



INSTRUCTION MANUAL



Laboratory Equipment Pty Ltd

Laboratory Equipment Pty Ltd
email: sales@labec.com.au
Ph: 02 9560 2811 • Fax: 02 9560 6131
www.labec.com.au

Operation Manual for
Density/Specific Gravity Meter
DA-100



PLEASE READ THIS MANUAL CAREFULLY BEFORE OPERATION

1. FOREWORD

The DA - 100 meter determines the density/specific gravity of liquids and gases with easy operation.

Density can be converted to concentration values if desired.

Stable temperature control by the built-in thermostat has improved accuracy and the wait-time to reach the desired set temperature is dramatically reduced.

The DA - 100 meter requires no complicated operations.

However please read this manual thoroughly in order to gain a full understanding of its many practical features.

Please always keep this manual near your DA - 100 for quick reference.

This will help you operate your DA - 100 correctly and safely.

1

2

2. WHAT IS THE DA - 100 ?

The DA - 100 is an easy-to-operate compact instrument for metering density/specific gravity of liquids and gases with a small amount of sample.

The detection sensor is made of glass tubing and is called the "Measuring cell".

The measuring cell needs to be calibrated before analysis operation.

Such calibration is called "Factor correction" or "Factor measurement" of the measuring cell.

After calibration, a sample is injected into the measuring cell for density metering. Measurement accuracy is $\pm 0.001 \text{ g/cm}^3$.

The DA - 100 has a built-in thermostat to control temperature of the measuring cell. Temperature range is 15.0 °C to 40.0 °C or 59°F to 104°F.

It also contains an air pump to purge and dry the measuring cell.

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3. SYSTEM SET – UP

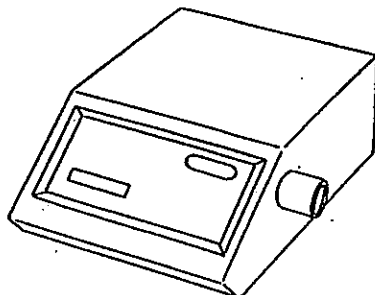
3 – 1. Main unit and accessories

The package you have received contains DA – 100 Main unit and accessories including a copy of Operation Manual.

Please check the delivered items with reference to the below illustration. If any part is missing or broken, please contact your dealer.

3

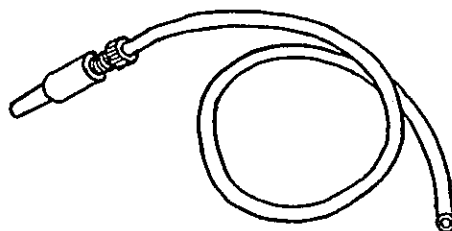
- ① DA – 100 Main unit



- ② Sample syringe 10 pcs.(polyethylene, 2ml)



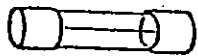
- ③ Sampling/Drain tube (25cm, 2pcs, for Tube joint)



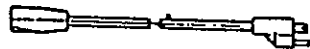
- ④ Desiccator (with silica gel)



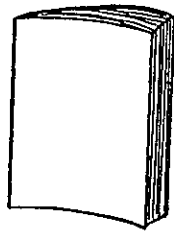
⑤ Tube fuse (T2.5A/250V 2pcs.)



⑥ Power cord



⑦ Operation manual (1 copy)

