# Digital COD Meter

# HC-607

## User's Manual

CIKC

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# Digital COD Meter

# HC-607

# User's Manual

CENTRAL KAGAKU CORP.

# Introduction

Thank you for purchasing the HC-607 COD meter.
The HC-607 COD meter allows quick and simple measurement of organic pollutants in water, a primary cause of water pollution, as COD. The reagents required for measurements are pre-prepared, and measurements may be taken simply and without complex operations.
Please read this User's Manual carefully before use.

# Before Using

- Read this User's Manual carefully and understand its content before using this product.
- Store this User's Manual carefully in a convenient place, readily accessible whenever it becomes necessary.
- Use this product as intended and as described in this User's Manual. Do not use this product for any purpose other than measuring COD.
- Understand the instructions given in this User's Manual with respect to safety and always follow those instructions when using the product.

# About the User's Manual

- The content of this User's Manual is subject to change without notice for reason of improvements in product performance or functions.
- Unauthorized reproduction or copying of this User's Manual, in full or in part, is strictly prohibited.
- If you lose this User's Manual, please contact Central Kagaku Corporation.
- Through due care has been taken in the production of this Operation Manual, should you encounter any instances of ambiguity, error or omission, please contact Central Kagaku Corporation for clarification.


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# Table of Contents

# 1 Overview of the HC-607 COD Meter

The HC-607 COD meter allows quick and simple measurement of chemical oxygen demand (COD), recognized as an important index of water pollution in the areawide water quality of city water, drainage, river water and the like in conformance with Japan Industrial Standard JIS K 0102 "Measurement of oxygen consumption by potassium permanganate at 100°C" and is capable of reading the sample COD value directly in units of mg/L.

The HC-607 COD meter is the product of extensive experience and data gathered since development of the first-generation areawide water quality COD meter, and the incorporation of a microcomputer provides exceptional stability and reliability, as well as superior operability.

# 2 Principle of Measurement

The HC-607 COD meter applies the method of coulometric titration.

The HC-607 heats a solution for five minutes to induce a reaction between organic matter in the sample and a known quantity of potassium permanganate added beforehand and then measures the residual potassium permanganate by means of coulometric titration.

When measurement of the heated sample begins, $Fe^{3+}$ in reagent solution B is reduced to $Fe^{2+}$ by electrolysis. The reduced $Fe^{2+}$ quickly consumes the residual potassium permanganate. When the potassium permanganate is fully consumed, the $Fe^{2+}$ in the sample increases rapidly and is detected by the indicator electrode. The residual potassium permanganate is quantified from the quantity of electricity (current $\times$ time) consumed in electrolysis up to that point, and a back-calculation performed to display the COD value (mg/L).

# 3 Specifications

| | |
|---|---|
| Principle of measurement | Coulometric titration |
| Measurement method | Acid or dichromatic titration |
| Final detection method | Potential difference (secondary differential) |
| Measurement ranges | 7 ranges: 10, 20, 40, 100, 200, 400 and 1,000 mg/L<br>User-defined measurement ranges from 0 to 2000 mg/L |
| Measurement precision | ±2% FS (acid measurement) |
| Minimum reading | 0.01 mg/L (in the 0-10 mg/L range) |
| Display | 16-Character, 2-line LED (backlit) |
| End Measurement | Automatic electrolysis stoppage and bell signal |
| End Oxidation | Buzzer sounded (1 min before completion) |
| Oxidation timing | 0'00" - 9'59" digital timer |
| Error display | 1) Blank over<br>2) Time over<br>3) Invalid titrations (lacking endpoints)<br>4) RAM errors<br>5) CMOS errors |
| Calculations | 1) Y=a+bX conversion<br>2) Statistical calculation<br>3) Automatic zero adjustment<br>4) Normal value range evaluation |
| External output | RS-232C, 1 port standard<br>Communications specs: Baud rate 9600 bps<br>Character lengt 8 bits<br>Parity check None<br>Step bit 1 bit |
| Power supply | AC 100V, 50/60 Hz |
| Power consumption | approx.100 VA |
| Dimensions | 310 (w) x 270 (d) x 300 (h) mm |
| Weight | approx.5 kg |

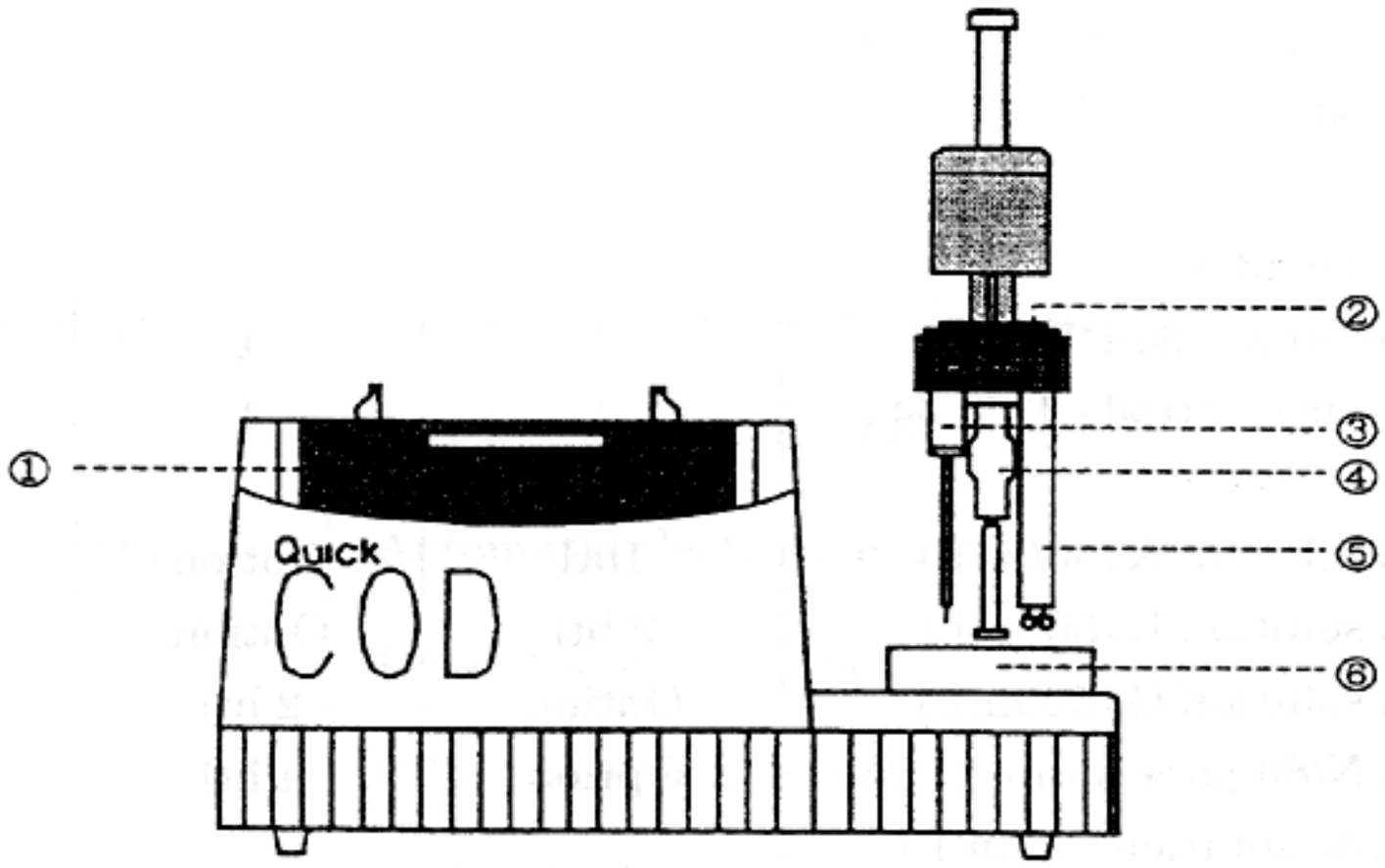
# 4 Configuration

Please confirm that the product and components packaged are as given below.

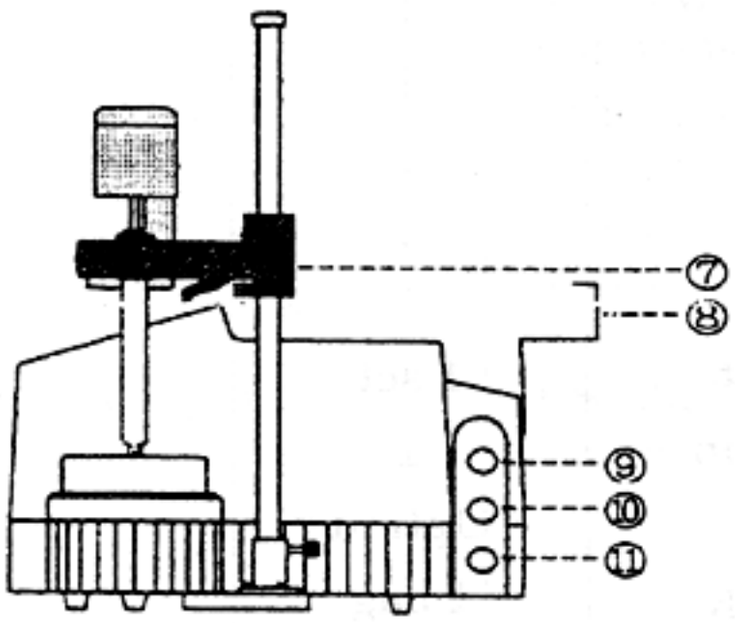
| | | Qty | | |
|---|---|---|---|---|
| **Section** | **Component** | **Acid Method** | **Dichromate Method** | **Remarks** |
| Measurement unit | Main unit HC-607 | 1 | 1 | |
| | Power cord | 1 | 1 | |
| Electrodes | Electrode holder | 1 | 1 | |
| | Indicator electrode PTW-341 | 1 | 1 | |
| | Electrolysis electrode TPT-341 | 1 | 1 | |
| Reagents | Reagent solution A (500mL) | 1btl | Option | |
| | Reagent solution B (500mL) | 2 btl | Option | |
| | Reagent solution G (500mL) | Option | 2 btl | |
| | Reagent N/80 potassium dichromate solution (500mL) | Option | 1 btl | |
| Accessories | Plug adapter | 1 | 1 | |
| | Printer fittings | 1 | 1 | |
| | Beaker guide | 1 | 1 | |
| | Connector cover | 1 | 1 | |
| | Special tall beaker | 3 | 3 | |
| | Special heater | 1 | 1 | |
| | Safety bands | 1 set | 1 set | |
| | Cooling vessel | Option | 1 | |
| | Watch glass | 1 | Option | |
| | Emery (25 g) | 1 bag | 1 bag | |
| | PVC rod | 1 | 1 | |
| | Heat-control plate | 1 | 1 | |
| | Fuse w/ glass tubes | 2 | 2 | |
| | Printy3 HC-607 printer | Option | Option | Printer, AC adapter, connection cord |

# 5 Names and Functions of Components

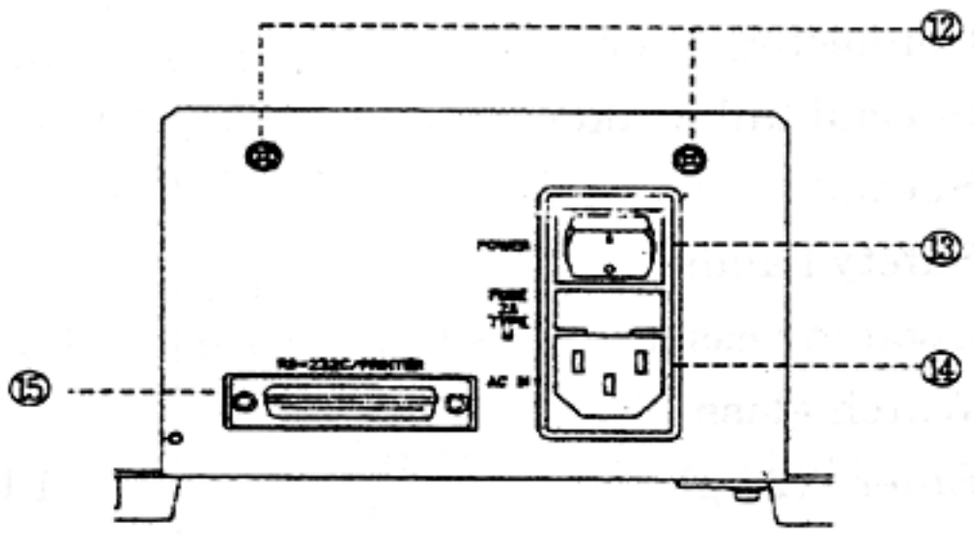
## 5.1 Main Unit




Front view



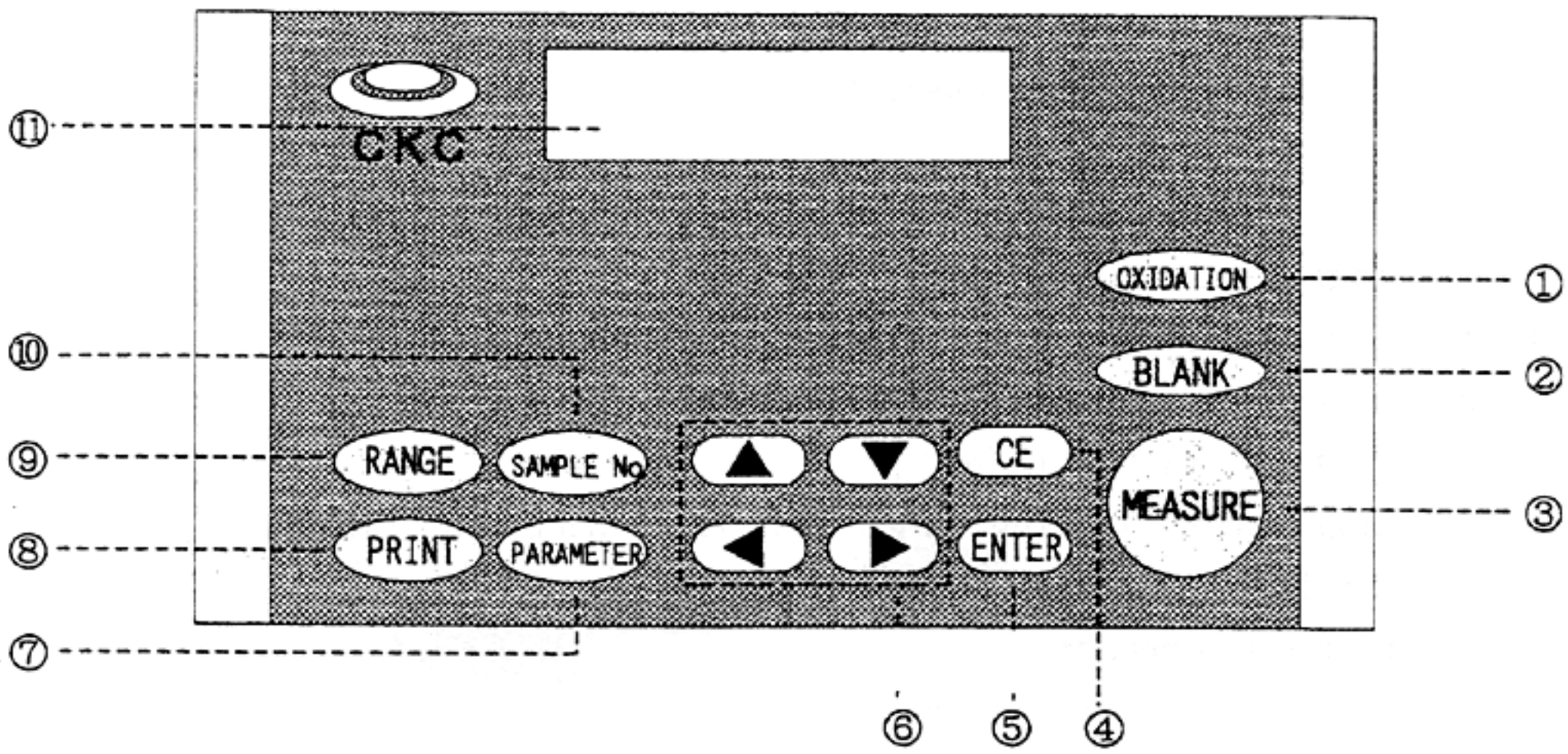

Right side




Rear view

① Control panel (See section 5.2, P.6)
② Electrode holder
③ Indicator electrode: Detects reaction endpoint
③ Stirrer: Stirs sample during measurement
④ Electrolysis electrode: Performs electrolysis
⑤ Beaker guide
⑥ Electrode holder stopper: Used to adjust electrode height
⑦ Printer fittings: Used for attaching printer
⑧ Indicator electrode connector: Connects indicator electrode
⑨ Electrolysis electrode connector: Connects electrolysis electrode
⑩ Stirrer connector: Connects stirrer
⑪ Printer fittings connection screws: Used to fasten down printer fittings
⑫ Power switch: Turns COD meter power on and off
⑬ AC IN connector: Connection for power cord
⑭ Communications connector: Connection for RS-232C output cable (25-pin)

## 5.2 Control Panel




① OXIDATION key: Starts and stops oxidation timer.

