 is an excellent solvent fulfilling the conditions required for an oil extraction solvent.

10.3.2 Reclamation methods

- To reclaim the solvent, use the optional solvent reclamation device (SR-300).

10.3.3 Property table

Property		S-316
Chemical formula		Cl (CF ₂ -CFCl) ₂ Cl
Molecular weight		304
Boiling point		+134
Freezing point		-143
Specific gravity (g/ml,at25°C)		1.75
Surface tension (dynes/cm,at25°C)		27
Viscosity (cst,at25°C)		0.96
Vapor pressure (mmHg)	at25°C	11.5
	at50°C	38
Bending ratio (n ₂₅)		1.380
Saturation point in water (ppm)	5°C	45
	25°C	48
	50°C	55
Solubility in water (ppm)	25°C	4.5
	50°C	7.5
Acute oral toxicity (LD ₅₀)		Greater than 52.5 g/kg

10.4 CFC-113

In 1987, the "montreal protocol on substances that deplete the ozone layer (1987)" is adopted for the purpose of the preservation of ozone layer. The subsequent revises determine the total abolition of the specific flon until 1996. However, because of the unsuccessful reseach of the alternative fluorocarbon the revised determination allows "the essential use" for 2years from 1996, where the use of the specific flon is granted. (S-316 is originally out of this protocol).

Note CFC-113 is easier to evaporate compared with S-316, and may cause the error in the measurement.

10.5 The measurement value stable display function

The OCMA-350 automatically judges the stability of the measurement value from the time the liquid is transferred to the measurement cell until the measurement results are displayed. The reason for this function is to remove the measurement errors due to individual variations.

To Judge the stability, the moving average for 10sec. per 1sec. of sampling time is applied. The final average is displayed when each moving average gets under 0.1mg/l for 10sec., which is the standard for the judgement. This judging time takes approx 20sec.

10. Technical Reference

10.6 Specifications

The following are the specifications for the OCMA-350.

Model name	OCMA-350
Measurement method	Solvent extraction – non-dispersive infrared absorption analysis method
Measured objects	Substances that are extracted by solvents from test sample water and which show infrared absorption in the proximity of 3.4 μm to 3.5 μm wavelengths
Measurement unit	mg/l,mg/kg,Abs.
Measurement range	0~200mg/l 0~1000mg/kg 0~1.000Abs.
Resolution	0~99.9mg/l :0.1mg/l 100~200mg/l :1 mg/l 0~9.9mg/kg :0.01 mg/kg 10~99.9mg/kg :0.1 mg/kg 100~1000mg/kg:1 mg/kg 0~1.000Abs. :0.001Abs.
Repeatability	0~9.9mg/l : $\pm 0.4\text{mg/l} \pm 1\text{dig.}$ 10.0~99.9mg/l: $\pm 2.0\text{mg/l} \pm 1\text{dig.}$ 100~200mg/l : $\pm 4\text{mg/l} \pm 1\text{dig.}$ 0~1.000Abs. : $\pm 1\%\text{F.S}$
Display method	Backlit 3 character LCD
Calibration method	Zero, span calibration: Automatic calibration after liquid is poured in.
Extraction solvent	S-316,CFC-113
Amount of extraction solvent required	Approx. 6.5ml
Extraction method	Depends on the external extracting function
Ambient operating temperature	0~40°C
Power supply	AC100V~240V $\pm 10\%$ 50/60Hz
Power consumption	Approx. 60VA
External dimensions	200×250×285(H×W×D)
Weight	Approx. 5 kg
External output	RS-232C output Printer output (centronics)
Other	Self determination function Measurement stabilized value display function Clock function