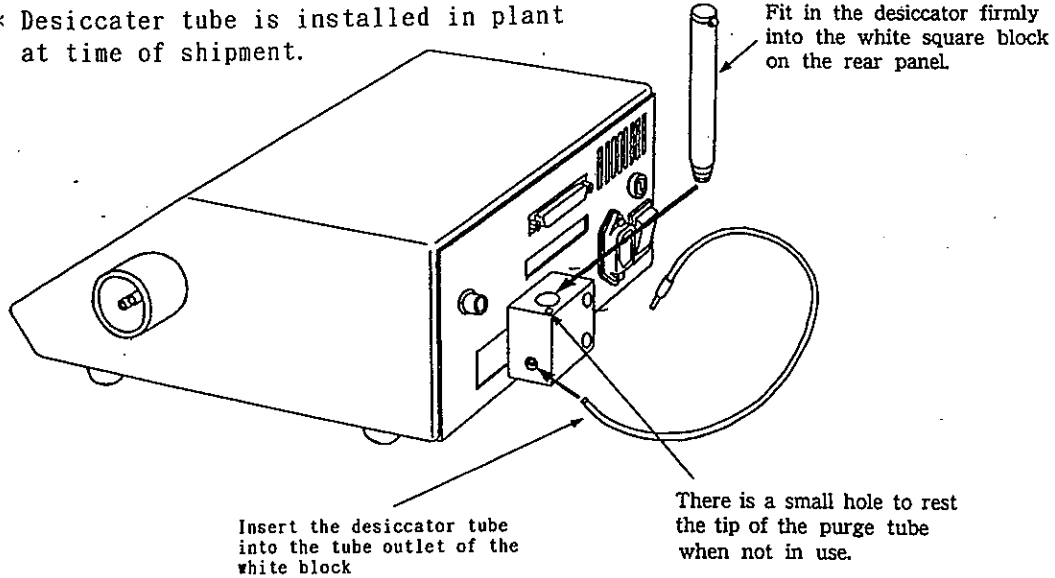


3 - 2. System set - up

1. Installation of the desiccator

2. Connect the purge tube

* Desiccator tube is installed in plant at time of shipment.

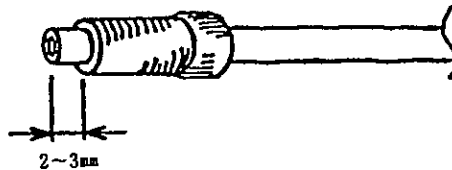


3. Insert sample/drain tube into the tube joint

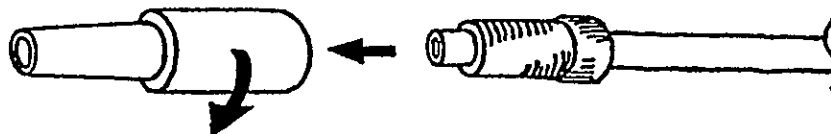
* Tube joint for supplied sampling/drain tube is fixed in plant at time of shipment.

Insert the tube into the smaller joint.

Extend the end of the tube by 2 to 3mm out of the joint.



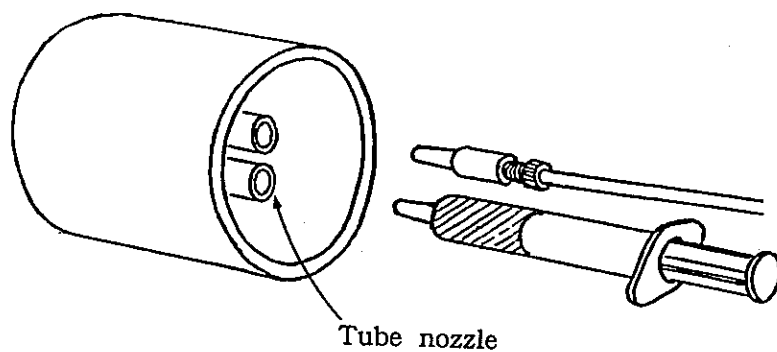
Screw in the joint into the larger joint.



4. Attach the joint block to the tube nozzle

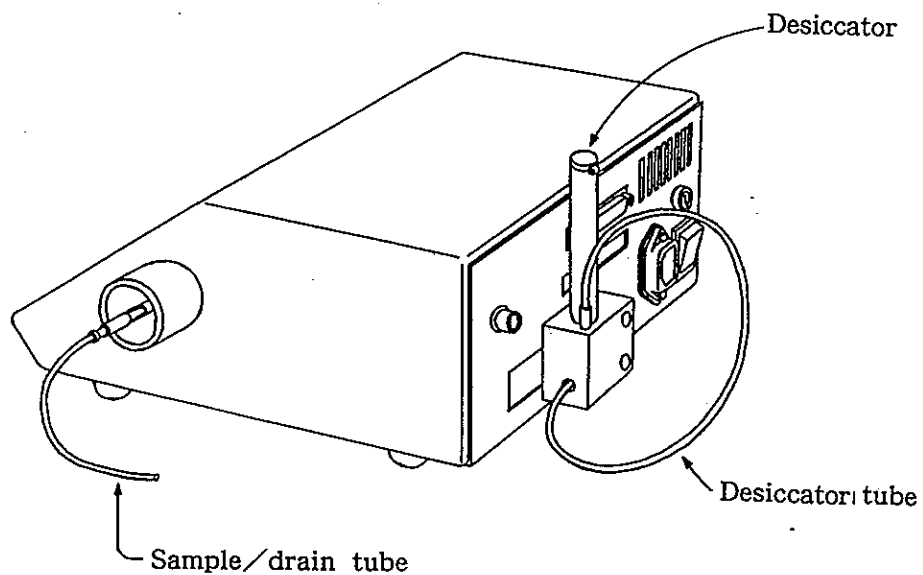
Push in the joint block (of the preceding 3) into one of the tube nozzles on the side wall of the unit.