② BLANK key: Starts blank measurement.
Press again to stop measurement.

③ MEASURE key: Starts sample measurement.
Press again to stop measurement.

④ CE key: Clears settings.

⑤ ENTER key: Reconfirms settings.

⑥ Arrow keys: Move to settings screen.
Select settings options.
Move cursor.
Edit numeric values.

⑦ PARAMETER key: Defines first and second parameter sets.
Clears measurement readings.
Executes system initialization.

⑧ PRINT key: Prints measurement readings.
Prints statistical output.
Prints internal settings.

⑨ RANGE key: Sets measurement range.

⑩ SAMPLE No. key: Selects sample numbers.

⑪ Display: 16-character, 2-line LED

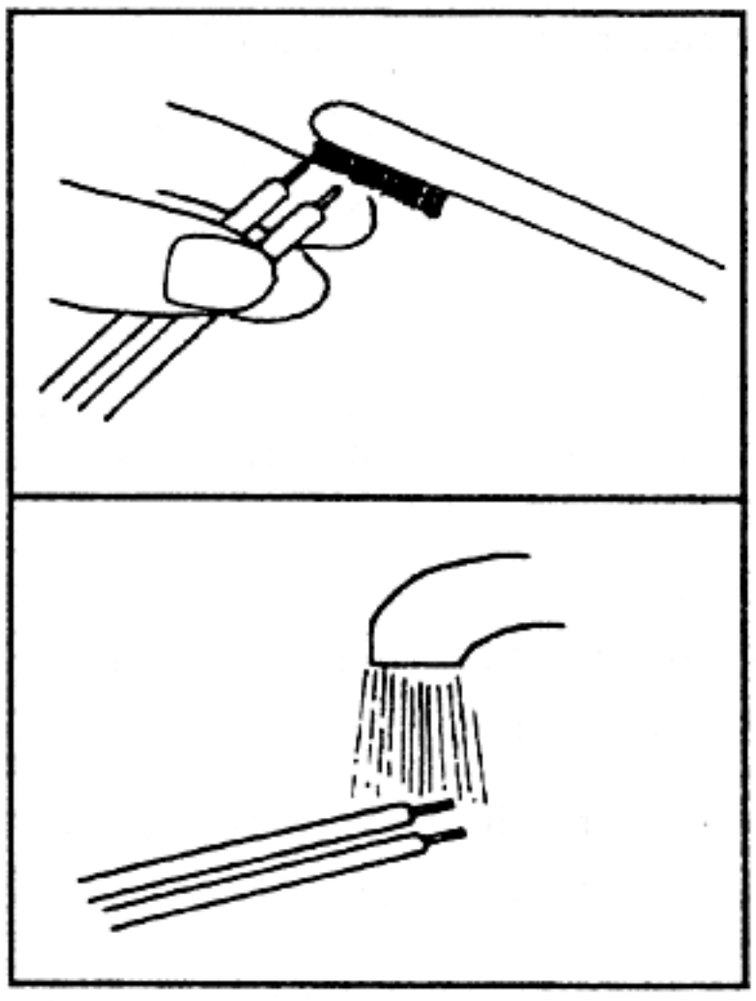
# 6 Preparations for Measurement

Chemical oxygen demand (COD) is an index of water pollution.
To perform measurements correctly, always wash the electrodes and beaker before starting measurements.

## 6.1 Electrode Preparation

Metal segments of a new electrode may have an oily film on them. An electrode that has not been used for a long time may have an oxide film. Polish and wash the electrodes before taking measurements.

### 6.1.1 Polishing the Indicator Electrode



①Rest the metal segments of indicator electrode PTW-341 on your finger and polish them with a brush provided with cleanser.

②Wash thoroughly with tap water, then rinse in distilled water.

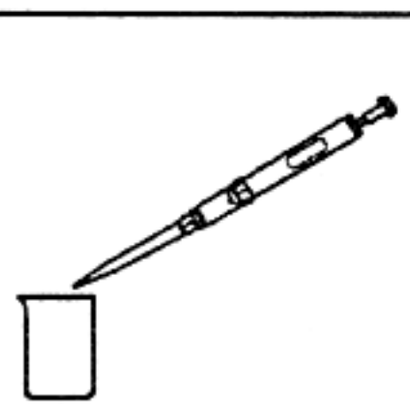
### 6.1.2 Cleaning the Electrolysis Electrode

Wash the coiled metal segments of electrolysis electrode TWT-341 thoroughly with tap water, then rinse in distilled water.

## 6.2 Cleaning the Tall Beaker

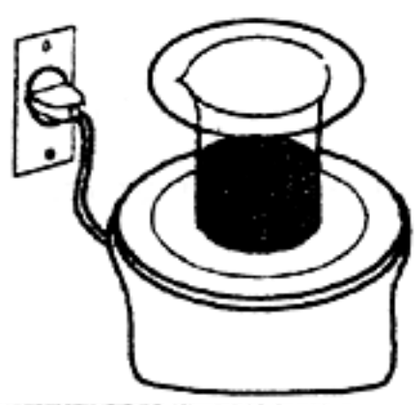
### 6.2.1 Extended cleaning the Tall Beaker

Stood unused for a long period of time, the tall beaker may collect dust and other impurities. Wash the tall beaker at high temperature according to the following procedures.

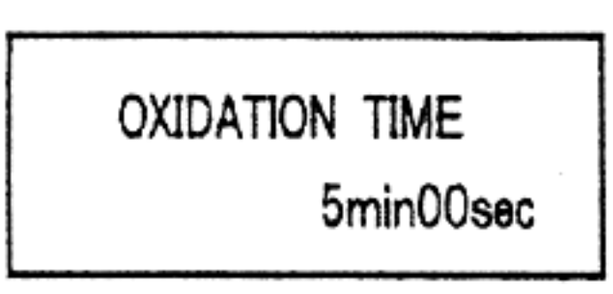


①Add reagents to the dried special tall breaker in the following order.*Notes a, b

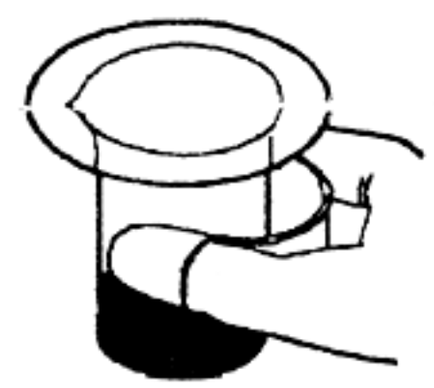
1. Reagent solution B 10 mL*Note c
2. Reagent solution A 1 mL
3. Add distilled water up to the marked line.



②Place the watch glass over the special tall beaker.
Place the beaker on the red-hot electrothermal heater.*Note d




③When it begins boiling and bubbling uninterruptedly from the bottom of the special tall beaker, press the OXIDATION key.
The five-minute reaction time starts.
The buzzer sounded after four minutes and then again when the five-minute reaction time has passed.



④When the bell signals that reaction time has completed, press the OXIDATION key again and cut off the timer bell.

⑤Place the safety bands on your fingers and remove the tall beaker from the electrothermal heater.

⑥Rinse thoroughly in distilled water.

Notes

a Use the special tall beaker after drying the bottom of it thoroughly. (cf. Section 6.2.2 , P 9)

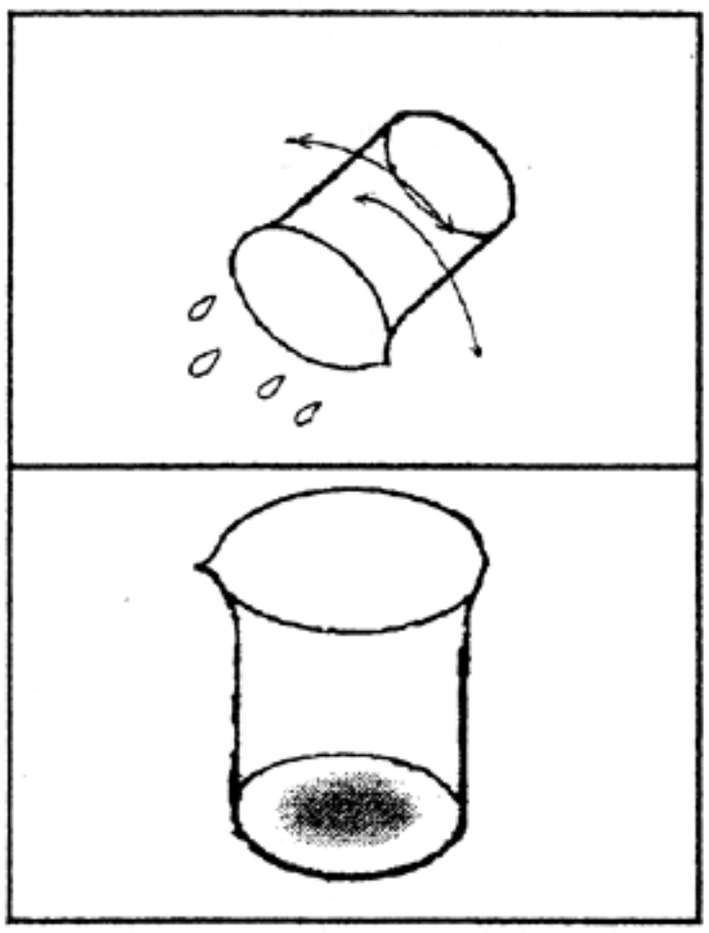
b Use a special pipette for each reagent.

c Reagent solution B contains sulfuric acid. Handle with care.

d The electrothermal heater may become hot. Place it on the heat-control plate for use.

### 6.2.2 Drying the Tall Beaker Carefully

In order to prevent bumping when boiling and also to obtain stable reactions, dry the bottom of the tall beakers after each measurement.



① After completing a measurement, rinse the tall beaker thoroughly in distilled water and shake it free of water.
Place a Kimwipe or tissue over the top of the beaker and shake the water free vigorously. This shakes the water off more uniformly.

② Place the tall beaker, well shaken free of water, on the heater. When the bottom has dried somewhat (when it whitens), remove it from the heater.

③ Wait until the whole of the bottom whitens with the remaining heat. The drying process is complete when the whole of the bottom whitens.

## 6.3 Reagents and Distilled Water

### 6.3.1 Reagents

- Variation in the quality and sample size of reagent solution A affects measurement readings. Replace the reagent with a new bottle when sediment collects in the bottom of the bottle.
- Use a clean instrument, and one as accurate as possible, when sampling reagent solution A.
  Use a new chip when using an auto-handling pipette.

### 6.3.2 Distilled Water

- Distilled water not containing any organic compound is required. Do not use ion-exchange water or tap water.

# 7 Preparation of the Equipment

## 7.1 Installation of the Equipment

The HC-607 COD meter is precision equipment and should be used in a location satisfying the following conditions.

| | |
|---|---|
| Power source: | AC 100V, 50/60 Hz |
| Ambient temperature: | 0～50°C |
| Ambient humidity: | 0～90% |
| Location: | Indoor locations only.<br>Place on a stable, level surface not subject to vibration.<br>Little dust or grime.<br>No equipment generating a strong line of magnetic force.<br>No combustible or explosive substances. |

- **The equipment includes a special heater using nichrome cords. Install the equipment in a location not exposed to flammable gas or combustible liquids. Do not place combustible substances in the vicinity of the equipment.**
- **Place the special heater on the heat-control plate for use.**
- **Measurements involve the heating of sulfuric acid. Since the process produces gas, perform measurements in a location that is well ventilated or that may be well ventilated.**

## 7.2 Connection to a Power Source

Before connecting the equipment to a power source, make sure its power switch is in the Off position.

1) Power cord connection

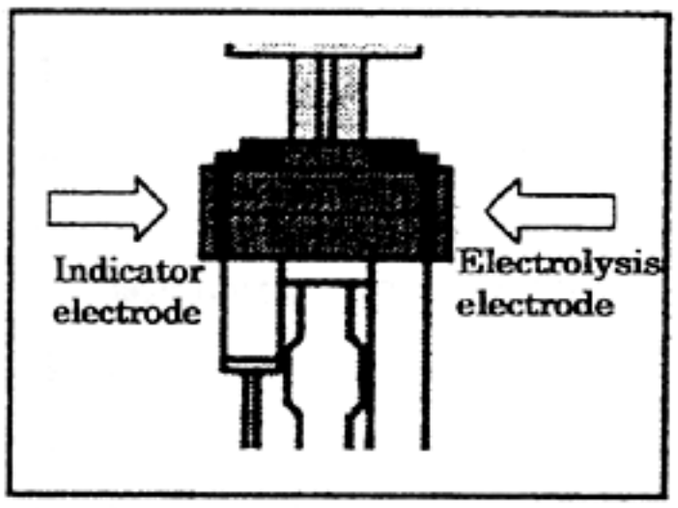
   Plug the power cord into an AC power outlet. If the power outlet is for a three-prong plug, remove the plug adapter to plug the cord in. In this case, grounding is not necessary.

2) If the power outlet is for a two-prong plug, connect the ground wire from the plug adapter. If it cannot be grounded nearby, use the included ground extension.

- **Do not under any circumstances connect the ground lead in a dangerous location, such as the vicinity of a gas tube.**

## 7.3 Assembly of the Main Unit

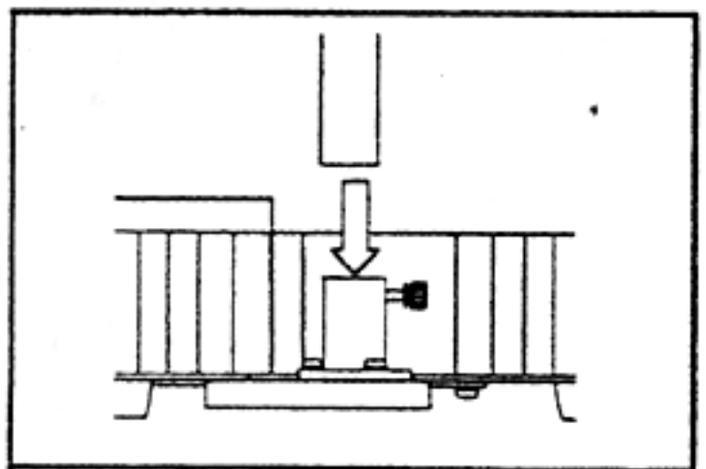
### 7.3.1 Mounting the Electrodes in the Electrode Holder



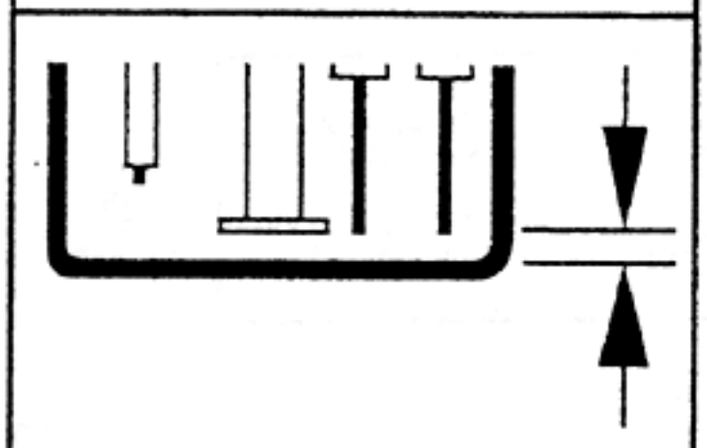

①Mount indicator electrode PTW-341 in the left side of the electrode holder.

②Mount electrolysis electrode TPR-341 in the right side of the electrode holder.

### 7.3.2 Mounting the Electrode Holder to the Main Unit

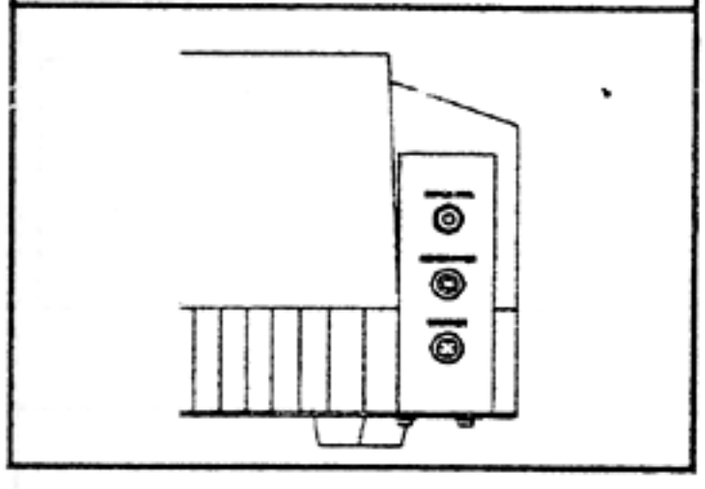


①Fit the electrode holder into the attachment hole for the electrode holder on the right side of the main unit and fasten the screw.



②Place a tall beaker below the electrode unit.
Adjust the stopper screw so that the electrode unit lowers to a height such that neither electrode touches the bottom of the tall beaker.

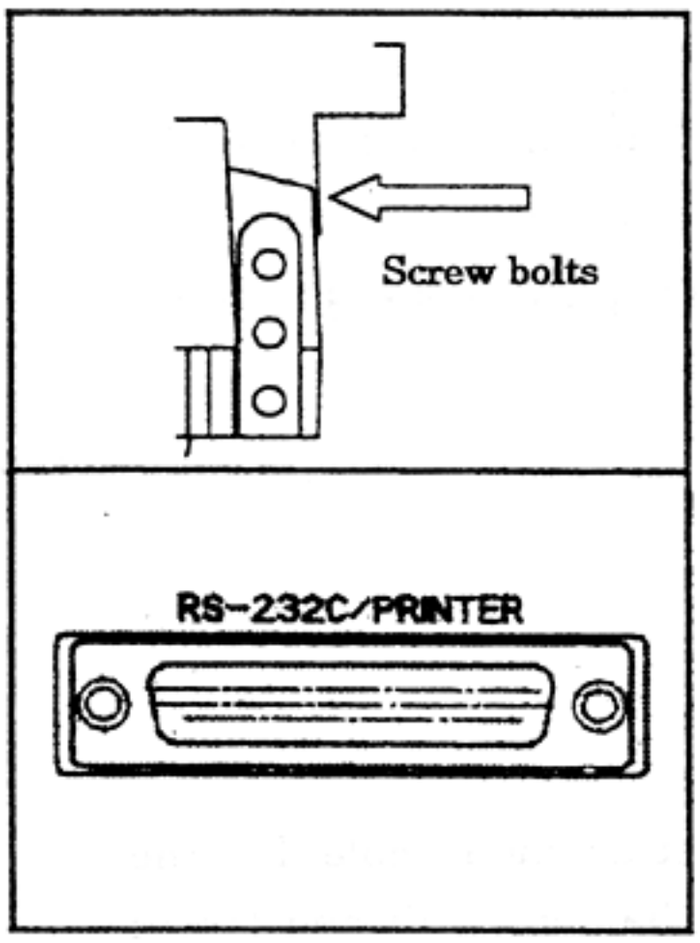
***Note**: Operating the equipment with an electrode touching the bottom of the beaker may damage it with a bent axis.*



③Insert the electrode and stirrer lead connector terminals into the connectors on the right side of the main unit.

④Clamp the leads with the stoppers provided on the printer fittings. Place the connector covers over the connectors.

## 7.4 Connecting the Printer (optional)




① Attach the printer fittings with the two screw bolts on the rear of the main unit.

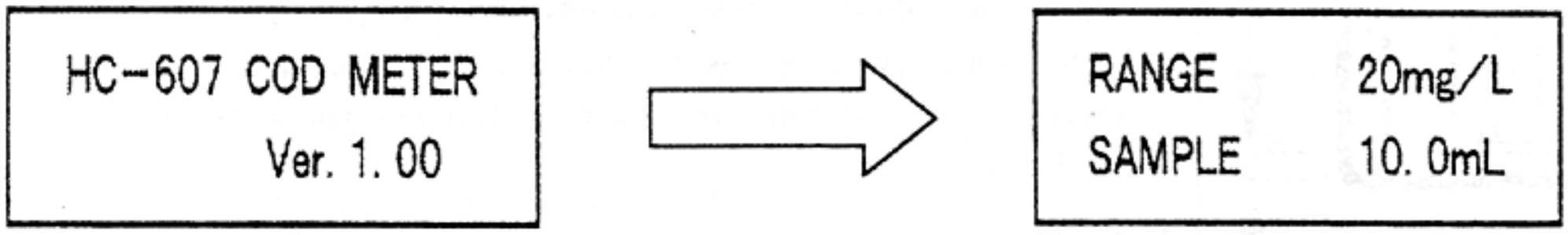
② Connect the printer RS-232C output cable to communication connector on the rear of the main unit.

*Note:Confirm that the printer is selected in the second set of parameter settings "Communication* device selection". (cf. *Section 12.3.2 (3), P. 36)*

## 7.5 Turning on the Power

Turn the power switch on the rear of the main unit to On.

The start-up screen displays for around ten seconds, then the current measurement range.




Start-up screen　　Measurement range

# 8 Acid Method

## 8.1 Required Apparatus and Reagents

1) Reagent solution A
2) Reagent solution B
3) Clean tall beaker (washed at high temperature, cf. section 6.2.1, P.8 for cleaning methods)
4) Watch glass
5) Safety bands
6) 1 mL, 10 mL and 0.1-10 mL pipettes for sample size suited to the measurement range
7) Distilled water, Cleaning bottle, waste liquid container, Kimwipes

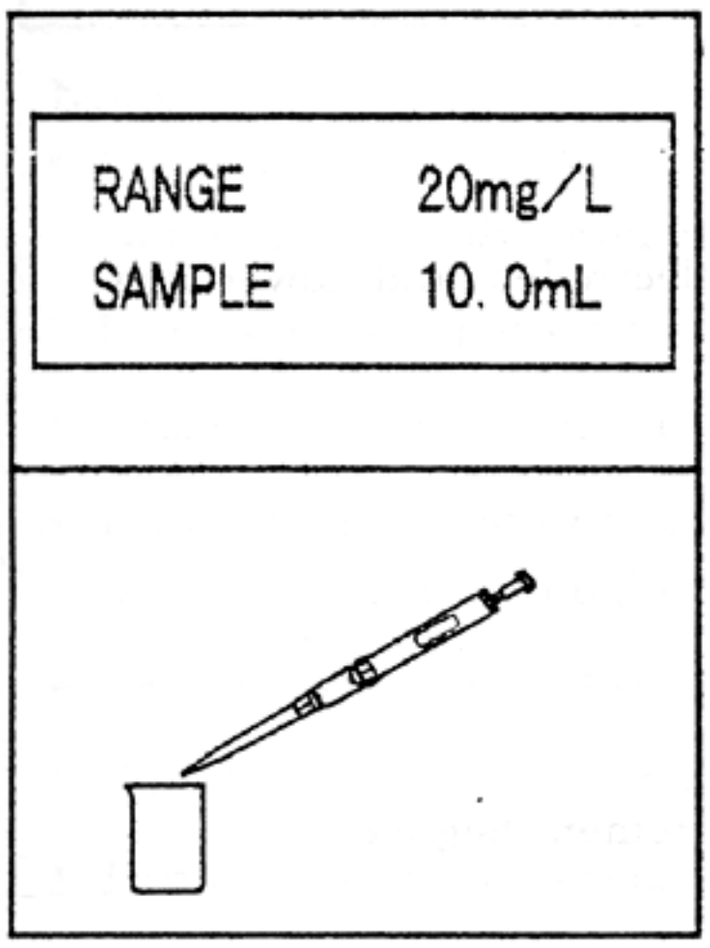
- **Chemicals Warning: Contact with hands or skin may cause irritation. On contact, immediately wash away with large volumes of water. On contact with the eyes, promptly wash with large volumes of water and then consult a physician.**

## 8.2 Measurement Procedures

* If the pH of the sample is extremely alkali, first adjust the pH to neutral.

* Chloride ions in the sample interfere with measurement. (cf. section 8.4 on page 18)

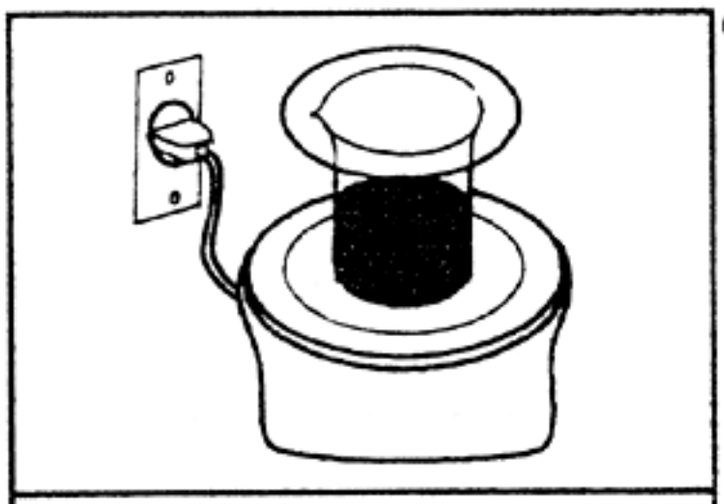
- **Measurement entails heating samples to which sulfuric acid has been added. Make sure that there is no combustible matter and no combustible gas emitted in the vicinity and that there is sufficient ventilation.**



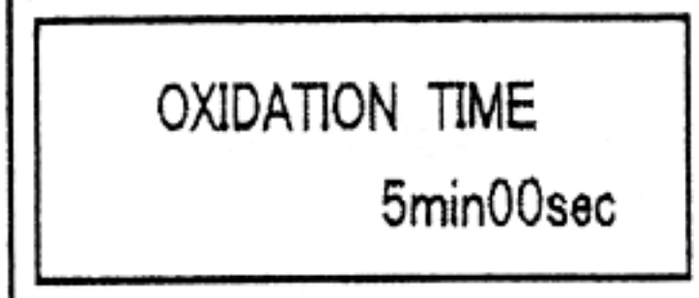

①Press the RANGE key on the main unit. Use the up and down arrow keys to select a measurement range double that of the expected COD concentration.
The lower half of the screen shows the volume (mL) of the water sample.
Ex. If expected COD concentration is 50 mg/L, select a measurement range of 100 mg/L.

②Add the reagents and sample precisely to the dried special tall beaker in the following order.*Notes a, b

1. Reagent solution B 10 mL*Note c
2. Sample Volume shown in step (1) above*Note d
3. Reagent solution A 1 mL*Note e
4. Add distilled water up to the marked line.

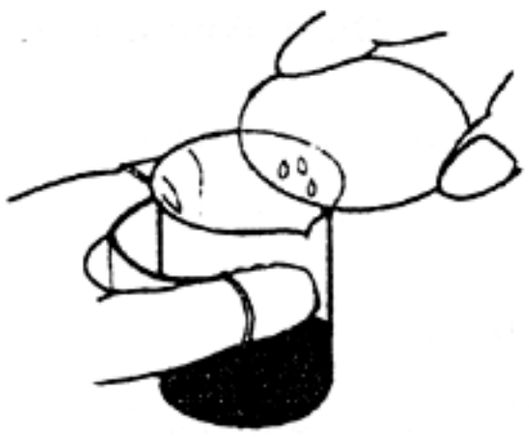


③Cover the top of the special tall beaker with the watch glass and place it on the red-hot electrothermal heater. *Note f



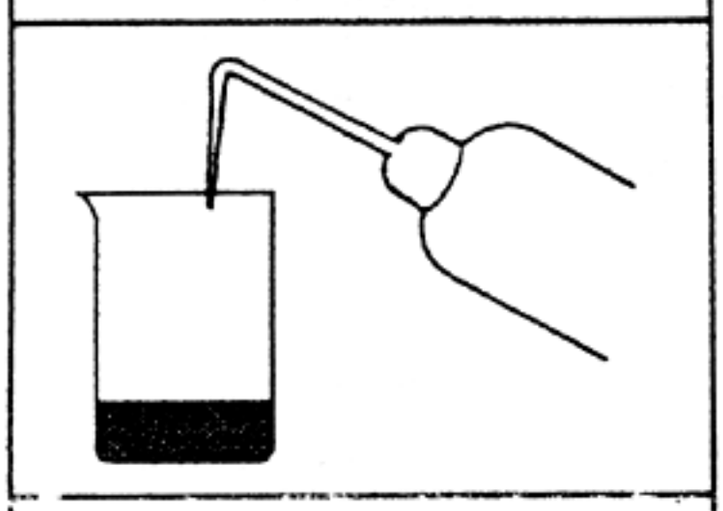

④When it begins boiling and bubbling uninterruptedly from the bottom of the special tall beaker, press the OXIDATION key.
The five-minute reaction time starts.
The bell signals after four minutes and then again when the five-minute reaction time has passed.

⑤When the bell signals that reaction time has completed, press the OXIDATION key again and cut off the timer bell. *Note g

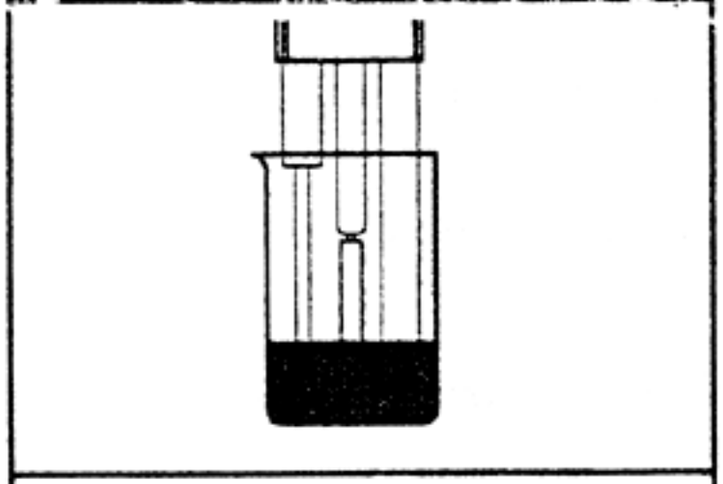


⑥Using the safety bands, remove the tall beaker from the electrothermal heater.

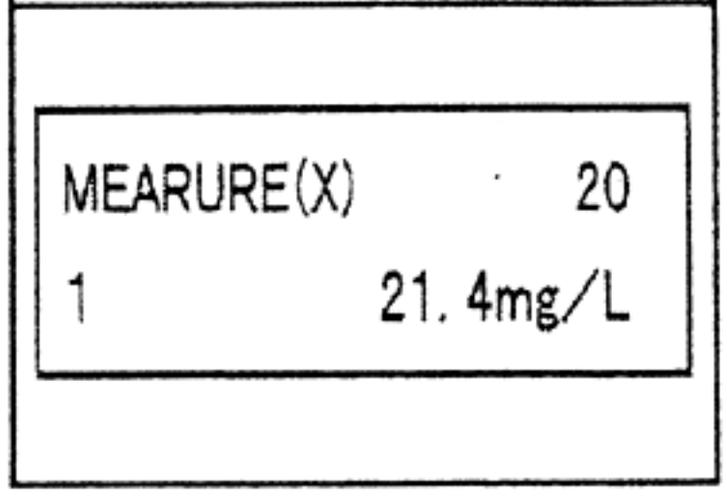
⑦Remove the watch glass. When doing so, wipe the water drops on it off on the edge of the tall beaker.



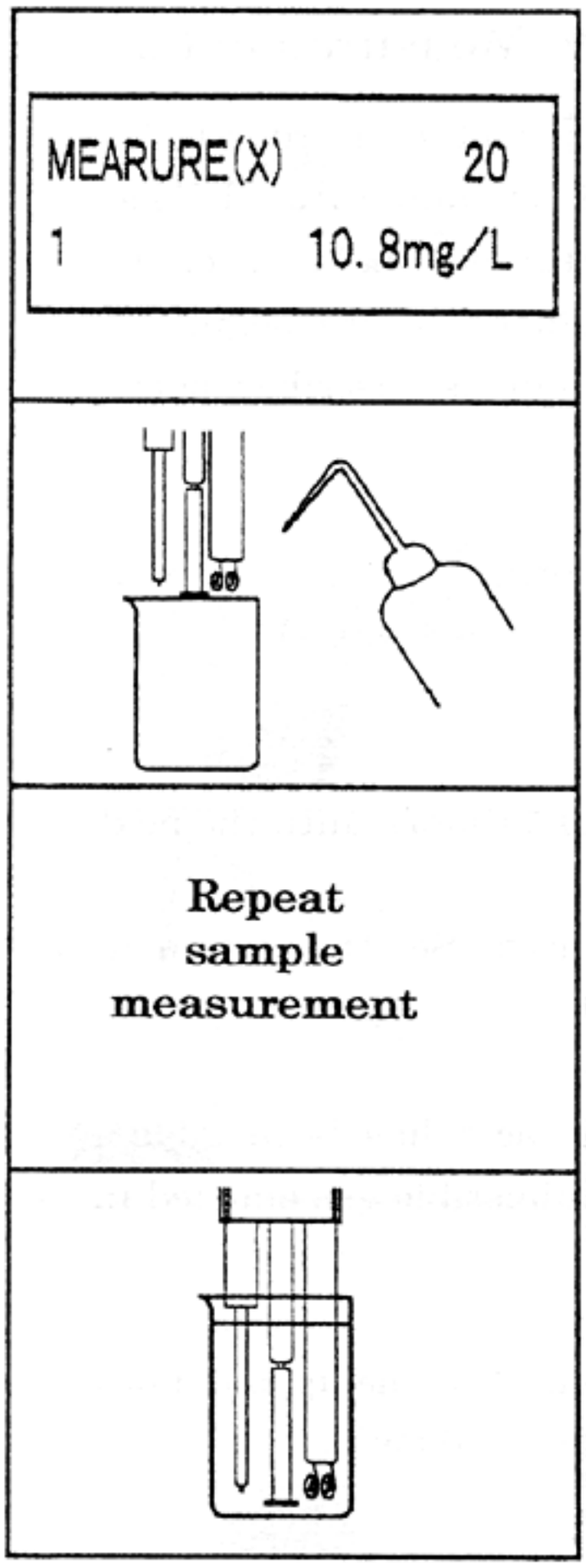
⑧Immediately add distilled water up to the marked line.