The other tube nozzle is used for sampling by the syringe.



3

5. Rear/side view of the instrument after the Above 1 through 4 are assembled and installed.



3 - 3. Cautions

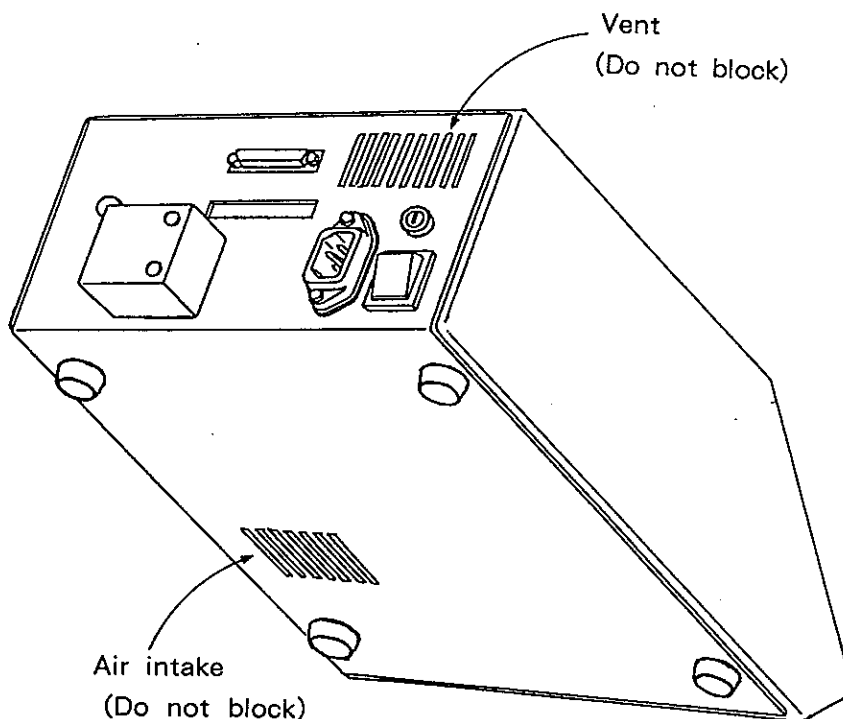
1. Installation

- Avoid strong vibration.
- Avoid direct exposure to sunlight.
- Do not allow corrosive gas in the vicinity of the instrument.
- Install where no strong electrical or magnetic fields are in close proximity.
- The ambient temperature for DA - 100 is 5 °C to 35 °C.
- Avoid a place where temperature exceeds the range.
- There is an air intake motor fan under the unit.

Be careful not to place the DA - 100 on any loose object such as paper which may be pulled up against this vent, blocking it.

There is also a vent for the air coming out.

Do not block or cover this vent.



2. Power source

- AC power unit inside DA - 100 is adjusted in plant before shipment to meet local voltage.
AC frequency is 50 or 60 Hz.

3. Storage

- If the instrument will not be used for a while, please store the unit after the measuring cell is cleaned and dried.
Use the carton box of DA - 100 for secured storage.
- Avoid a place of high (or low) temperature, high humidity or heavy dust, etc.

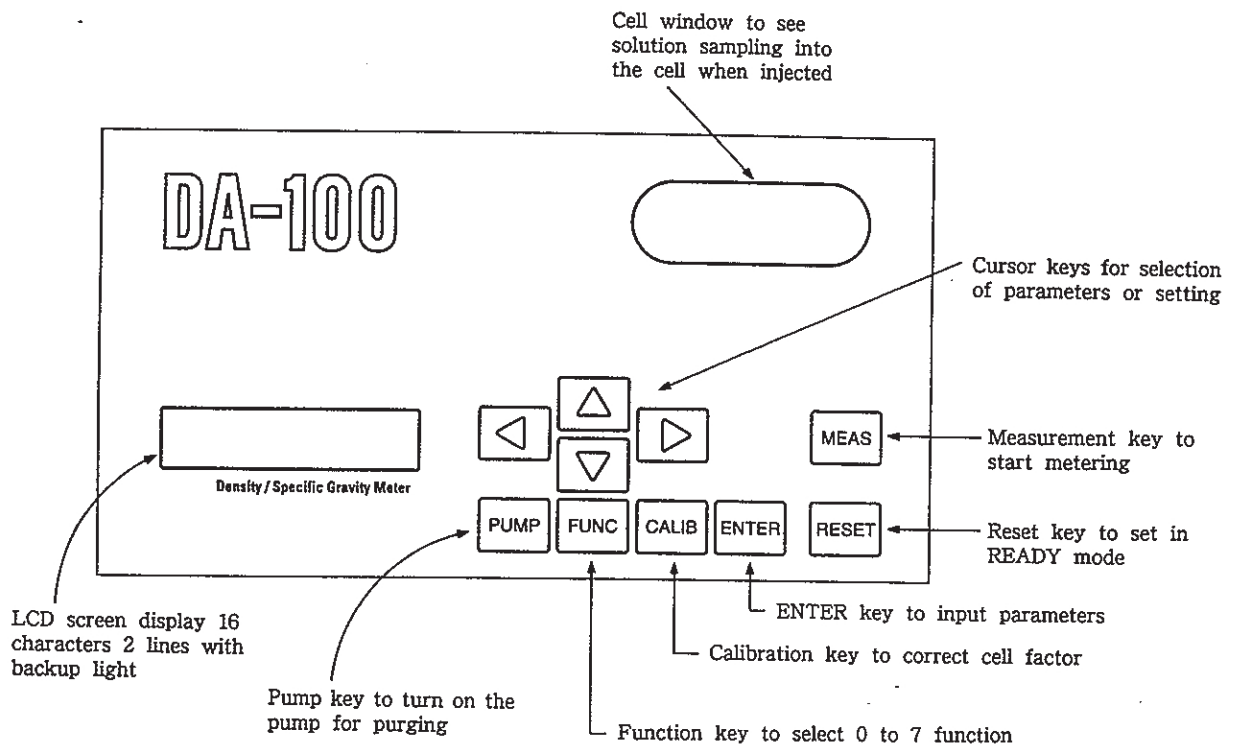
4. Handling

- ~~Measuring part of the instrument is made of glass.
Please do not shock or drop the instrument.~~
- After the day's work is finished, please be sure to clean and dry the measuring cell.
- Use enough ventilation and keep any fire away when handling inflammable samples and cleansing solvent.
- Use gloves, safety glasses or mask protector when necessary.