⑨Place the tall beaker below the electrodes and lower the electrode unit.




⑩Press the MEASURE key.
The stirrer rotates and sample measurement begins.




⑪The bell signals the completion of measurement, and the display gives the COD reading (mg/L). *Note h
The reading shown is the value selected in the first set of parameters. (cf. section 12.3.1 (1) on page 34)

⑫Raise the electrode unit and wash the electrodes with distilled water. Wipe away any water drops from the electrodes.

⑬Rinse the tall beaker thoroughly in distilled water, and dry it out.

Repeat procedures ② through ⑬to perform sample measurements.

After completing measurements, fill the tall beaker with distilled water and store the electrodes immersed in it. (cf. section 10.2.1 on page 26) *Note i

## Notes

a Use a special tall beaker washed at high temperature (cf. section 6.2.1 on page 8) with its bottom thoroughly dried out. (cf. section 6.2.2, P.9) There is danger of bumping and damage.

b Use a special pipette for each reagent.

c Reagent solution B contains sulfuric acid. Handle with care.

d If the sample contains chloride ions, it will cloud when added to reagent solution B and so must be mixed thoroughly in the tall beaker.

e Add precisely 1 mL of reagent solution A.

f The electrothermal heater may become hot. Place it on the heat-control plate for use.

g Perform steps ⑥ through ⑩ together quickly.

h If a question mark [?] is shown as the reading, it is recommended to change the measurement range and perform the measurements over again.

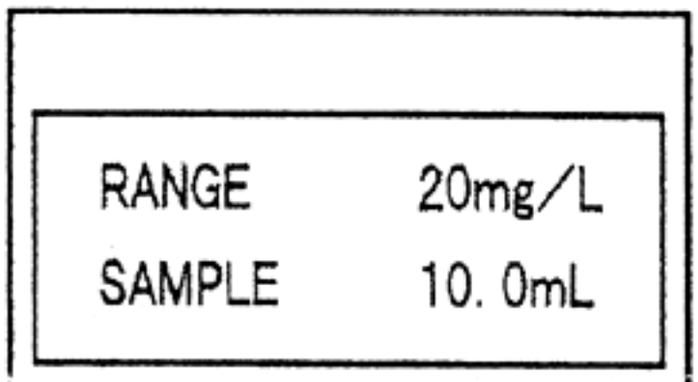
i Turn off the power to the heater promptly after completing measurements.

## 8.3 Blank Measurements (Obtaining More Accurate Measurements)

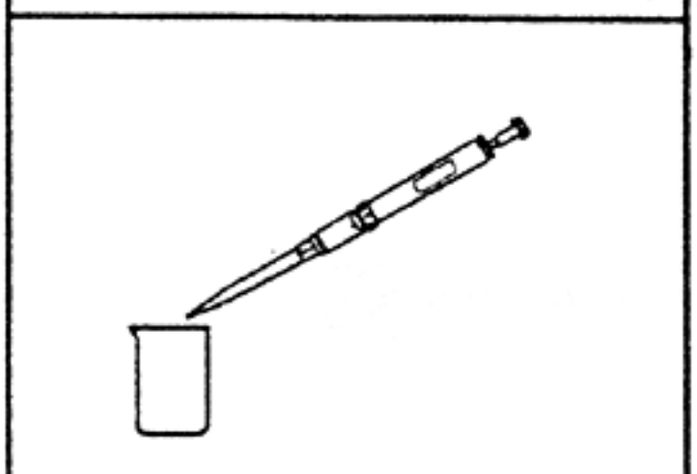
Blank measurements are important when using the HC-607 COD meter in order to (1) subtract the gross error of the reagents (A and B), the water used, the apparatus (beaker and electrodes) and equipment during measurement, and (2) determine the span of the measurement range correctly. A blank measurement is recommended before beginning sample measurements. In particular, perform a blank measurement as described below when the following circumstances obtain.

1. Purchase of equipment
2. Replacing reagent solution A or reagent solution B with a new bottle.
3. Change in the water used (e.g. changing from distilled water to purified water)
4. Changing to a new tall beaker
5. Measuring a sample of low concentration (5 mg/L or less)
6. A blank measurement is recommended when there will be a week or more until the next measurement.
7. High variation among measurement readings or other irregularities (See the section on Troubleshooting for instructions on how to check the equipment)

- **Measurement entails heating samples to which sulfuric acid has been added. Make sure that there is no combustible matter and no combustible gas emitted in the vicinity and that there is sufficient ventilation.**

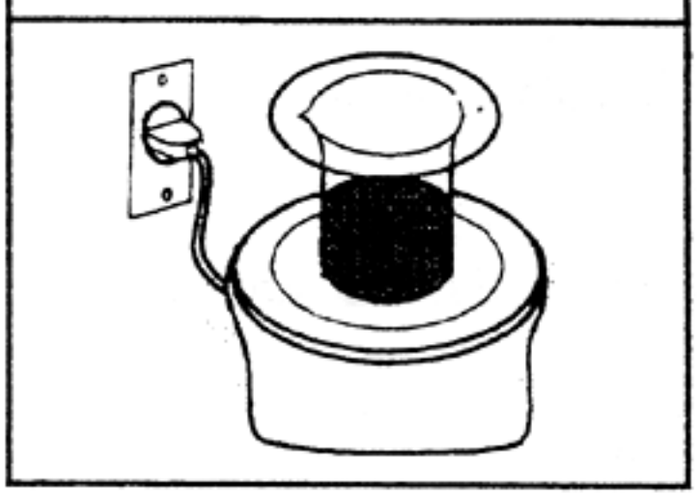



①Press the RANGE key on the main unit. Use the up and down arrow keys to set the measurement range to 20 mg/L.



②Add the reagents and sample precisely to the dried special tall beaker in the following order.*Notes a, b

1. Reagent solution B10 mL*Note c
2. Reagent solution A1 mL*Note d
3. Add distilled water up to the marked line.



③Cover the top of the special tall beaker with the watch glass and place it on the red-hot electrothermal heater. *Note e

④When it begins boiling and bubbling uninterruptedly from the bottom of the special tall beaker, press the OXIDATION key.
The five-minute reaction time starts.
The bell signals after four minutes and then again when the five-minute reaction time has passed.

⑤When the bell signals that reaction time has completed, press the OXIDATION key again and cut off the timer bell.*Note f

⑥Using the safety bands, remove the tall beaker from the electrothermal heater.

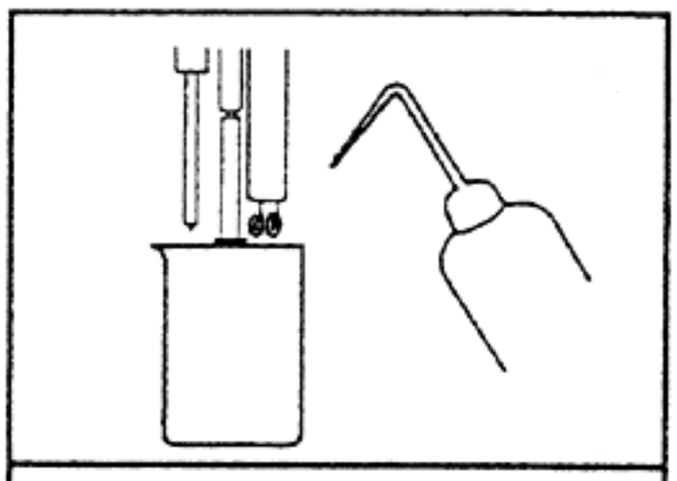
⑦Remove the watch glass. When doing so, wipe the water drops on it off on the edge of the tall beaker.

⑧Immediately add distilled water up to the marked line.

⑨Place the tall beaker below the electrodes and lower the electrode unit.

⑩Press the BLANK key.
The stirrer rotates and sample measurement begins.

⑪The bell signals the completion of measurement, and the upper half of the display gives the blank measurement. The lower half of the screen gives the average blank value.



**Repeat Sample measurement**

⑫Raise the electrode unit and wash the electrodes with distilled water. Wipe away any water drops from the electrodes.

⑬Rinse the tall beaker thoroughly in distilled water, and dry it out.

Repeat procedures② through⑬ above. Repeat for around three blank measurements and make sure there is little variation in measurements (±1.0 mg/L).

From the second measurement onwards, the blank value is averaged and corrected. (Correction is with the first measurement if only one measurement is performed, and with the second measurement if two measurements are performed.)

Blank correction is performed automatically with the subsequent measurement.

Notes

[a] Use a special tall beaker with its bottom thoroughly dried out. (cf. section 6.2.2 on page 9)

[b] Use a special pipette for each reagent.

[c] Reagent solution B contains sulfuric acid. Handle with care.

[d] Add precisely 1 mL of reagent solution A.

[e] The electrothermal heater may become hot. Place it on the heat-control plate for use.

[f] Perform steps (6) through (10) together quickly.

## 8.4 Interfering Substances

Chloride ions in the sample will cause positive interference.

If the sample clouds and precipitates when reagent solution B is added, the sample contains chloride ions. This deposition is silver chloride produced by the reaction between silver sulfate in the reagent solution And chloride ions in the sample.

Table 1 gives concentrations of chloride ions that may be masked in reagent solution B. If the sample has a higher concentration of chloride ions, perform measurements after adding silver sulfate and removing the chlorides.

**Table 1 Maskable concentrations of chloride ions**

| Measurement Range | Sample (mL) | Maskable Chloride Ion Concentration (mg/L) |
|---|---|---|
| 10 | 20 | 800 |
| 20 | 10 | 1600 |
| 40 | 5 | 3200 |
| 100 | 2 | 8000 |
| 200 | 1 | 16000 |
| 400 | 0.5 | 32000 |
| 1000 | 0.2 | 80000 |

# 9 Dichromate Method

## 9.1 Apparatus and Reagents Required

1) 1/80N potassium dichromate solution
2) Reagent solution G
3) High-grade concentrated sulfuric acid
4) High-grade silver sulfate
5) Clean tall beaker
6) Cooling vessel (with clean exterior)
7) Safety bands
8) 2 mL and 5 mL pipettes, and 0.1-10 mL pipettes for sample volume suited to the measurement range
8) Distilled water, cleaning bottle, waste liquid container, Kimwipes

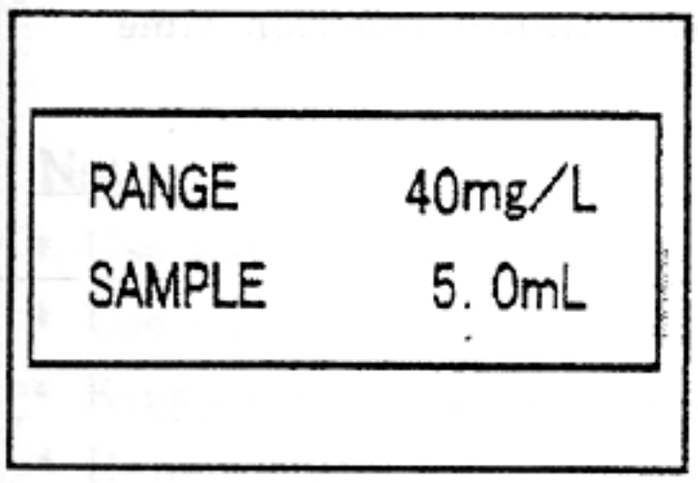
⚠ • **Chemicals Warning: Contact with hands or skin may cause irritation. On contact, immediately wash away with large volumes of water. On contact with the eyes, promptly wash with large volumes of water and then consult a physician.**

## 9.2 Measurement Procedures

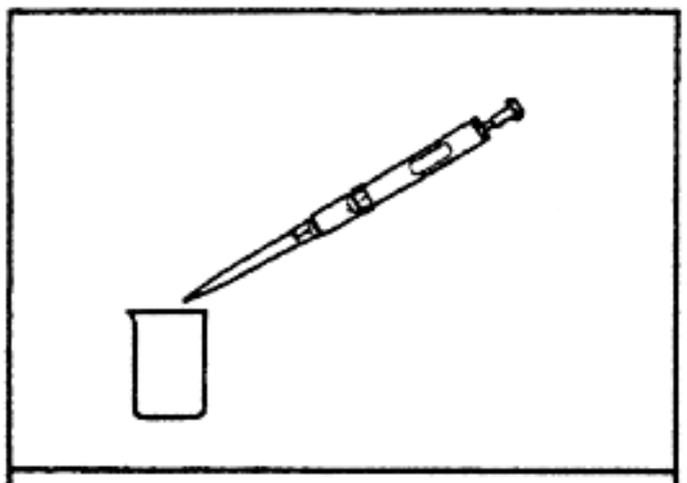
Always perform sample measurements after performing blank measurements. Before performing sample measurements, first perform blank measurements.
Also perform blank measurements over again when changing a reagent.

⚠ • **Measurement entails heating samples to which sulfuric acid has been added. Make sure that there is no combustible matter and no combustible gas emitted in the vicinity and that there is sufficient ventilation.**

### 9.2.1 Blank Measurements

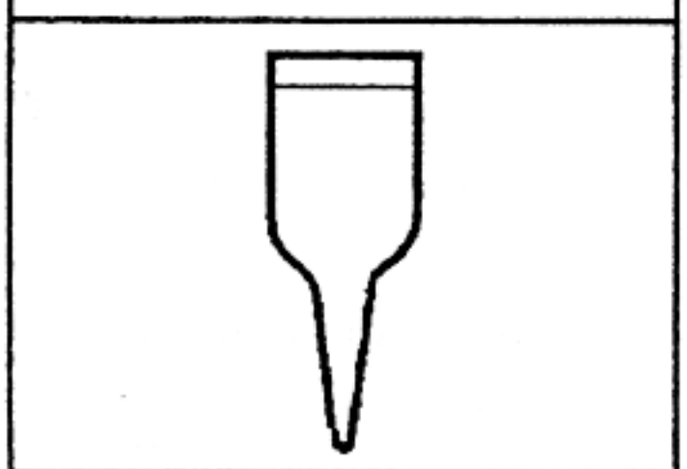



①Press the RANGE key on the main unit. Use the up and down arrow keys to select the 40 mg/L measurement range.

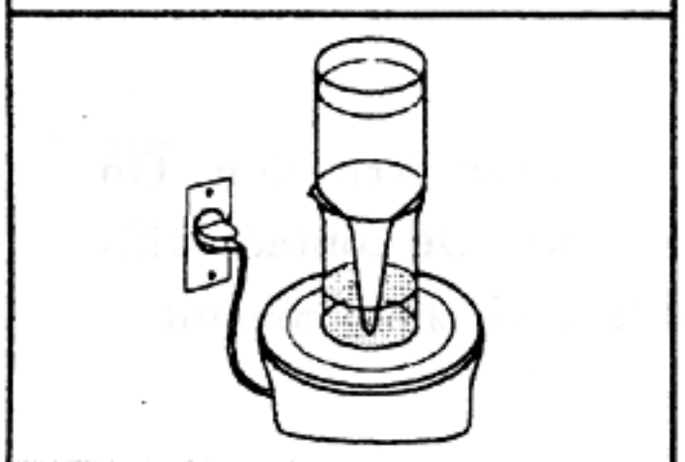


②Add reagents precisely to the dried special tall beaker in the following order.*Notes a, b

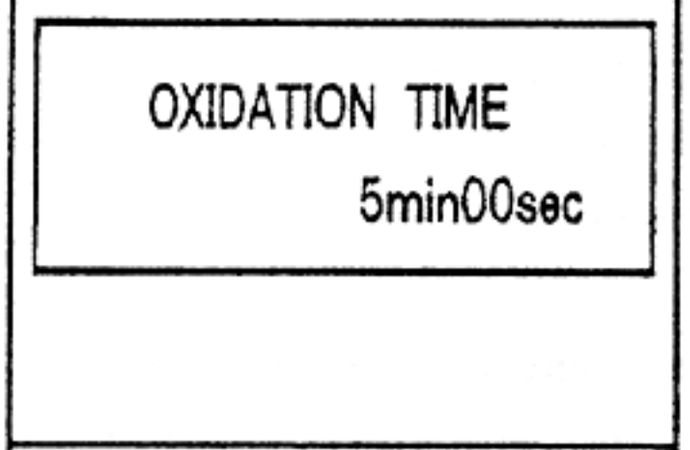
1. Distilled water　5 mL
2. Silver sulfate　Add 0.1 g and stir for 3 minutes.*Note c
3. Concentrated sulfuric acid　5 mL*Notes d, e
4. N/80 potassium dichromate　2 mL*Note f



③Add distilled water to the special cooler up to the 80% level.*Note g

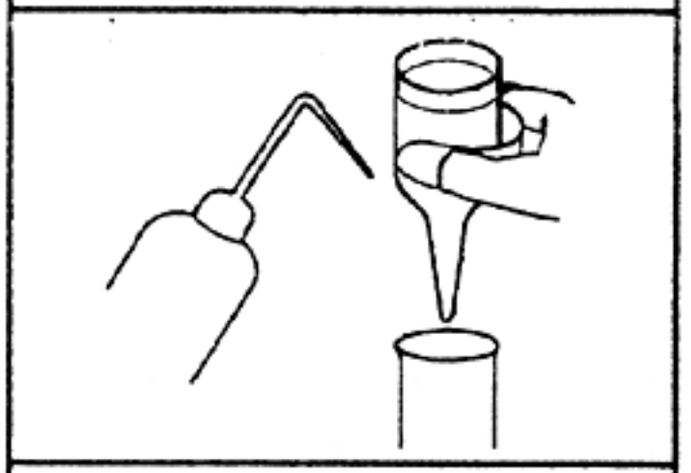


④Place the special tall beaker on the cooler, then place them together on the red-hot electrothermal heater.*Note h



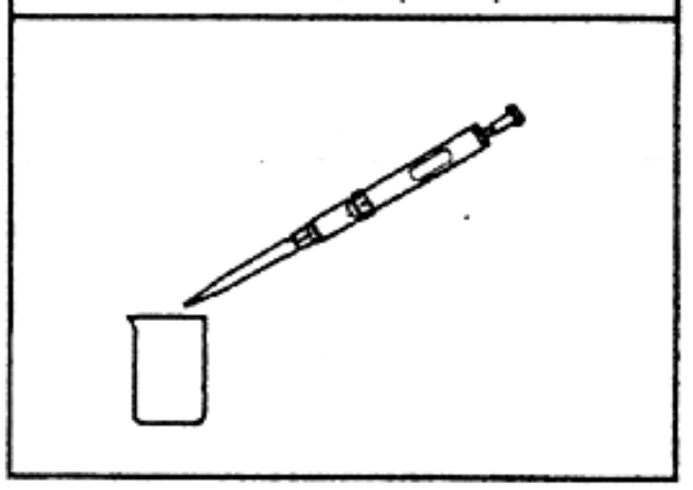

⑤When it begins boiling and bubbling uninterruptedly from the bottom of the special tall beaker, press the OXIDATION key. The reaction time has passed.
The buzzer sounds after four minutes and then again when the five-minute lavage runs down the sides of the tall beaker into the sample.

⑥When the buzzer sounds that reaction time has completed, press the OXIDATION key again and cut off the timer.*Note i

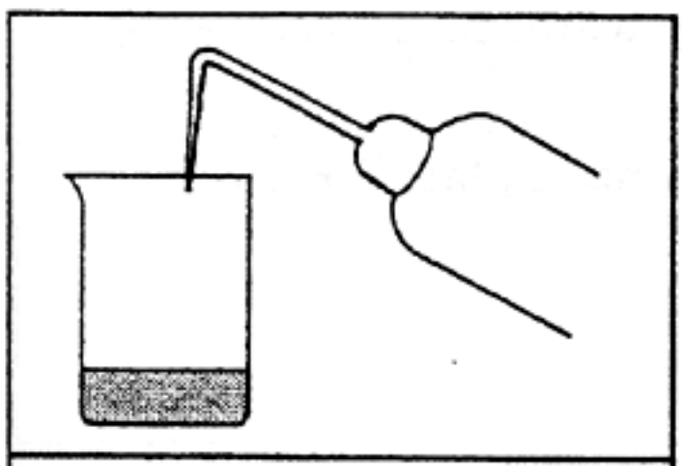


⑦Using the safety bands, remove the tall beaker from the electrothermal heater.

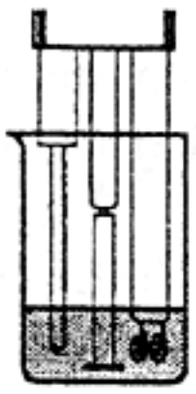
⑧Wash the leg of the cooler with a small amount of distilled water. Do so gently so that the five-minute reaction time starts.



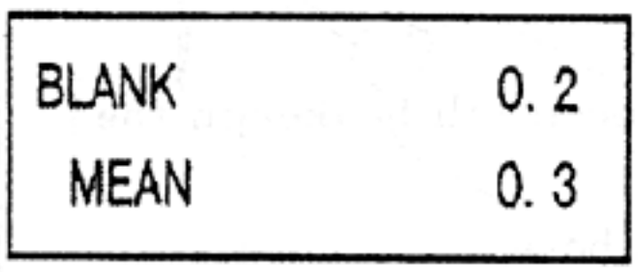
⑨Add 10 mL of reagent solution G.*Note j



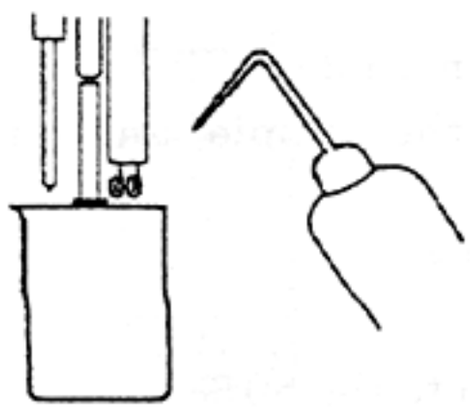
⑩Add distilled water up to the marked line.



⑪ Place the tall beaker below the electrodes and lower the electrode unit.




⑫ Press the BLANK key.
The stirrer rotates and blank measurement begins.
⑬ The bell signals the completion of measurement, and the upper half of the display gives the blank measurement. The lower half of the screen gives the average blank value.



⑭Raise the electrode unit and wash the electrodes with distilled water. Wipe away any water drops from the electrodes.
⑮Rinse the tall beaker thoroughly in distilled water, and dry it out.

**Repeat blank measurements**

Repeat procedures ②through ⑮ above. Repeat for around three blank measurements and make sure there is little variation in measurements.
From the second measurement onwards, the blank value is averaged and corrected. (Correction is with the first measurement if only one measurement is performed, and with the second measurement if two measurements are performed.)
Blank correction is performed automatically with the subsequent measurement.

Notes

[a] Use a special tall beaker with its bottom thoroughly dried out. (cf. section 6.2.2, P. 9)
[b] Use a special pipette for each reagent.
[c] Keep out of direct sunlight.
[d] Handle sulfuric acid with care. Mixing with distilled water may generate heat. Be careful when mixing.
[e] Mix well since there is danger of bumping.
[f] Add precisely 2 mL of N/80 potassium dichromate. Handle with care.

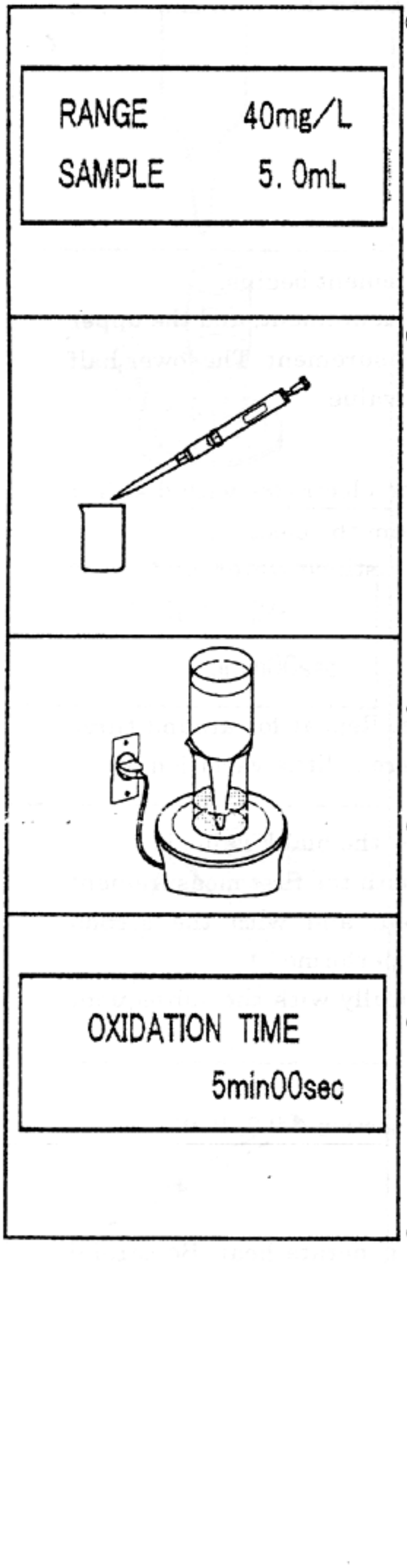
g Replace the cooler water with each measurement. When using tap water in the cooler, be careful not to spill it outside the cooler.

h The electrothermal heater may become hot. Place it on the heat-control plate for use.

i Perform steps ⑦ through ⑫ together quickly.

j Reagent solution G contains sulfuric acid. Handle with care.

### 9.2.2 Sample Measurements




①Press the RANGE key on the main unit. Use the up and down arrow keys to select a measurement range double that of the expected COD concentration.
The lower half of the screen shows the volume (mL) of the water sample.

②Add reagents precisely to the dried special tall beaker in the following order.*Notes a, b

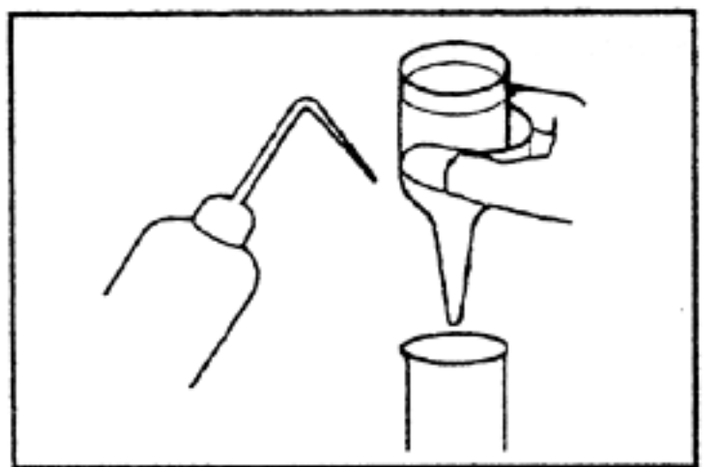
1. Sample Volume shown in step (1) above
2. Distilled water The remainder of a total volume of 5 mL, as per Table 2
3. Silver sulfate Add the amount given in Table 3 corresponding to the chloride content of the sample, and mix for three minutes.*Note c
4. Concentrated sulfuric acid 5 mL*Notes d, e
5. N/80 potassium dichromate 2 mL*Note f

③Add distilled water to the special cooler up to the 80% level. *Note g

④Place the special tall beaker on the cooler, then place them together on the red-hot electrothermal heater. *Note h

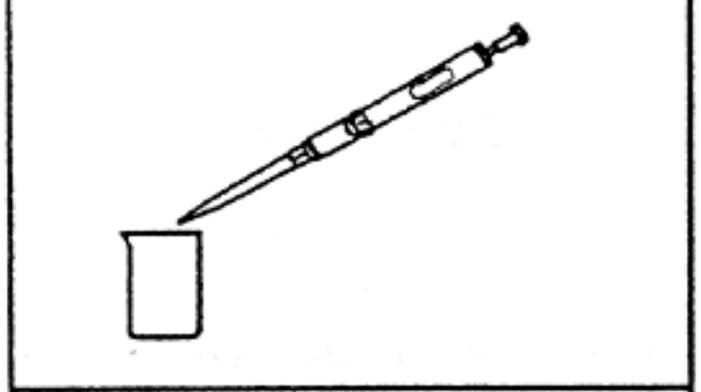
⑤When it begins boiling and bubbling uninterruptedly from the bottom of the special tall beaker, press the OXIDATION key.
The five-minute reaction time starts.
The bell signals after four minutes and then again when the five-minute reaction time has passed.

⑥When the bell signals that reaction time has completed, press the OXIDATION key again and cut off the timer bell. *Note i

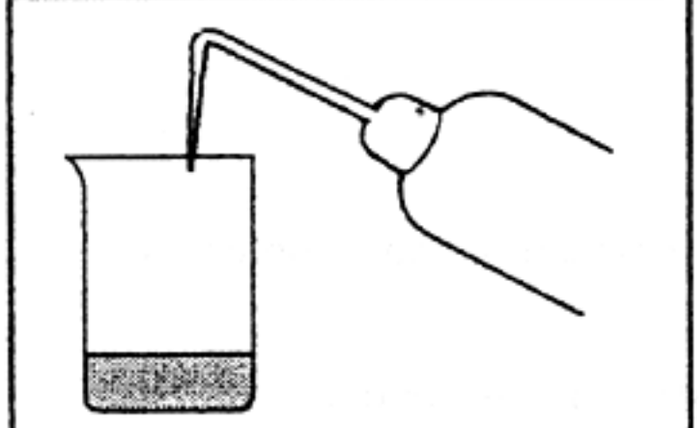


⑦Using the safety bands, remove the tall beaker from the electrothermal heater.

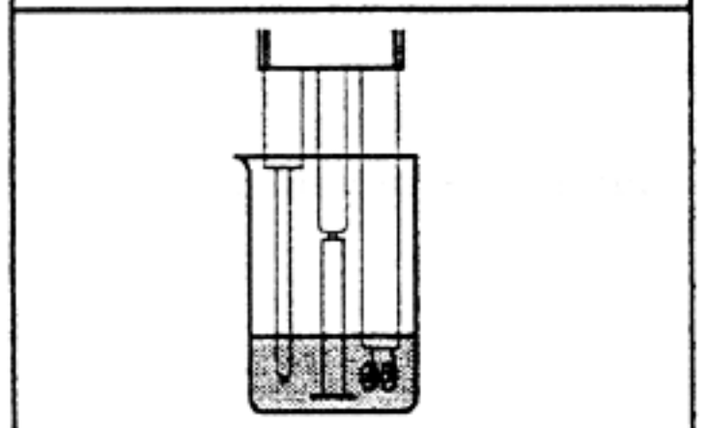
⑧Wash the leg of the cooler with a small amount of distilled water. Do so gently so that the lavage runs down the sides of the tall beaker into the sample.



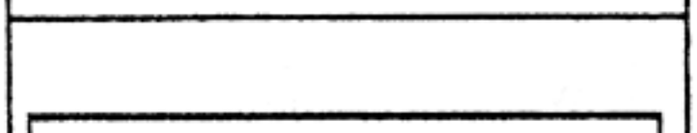
⑨Add 10 mL of reagent solution G. *Note j



⑩ Add distilled water up to the marked line.

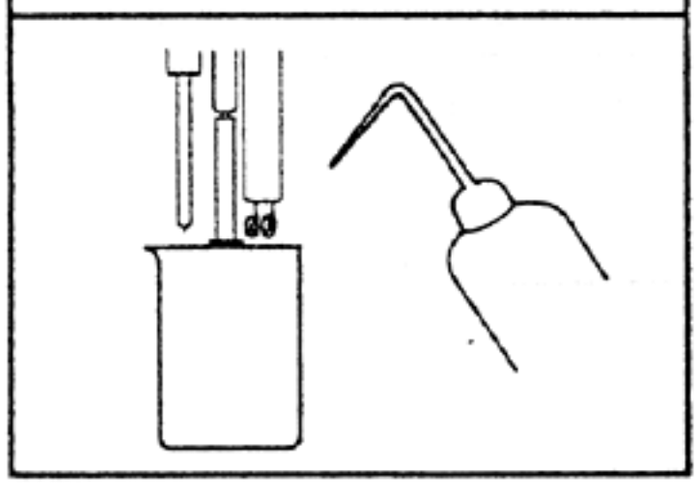


⑪ Place the tall beaker below the electrodes and lower the electrode unit.




⑫ Press the MEASURE key.
The stirrer rotates and sample measurement begins

⑬ When the bell goes off, measurement has completed. The value shown at this time is the $COD_{Cr}$ value (mg/L) *Note k



⑭Raise the electrode unit and wash the electrodes with distilled water. Wipe away any water drops from the electrodes.