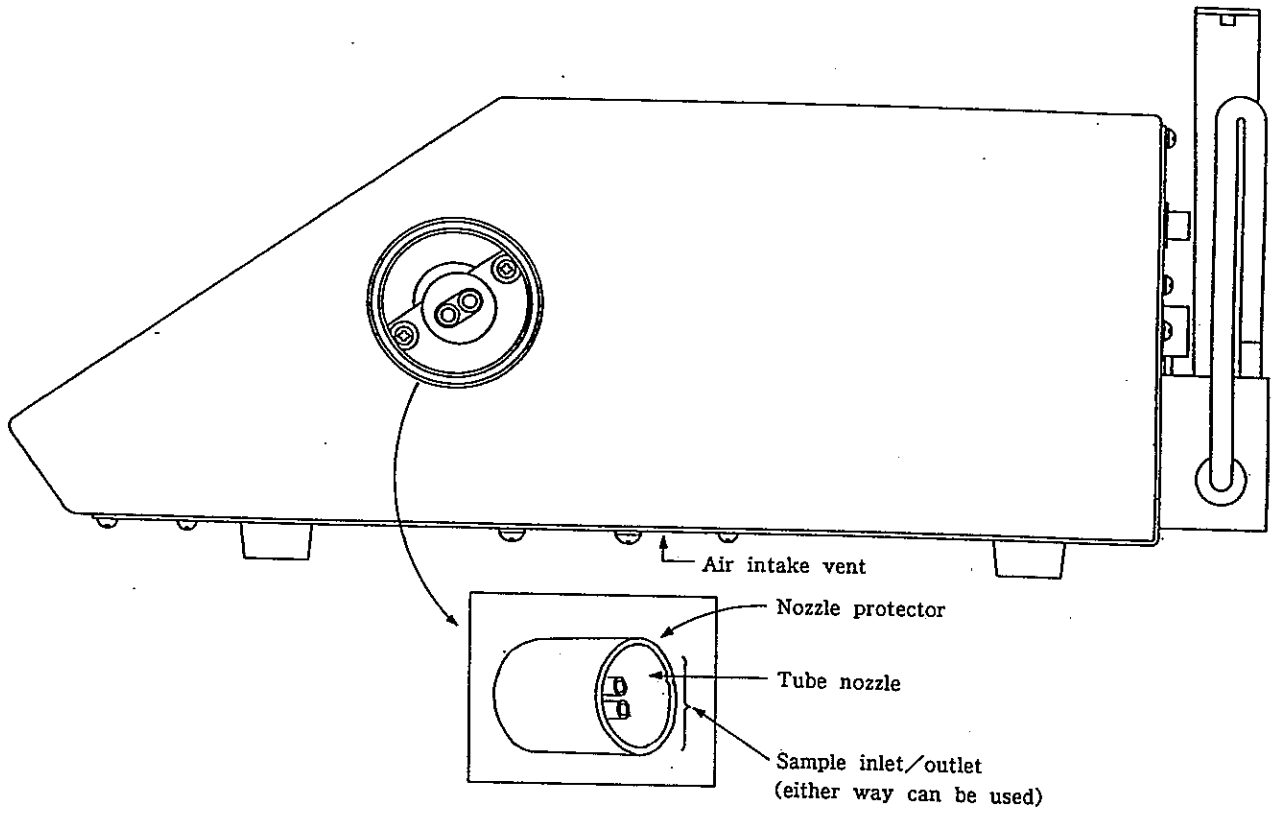
3 - 4 Identification of parts

【 Front view 】

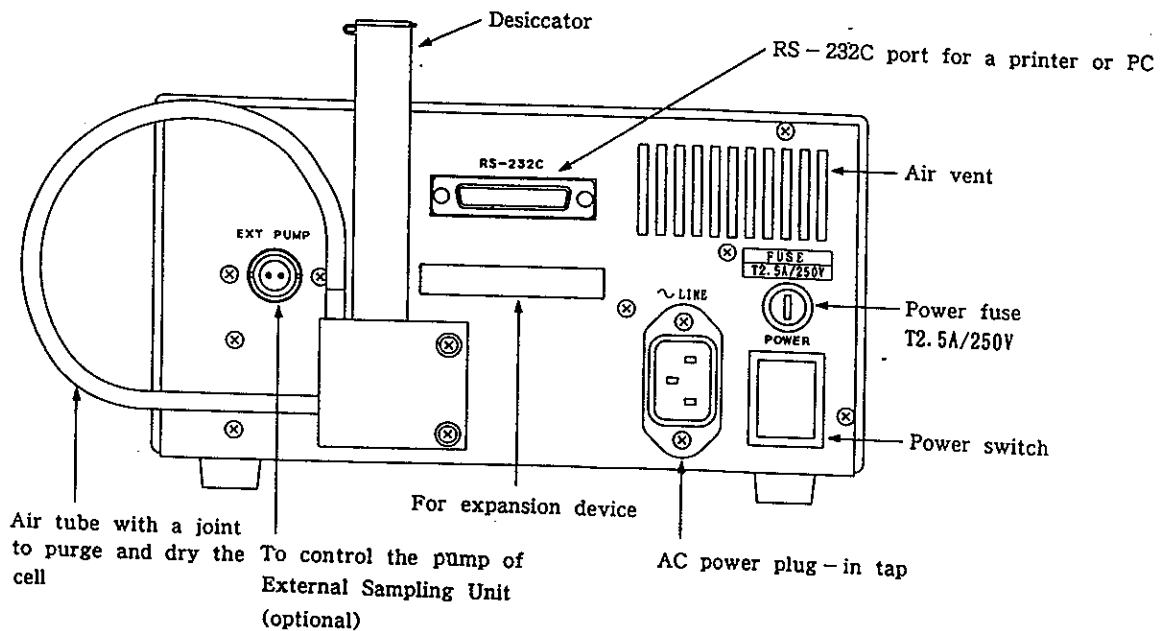
3



【Side view】



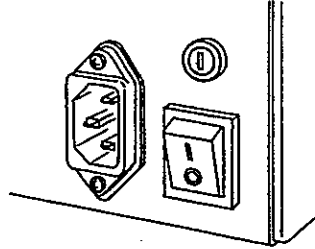
【Rear view】



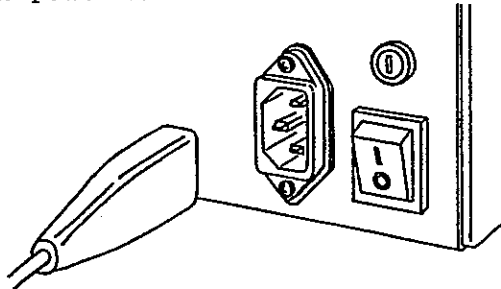
3 - 5. Power - up and warm - up

1. Turning on power

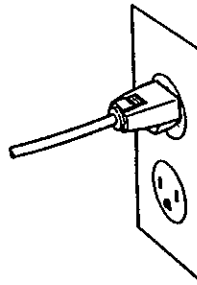
- ① Make sure the power switch is in the "OFF" position.



- ② Connect the power cord to the unit.



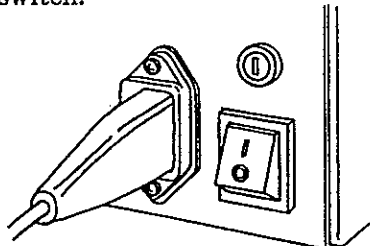
- ③ Plug in the power cord to an electrical outlet.



(3 - pin outlet)

3 - pin line automatically grounds the earth line.

- ④ Turn on the power switch.

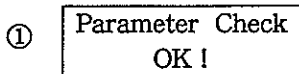


2. Initial display and Main display

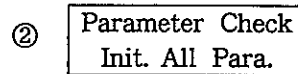
The backup light turns on LCD screen, and Initial display appears for 2 seconds.



Then, it goes on to parameter check which is stored in memory. (Parameters remain in memory even after the power is turned off.) Either of the following two displays ① or ② appears.



When it is in normal condition after parameter check.



This display appears when power is turned on for the first time after purchase or after parameters are initialized.

3

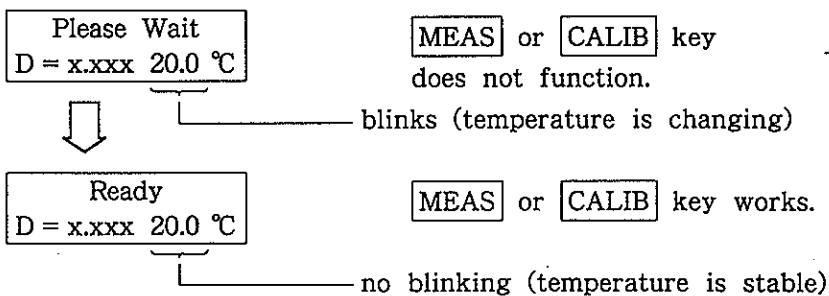
Then, the following display appears with a beep. This screen display is called "Main display" of DA - 100.



The selected temperature is displayed at the lower right hand corner. When the temperature is not adjusted to the selected temperature, "Please Wait" message appears and the selected temperature blinks on screen.

While the temperature blinks with "Please Wait" sign, neither sample measurement nor factor correction can be performed. Wait until the temperature stabilizes.

When the displayed temperature is stable, "Ready" sign appears and blinking stops. The DA - 100 is now ready for calibration or measuring.