⑮Rinse the tall beaker thoroughly in distilled water, and dry it out.

**Repeat sample measurement**

⑯Repeat steps ② through ⑮ above, measuring the samples. *Note l

**Notes**

a Use a special tall beaker with its bottom thoroughly dried out. (cf. section 6.2.2 on page 9)

b Use a special pipette for each reagent.

c Keep out of direct sunlight.

d Handle sulfuric acid with care. Mixing with distilled water may generate heat. Be careful when mixing.

e Mix well since there is danger of bumping.

f Add precisely 2 mL of N/80 potassium dichromate. Handle with care.

g Replace the cooler water with each measurement. When using tap water in the cooler, be careful not to spill it outside the cooler.

h The electrothermal heater may become hot. Place it on the heat-control plate for use.

i Perform steps ⑦ through⑫ together quickly.

j Reagent solution G contains sulfuric acid. Handle with care.

k If a question mark [?] is shown as the reading, it is recommended to change the measurement range and perform the measurements over again.

l Turn off the power to the heater promptly after completing measurements.

**Table 2 Sampling volume**

| $COD_{Cr}$ Measurement Range (mg/L) | Sample Volume (mL) | Distilled Water Volume (mL)* |
|---|---|---|
| ~40.0 | 5 | 0 |
| ~100 | 2 | 3 |
| ~200 | 1 | 4 |
| ~400 | 0.5 | 4.5 |
| ~1,000 | 0.2 | 4.8 |

* After taking the sample, add distilled water for the remainder of a total 5 mL.

**Table 3　Chloride ion concentration and silver sulfate addition**

| Chloride Ion Concentration (mg/L) | Silver Sulfate Addition ( g ) | | | |
|---|---|---|---|---|
| | Measurement ranges ～40 mg/L | Measurement ranges ～100 mg/L | Measurement ranges ～200 mg/L | Measurement ranges ～400 mg/L |
| ～1500 | 0.1 | 0.1 | 0.1 | 0.1 |
| 1500-3000 | 0.2 | 0.1 | 0.1 | 0.1 |
| 3000-4500 | 0.3 | 0.2 | 0.1 | 0.1 |
| 4500-6000 | 0.4 | 0.2 | 0.1 | 0.1 |
| 6000-9000 | 0.6 | 0.3 | 0.2 | 0.1 |
| 9000-12000 | 0.8 | 0.4 | 0.2 | 0.1 |
| 12000-15000 | 1.0 | 0.4 | 0.2 | 0.1 |
| 15000-18000 | 1.2 | 0.5 | 0.3 | 0.2 |

Ex. If the sample is 0.2 mL, add 0.1 g of silver sulfate for a chloride ion concentration of up to 18,000 mg/L.

# 10 Storage and Maintenance

## 10.1 COD Meter Storage and Maintenance

Wipe the outside of the COD meter dry with a soft cloth or the like. (Do not use solvents as they will harm the surface.)

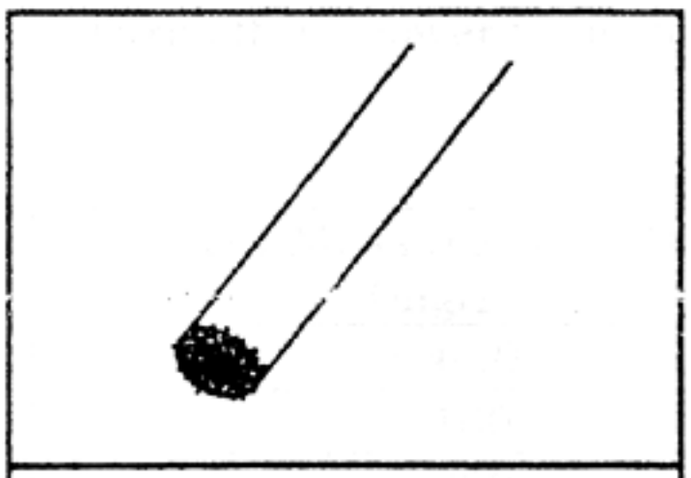
## 10.2 Special Tall Beaker Storage and Maintenance

### 10.2.1 Special Tall Beaker Storage

If COD measurements will be performed again within two or three days, wash the tall beaker thoroughly in distilled water after completing measurements and store it in distilled water. Stored thus, the tall beaker will retain its condition as washed at high temperature.
If more time will pass before the next measurements are performed, wash the tall beaker thoroughly, then rinse it with distilled water and store it away from dust after drying out.

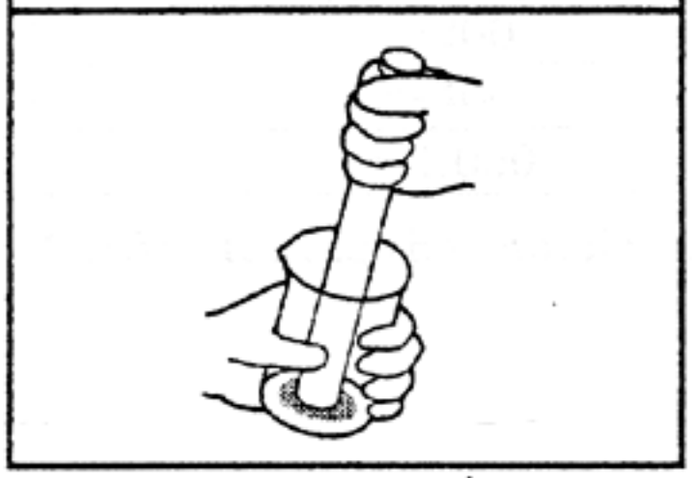
### 10.2.2 Special Tall Beaker Maintenance

In order to prevent bumping when boiling and also to maintain reaction stability, the bottoms of the included tall beakers have been subjected to a special rubbing process. Over long periods of use, however, the pits of the scratches fill in, making the beaker more susceptible to bumping. In such cases, perform the following procedures.

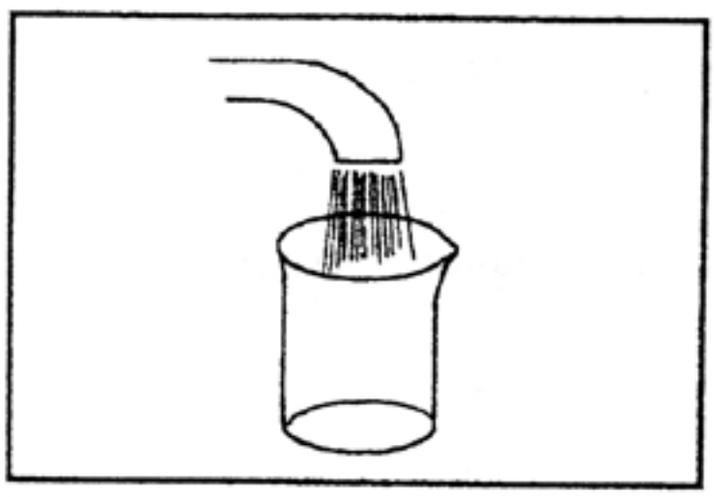


①Prepare the included emery and PVC rod.

②Wet the tip of the PVC rod with water and apply it to the emery.



③Rub the bottom of the tall beaker uniformly with the PVC rod until the ground scratches are clean.



④Wash out thoroughly with tap water, then rinse with distilled water.

## 10.3 Electrode Storage and Maintenance

### 10.3.1 Electrode Storage

1) When performing measurements daily, store the electrodes immersed in a beaker in distilled water. When a week or more will pass without measurements, store them in their boxes.

2) Be careful not to let the electrodes become bent or damaged. In particular, keep the spiral section of the electrolysis electrode level. If the stirrer is bent, it will spin erratically and stirring will not be performed normally.

### 10.3.2 Electrode Maintenance

If the following circumstances obtain, polish the indicator electrode. (cf. section 6.1.1 on page 7 for polishing methods)

1) When using a new electrode
2) When using an electrode after a long period of non-use
3) When the meter does not stop measurement although the endpoint is reached

## 10.4 Reagent Storage

1) Store reagent solution A sealed in a cool, dark place.
2) The presence of impurities will cause the reagents to deteriorate and affect measurement readings.

# 11 Data Storage

The HC-607 COD meter has memory capable of holding up to 99 sample measurements.

## 11.1 Measurement Records

Measurement values are recorded automatically with each measurement. Saving them requires no special operations. Default behavior is to automatically save measurement values from Record 1. When a measurement value is saved in Record 99, the records are then updated beginning with Record 1. These sample record numbers may also be user-defined. (cf. section 12.2, P.32) Data recorded is persistent after the power is turned off.

## 11.2 Retrieving Data

Hold the PRINT key for three seconds to display measurement readings on the screen. Use the up and down arrow keys to scroll through earlier and later measurement readings.

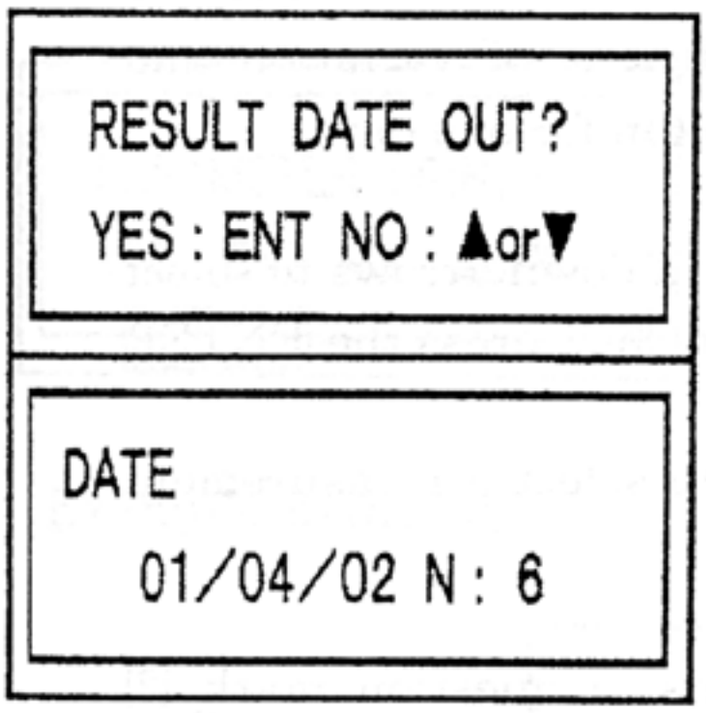
## 11.3 Deleting Data

To delete stored data, first retrieve it. Note that it is not possible to delete the data of a specific record number alone. See section 12.3.2 (8) on page 37 for instructions on deleting data.

## 11.4 Printing Data

Connect the printer (optional) to automatically print measurement values and blank values after measurements are completed. When doing so, make sure the printer is selected under "Communications device selection" in the second set of parameters. (cf. section 12.3.2 ③, P. 36)
(Measurement values are transmitted in the same fashion if the COD meter is connected to a personal computer. When doing so, make sure the computer is selected under "Communications device selection" in the second set of parameters.)

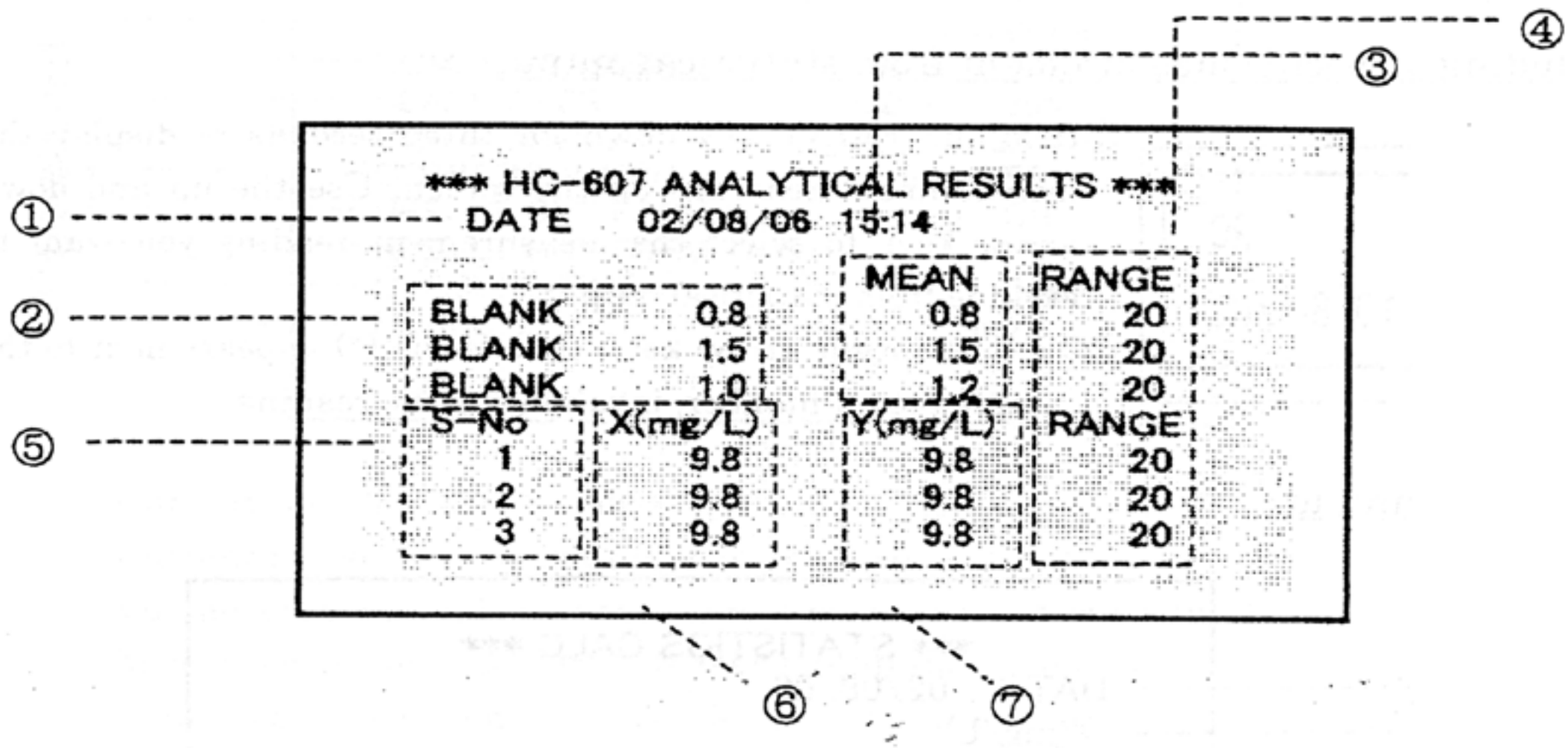
### 11.4.1 Printing Measurement Readings




①Press the PRINT key. Use the up and down arrows to select "Measurement readings print screen" and then press the ENTER key.

②Use the left and right arrows to select a measurement date.
Press the ENTER key to print.
If there are no past measurements, a question mark [?] appears.
N is the number of measurement records (including blank values).

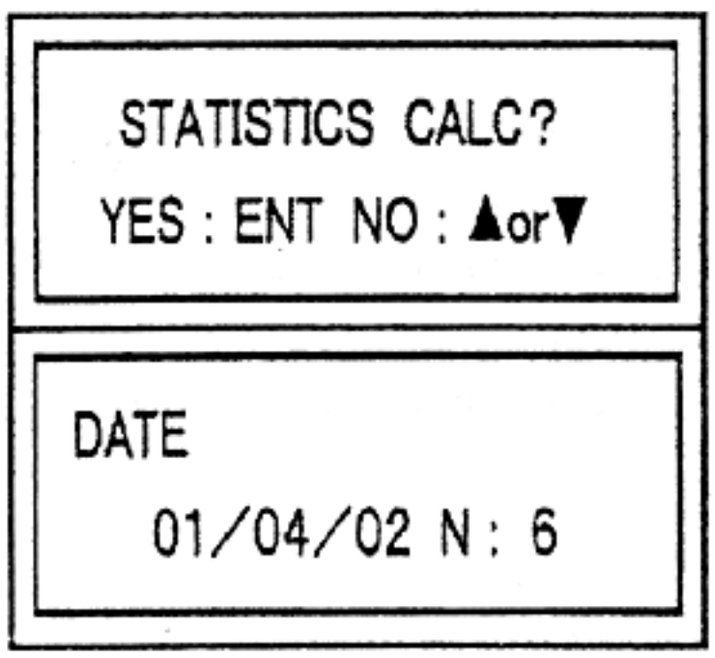
Example printout




① Date of measurement
② Blank value
③ Blank average
④ Measurement range
⑤ Sample record number
⑥ Measurement value (X)
Prints if ON is selected for "Measurement reading external output format selection ②)" in the second set of parameters.
⑦ Converted value (Y) or clone value (C)
Prints the value selected in "Measurement reading external output format selection ②" in the second set of parameters.

### 11.4.2 Printing Statistical Output

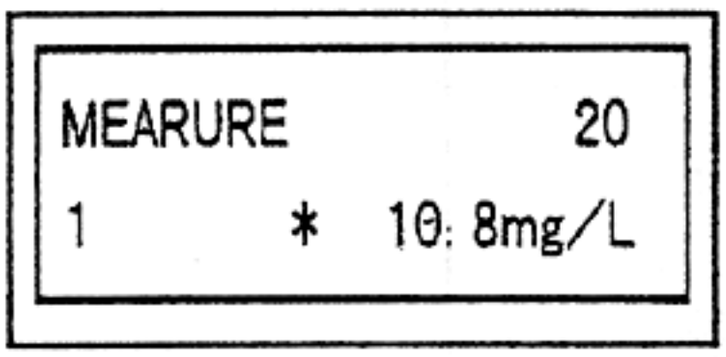
Data printed are the coefficient of variation and average of the measurements and the number of measurements taken. Data displayed are the coefficient of variation and average of the measurements and the number of measurements taken for one day.




①Press the PRINT key. Use the up and down arrows to select "Statistical output print screen" and then press the ENTER key.

②Use the left and right arrow keys to select a measurement date.
Press the ENTER key to print.
If there are no past measurements, a question mark [?] appears.
N is the number of measurement records (including blank values).

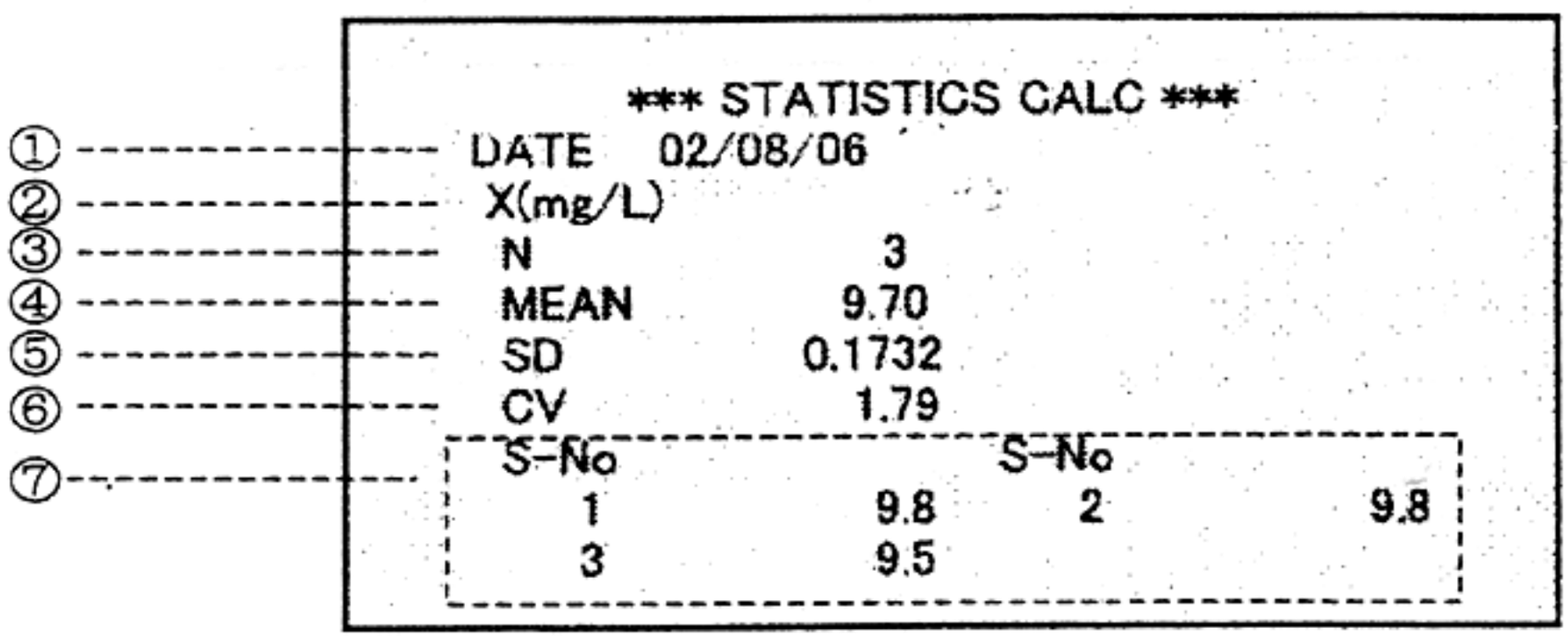
Excluding a specific measurement from statistical output




①Hold the PRINT key down for three seconds to display the measurement readings on the screen. Use the up and down arrow keys to select the measurement reading you want to exclude from statistical output.

②Press the right arrow key. An asterisk (*) appears next to the sample record number, invalidating the reading.

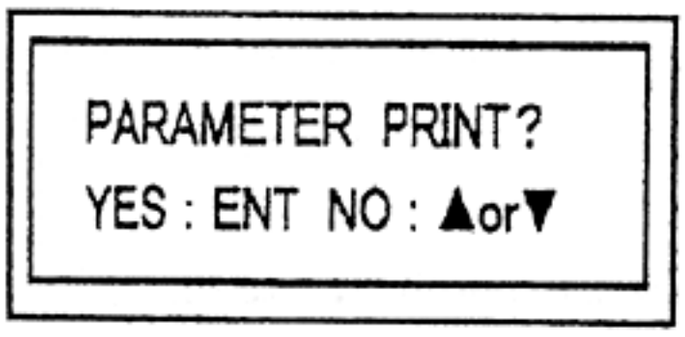
Example printout




① Measurement date
② Measurement value (X) (or converted value (Y) or clone value (C))
③ Number of measurement values, not including blank measurements
④ Average
⑤ Standard deviation
⑥ CV value
⑦ Input data

### 11.4.3 Printing Measurement Parameters

Output gives a printout of the measurement parameters.




Press the PRINT key. Use the up and down arrows to select "Measurement parameter print screen" and then press the ENTER key.

Example printout

```
                *** SYSTEM PARAMETER ***
①---------------- SAMPLE No.                          4
②---------------- RANGE-S                        500mg/L
③---------------- SAMPLE                          0.4mL
④---------------- RESULT DISP FORM                    X
⑤---------------- CONV.Y          a=  1.00   b=      0.0
⑥---------------- OXIDATION TIME                5min00sec
⑦---------------- NOMAL MEASURE          20 -      70%
⑧---------------- BLANK OVER            -30 -      30%
⑨---------------- BLANK REVISE                      3.5
⑩---------------- COMMUNICATION              PRINTER
⑪---------------- RESULT OUT FORM X                 ON
⑫---------------- RESULT OUT FORM YorC              OFF
⑬---------------- MEASURE TIME                   150sec
⑭---------------- MEASURE UNIT                    mg/L
```

① Current sample record number
② Current measurement range (mg/L)
③ Volume of sample taken in the current measurement range (mL)
④ Measurement reading output: Screen output (parameter set 1)
⑤ Conversion coefficient: Values a and b in the conversion formula Y=aX+b (parameter set 1)
⑥ Oxidation time (defined in parameter set 1)
⑦ Normal measurement reading range (parameter set 1)
⑧ High blank range (parameter set 2)
⑨ Blank correction value (parameter set 2)
⑩ Communications device (parameter set 2)
⑪ Measurement reading external output format 1 (parameter set 2)
⑫ Measurement reading external output format 2 (parameter set 2)
⑬ Measurement limit time (parameter set 2)
⑭ Measurement unit (parameter set 2)

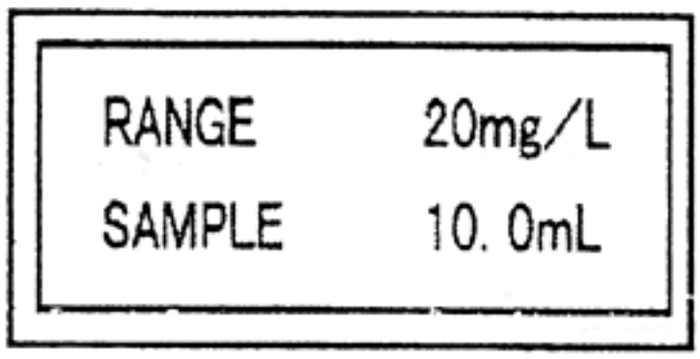
See section 12. Settings for a description of individual parameters.

# 12 Settings

## 12.1 Measurement Ranges

### 12.1.1 Measurement Ranges

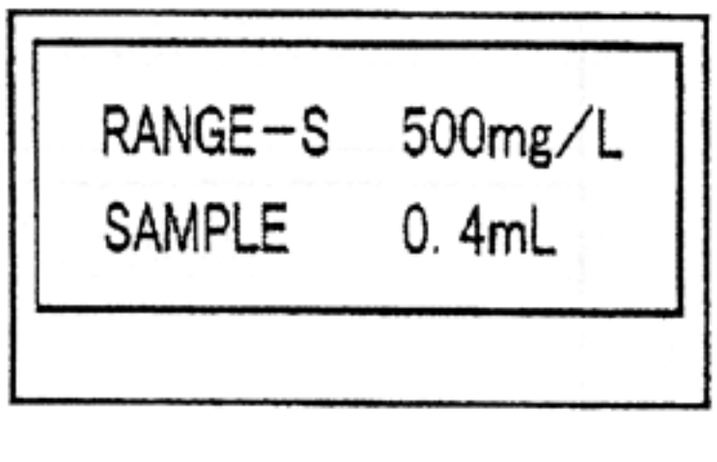
The default setting is 20 mg/L.




Press the RANGE key to display the current range in the top half of the screen and sampling volume in the bottom half of the screen.
Use the up and down arrow keys to move between the ranges (10, 20 , 40, 100, 200, 400, 1,000 and user-defined).

### 12.1.2 User-Defined Measurement Ranges

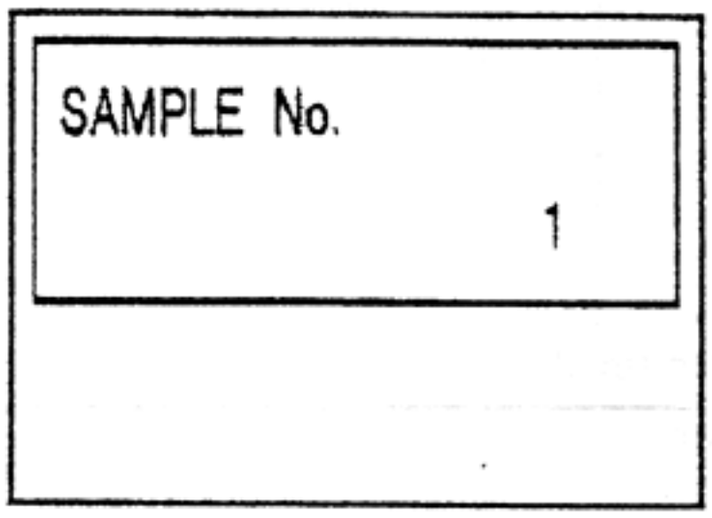
User-defined measurement ranges may be defined from 10 mg/L to 2,000 mg/L.
The default setting is 500 mg/L.




①Press the RANGE key, then use the up and down arrow keys to select the screen at left.
②Press the ENTER key to activate the cursor.
Use the left and right arrow keys to move the cursor, and the up and down arrow keys to adjust the numeric values.
③Press the ENTER key again. When done, the sampling volume displays again.

## 12.2 Sample Record Numbers

Measurement values are recorded automatically when measurement is completed. When a measurement value is recorded, a sample record number is assigned sequentially and may also be defined by the user.
The default first record number is 1.




①Press the SAMPLE No. key to display the current sample record number.
②Press the ENTER key to activate the cursor.
Use the left and right arrow keys to move the cursor, and the up and down arrow keys to adjust the numeric value.
③Press the ENTER key again to exit.
The next measurement value will have the sample record number thus assigned.

## 12.3 Measurement Parameters

The HC-607 COD meter is provided with the following additional functions.

**<Parameter Set 1>**

| | | | |
|---|---|---|---|
| ① | Measurement reading display | Reading displayed after measurement | p.34 |
| ② | Conversion coefficient | The values a and b in the conversion formula Y=aX+b for conversion to JIS method | p.34 |
| ③ | Oxidation time | Heating time for oxidation | p.34 |
| ④ | Measurement result normal range | Measurement range | p.35 |
| ⑤ | Date & time | Date and time | p.35 |

**<Parameter Set 2>**

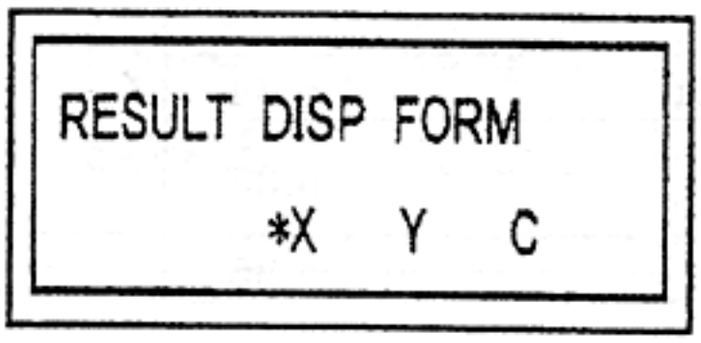
| | | | |
|---|---|---|---|
| ① | Blank range over | Normal range for blank values.<br>***Note**: Do not edit, as this may result in incorrect measurements.* | -- |
| ② | Blank correction value | Blank correction value<br>***Note**: Do not edit, as this may result in incorrect measurements.* | -- |
| ③ | Communication device | Communication device using RS-232C | p.36 |
| ④ | Measurement reading external output format selection 1 | Output format (measurement value X on/off) to communication device above | p.36 |
| ⑤ | Measurement reading external output format selection 2 | Output format (conversion value Y/clone value C) to communication device above | p.36 |
| ⑥ | Measurement limit time | Upper limit on measurement time<br>***Note**: Do not edit, as this may result in incorrect measurements.* | -- |
| ⑦ | Measurement unit | Measurement unit (mg/L or ppm) | p.36 |
| ⑧ | Clear all measurement readings | Clears all measurement data | p.37 |
| ⑨ | System initialization | Restores all settings to factory defaults (without clearing measurement readings) | p.37 |

### 12.3.1 Parameter Set 1

Press the PARAMETER key to bring up the "Measurement reading display selection" screen.
Use the up and down arrow keys to move among items (1) through (5).

①Measurement reading display

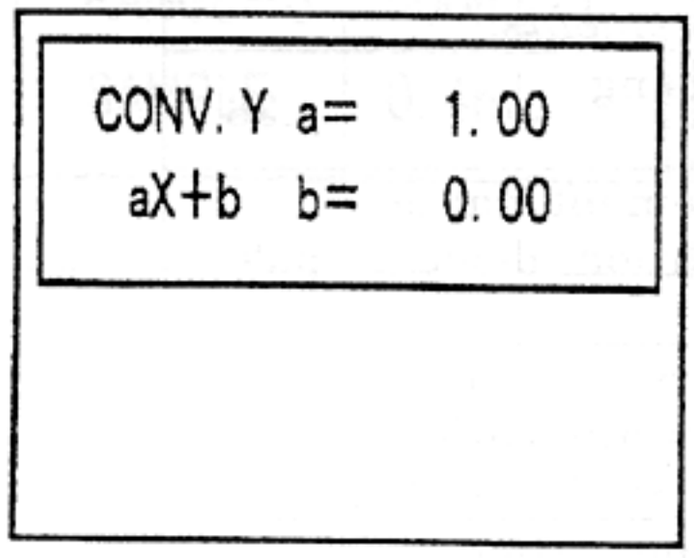
The default setting is X.




Press the PARAMETER key to bring up the "Measurement reading display selection" screen.
Use the left and right arrow keys to move the asterisk (*) and select an option.
X = Measured value, Y = Converted value, C = Clone value

②Conversion coefficient

Use the JIS method to measure the same sample measured with the HC-607 COD meter and obtain the values a and b for the regression equation Y=aX+b.
The default setting is a=1.00, b=1.00.

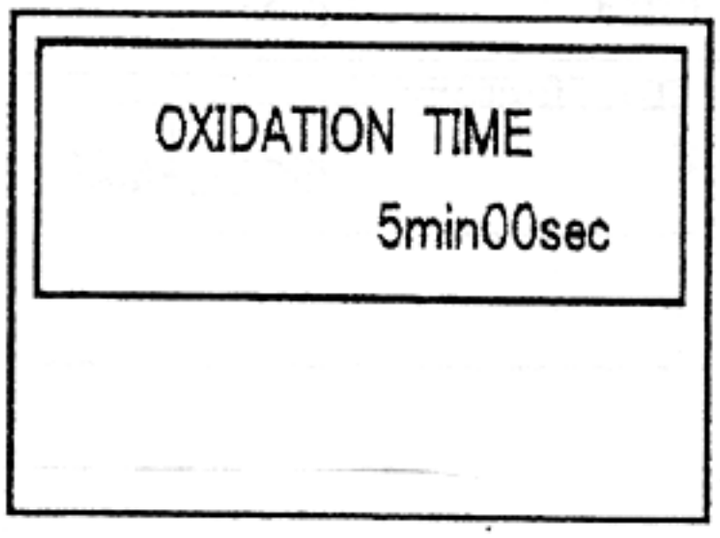



① Press the PARAMETER key. Use the up and down arrow keys to select the conversion coefficient setting screen.
② Press the ENTER key to activate the cursor. Use the left and right arrow keys to move the cursor, and the up and down arrow keys to adjust the numeric values.
③ Press the ENTER key to exit.

Definable ranges: a = 0.00～99.99
b = −999.99～999.99

③ Oxidation time

The default setting is 5 minutes 00 seconds.



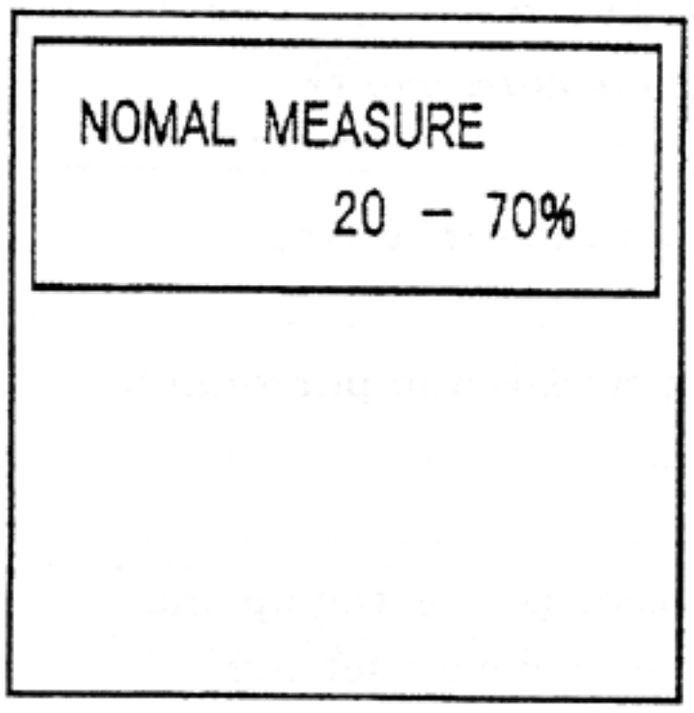

①Press the PARAMETER key. Use the up and down arrow keys to select the oxidation time setting screen.
②Press the ENTER key to activate the cursor. Use the left and right arrow keys to move the cursor, and the up and down arrow keys to adjust the numeric values.
③Press the ENTER key to exit.

Definable range: 0 min 00 sec～9 min 59 sec

④ Measurement result normal range

When a measurement reading exceeds the defined range, the measurement value is displayed as a question mark [?].

The default setting is 20～70%.




①Press the PARAMETER key. Use the up and down arrow keys to select the measurement result normal range setting screen.

②Press the ENTER key to activate the cursor. Use the left and right arrow keys to move the cursor, and the up and down arrow keys to adjust the numeric values.

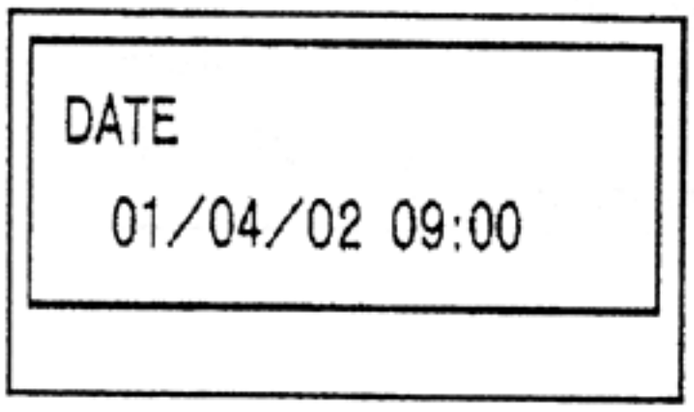
③Press the ENTER key to exit.

Definable ranges: a = 0.00～99.99

b = －999.99～999.99

To avoid the question mark [?] display, redefine this setting to 0 ～0% or 100～100%.

⑤Date & time




①Press the PARAMETER key. Use the up and down arrow keys to select the date and time setting screen.

②Press the ENTER key to activate the cursor. Use the left and right arrow keys to move the cursor, and the up and down arrow keys to adjust the numeric values.

③Press the ENTER key to exit.

### 12.3.2 Parameter Set 2

Hold down the PARAMETER key for three seconds to bring up the "High blank range" settings screen. Use the up and down arrows to select among items ① through ⑨

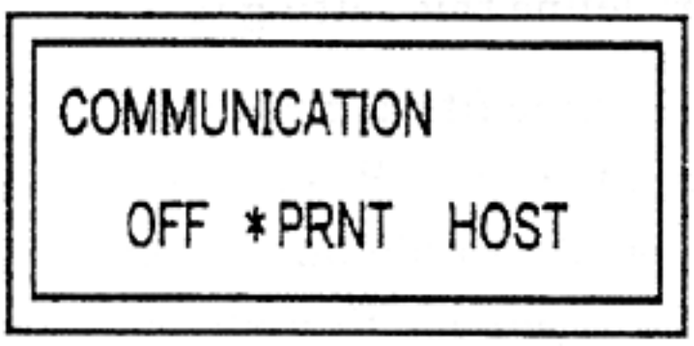
***Note:*** *Do not make any changes to ① High blank range② Blank correction value or ⑥ Measurement limit time. Changes here may cause incorrect measurements.*

③ Communication device

Use of RS-232C enables the transmission of measurement and parameter setting values.

The communications devices that may be selected are printer (optional) and personal computer (special software available separately).

**The default setting is the printer.**




Hold down the PARAMETER for three seconds. Use the up and down arrow keys to select the communication device setting screen.

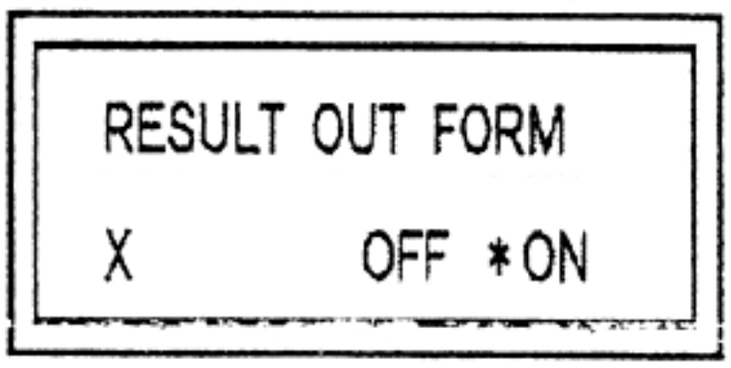
Use the left and right arrow keys to move the asterisk (*) and select a communication device.

OFF = No device, PRNT = Printer, HOST = PC

④Measurement reading external output format selection 1

This setting determines whether measurement value X is transmitted to the communication device selected in parameter 3 above.

**The default setting is On.**



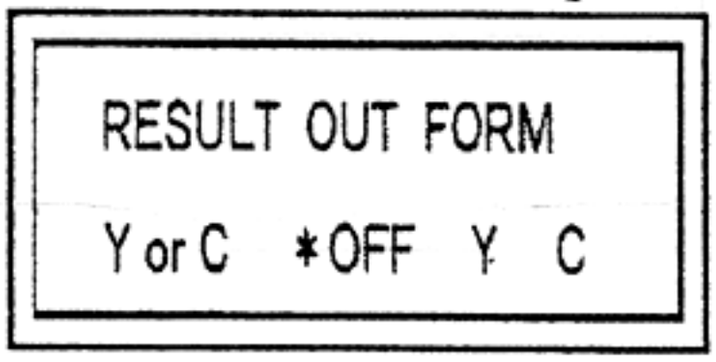

Hold down the PARAMETER for three seconds. Use the up and down arrow keys to select the measurement reading external output format selection 1 setting screen.

Use the left and right arrow keys to move the asterisk (*) and select On or Off.

⑤ Measurement reading external output format selection 2

This setting determines whether conversion value Y or clone value C is transmitted to the communication device selected in parameter 3 above.

**The default setting is Off (neither).**

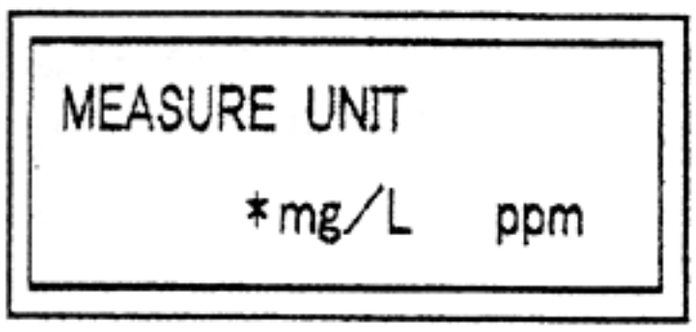



Hold down the PARAMETER for three seconds. Use the up and down arrow keys to select the measurement reading external output format selection 2 setting screen.

Use the left and right arrow keys to move the asterisk (*) and select Y (conversion value), C (clone value) or Off (neither).

⑦ Measurement unit

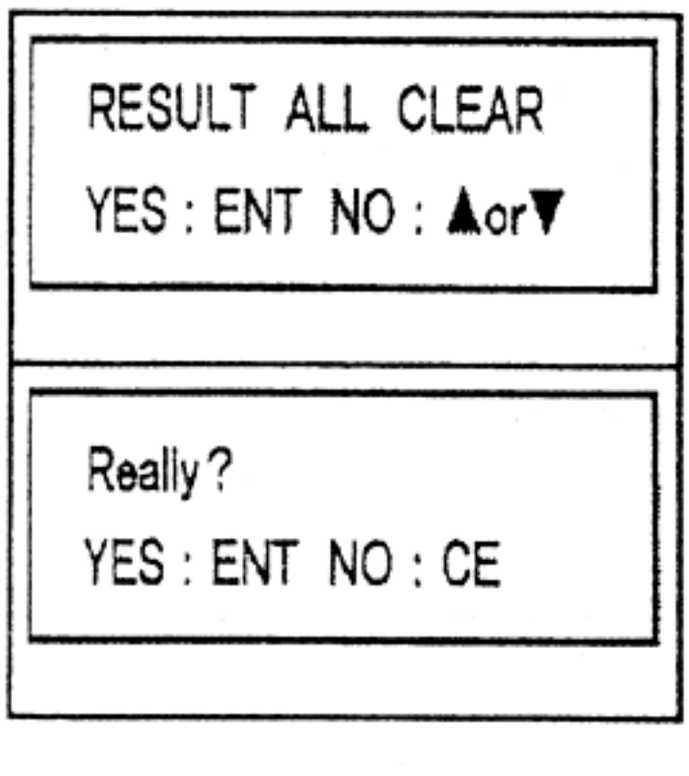
**The default setting is mg/L.**




Hold down the PARAMETER for three seconds. Use the up and down arrow keys to select the measurement unit setting screen. Use the left and right arrow keys to move the asterisk (*) and select mg/L or ppm.

⑧ Clear all measurement readings

Measurement readings may be stored in up to 99 records. This function clears all recorded data from memory.



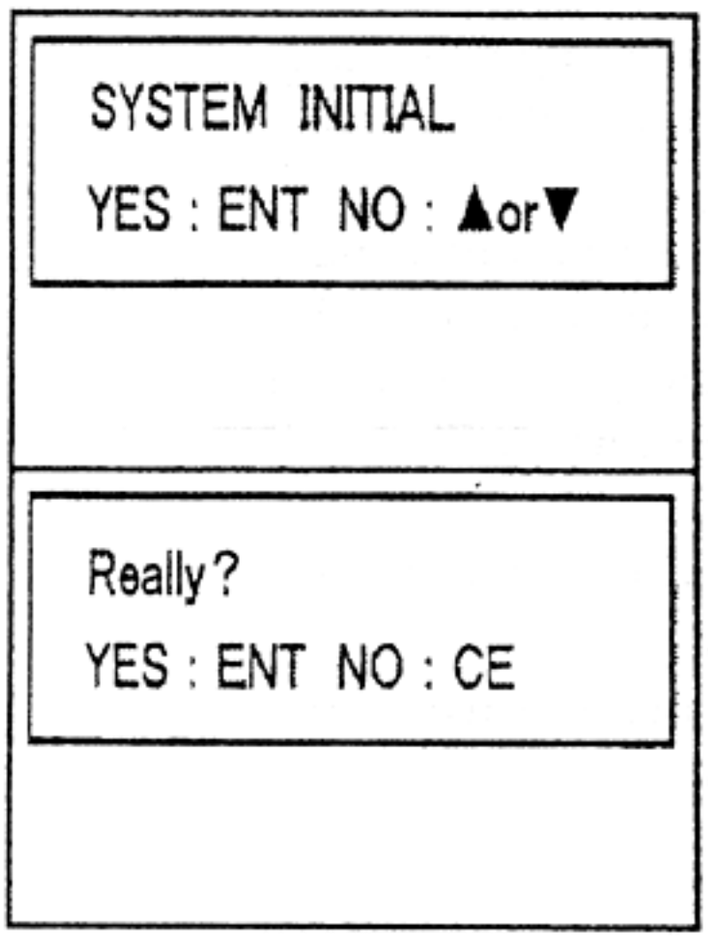

①Hold down the PARAMETER for three seconds. Use the up and down arrow keys to select the "Clear all measurement readings" screen.
To clear the data, press the ENTER key. (To exit without clearing the data, press the up or down arrow key to proceed to the measurement unit setting screen or system initialization screen.)

②Next, a reconfirmation dialog appears. To clear the data, press the ENTER key again. All data are deleted and the system initialization screen appears. (To quit without clearing the data, press the CE key to proceed to the system initialization screen appears without deleting the data.)

⑨ System initialization

This operation restores all internal settings (in parameter sets 1 and 2) to the factory defaults, deleting any changes that have been made to them.

Recommended practice is to make a record of extant parameter settings before performing this operation.




①Hold down the PARAMETER for three seconds. Use the up and down arrow keys to select the system initialization screen.
To initialize the system, press the ENTER key. (To exit without clearing the data, press the up or down arrow key to proceed to the "Clear all measurement readings" screen or high blank range settings screen.)

②Next, a reconfirmation dialog appears. To initialize, press the ENTER key again. Initialization procedures are executed and the system brings up the high blank range settings screen. (To quit without initializing, press the CE key to proceed to the high blank range setting screen without deleting any data.)

# 13 Troubleshooting

- Do not dismantle the HC-607 COD meter. If the procedures detailed below do not relieve the symptoms or if the COD meter is clearly damaged, contact your sales representative or Central Kagaku Corp.

## 13.1 Error Messages

The following error messages should be handled as specified below.

| Message | Meaning | Cause and action |
|---|---|---|
| BLANK OVER | Blank measurement in excess of full scale by 0±30%. | ① Reagent deterioration (contamination, etc.)<br>→ Replace reagent.<br>②Tap water, ion-exchange water or other water containing organic matter used for measurement.<br>→ Use distilled water or other water not containing organic matter.<br>③Glass vessel was not clean.<br>→ Used a glass vessel washed to be clean.<br>④ Incorrect amount of reagent solution A.<br>→ Add precisely 1 mL of reagent solution A. |
| TIME OVER | Measurement time over 150 seconds. | ①Indicator electrode disorder (if fluid in tall beaker changed from red to yellow)<br>→ Remove indicator electrode from electrode holder and polish.<br>② Electrolysis electrode disorder (if fluid in tall beaker remained red)<br>→ Electrolysis electrode needs replacing.<br>③ Incorrect amount of reagent solution A.<br>→ Add precisely 1 mL of reagent solution A. |
| EXCHANGE SAMPLE | Oxidant completely consumed in five minutes' heating time and measurement not possible. | ① Inappropriate measurement range<br>→ Dilute the sample or change the measurement range and perform the measurement again. |
| C MOS ERROR | Abnormal RAM condition | Contact your sales representative or Central Kagaku Corp. |
| RAM ERROR | Abnormal RAM condition | Contact your sales representative or Central Kagaku Corp. |

## 13.2 Blank Measurements

Blank measurements are both an extremely operation for the HC-607 COD meter in the sense that they subtract error resulting from the equipment and reagents and thus correct the measurement range, and constitute a averages of examining the COD meter in the event of such irregularities as high variation in measurement values.

The HC-607 COD meter is designed so that blank measurements will have a reproducibility of ±1.0 mg/L (at the 20 mg/L) when the equipment, reagents and measurement operations are all normal. These values should be checked for reference daily.