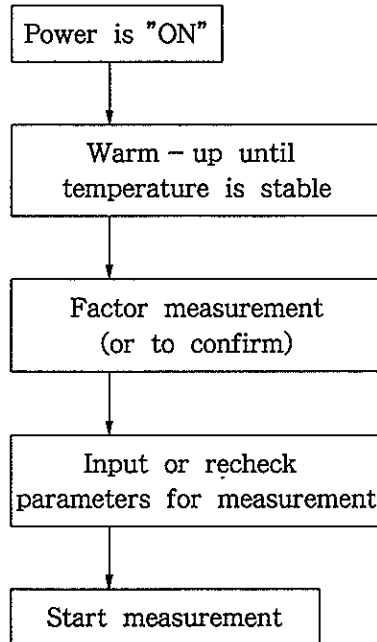
3. Warm - up after power is turned on

After power is turned on, wait until "Please wait" sign turns to "Ready" sign after warming up.

If the temperature difference between the ambient and selected temperature is within ± 5 °C, warming - up will be finished in 10 minutes.

The following flow chart presents the sequence from the power turned on to starting of sample measurement.

3



4. DESCRIPTION OF THE KEY AND THE DISPLAY

4 - 1. Description of the key and operation

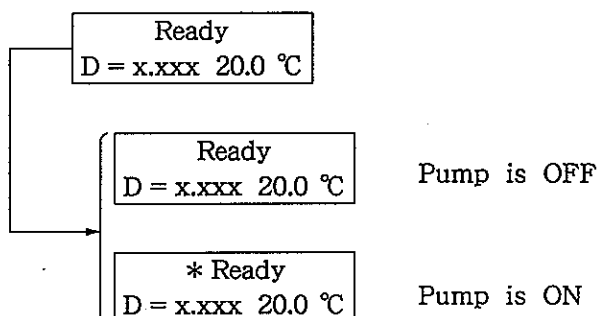
PUMP

key

This key is used to turn the built-in pump ON or OFF to dry the measuring cell.

The pump turns on or off each time the key is pressed.
(This key can also control the optional sampling unit when installed.)

The pump sign is displayed by * mark at the upper left corner of the screen.



The pump key features automatic purging which stops the pump automatically when the measuring cell determines it is dried.

In order to perform this automatic purging,
keep pressing the **PUMP** key for 2 seconds.
(see 5 - 3. "How to dry the measuring cell")

RESET

key

This key resets the display and all activities.

- * If a sample is being measured, it stops the measurement.
- * If cell factor is being corrected, it stops the calibration.
- * If the pump is in ON position, it stops pumping.

MEAS

key

This key is used to start measurement. Inject a sample into the measuring cell before measuring.

While a sample is being measured, "Measurement" sign blinks.

Measurement D = x.xxx 20.0 °C

 Sample is being measured.

When measurement is started by pressing **MEAS** key, the automatic function to search for equilibrium begins.

When equilibrium point is detected, the blinking "Measurement" sign turns to "Result" blinking sign with beep, and the measurement result appears on screen.

Result D = x.xxx 20.0 °C

 Measurement result is displayed.

And the measurement result is output through RS - 232C to a printer.(see 8 - 1.

"External output format and pin configuration" for output data and format).

CALIB

key

This key is used to correct the measuring cell factor.

Calibration can be completed with this key by following the messages that will appear on screen at each step of factor measurement.

Five kinds of messages for calibration appear on screen.

Use dry air and degassed pure water as standards for factor correction.

See 5 - 4."The purpose of factor correction and how to calibrate" for details.

FUNC

key

This key performs several functions like selection of measurement parameter, calendar setting, adjusting brightness of display screen, etc.

8 menus are available from Function 0 to Function 7.

Press **FUNC** key and select Function by cursor key **△** or **▽**

Use **ENTER** key and the cursor to select parameters.

To return to Main display, press **FUNC** key or **RESET** key.

Selection of parameters by each Function is as follows :

Function 0
Sample No. Clear

To clear sample number

Function 1
Meas. Parameter

To select parameter of temperature and measuring time limit

Function 2
Conc. Parameter

To select concentration equation parameters

Function 3
Calendar

To set up calendar date and time (year,month,day,hour,minute)

Function 4
RS - 232C

To select baud rate of RS - 232C

Function 5
Switch

To select temperature unit (°C or °F) and to switch pump (Int. or Ext.)


Function 6
LCD Contrast


To change brightness of LCD display


Function 7
Init. All Para.


To initialize all the parameters

4

 key
(Up key)

 key
(Down key)


 key
(Left key)

 key
(Right key)

These keys are called "cursor key" and are used for selection of parameter or setting of numerals.

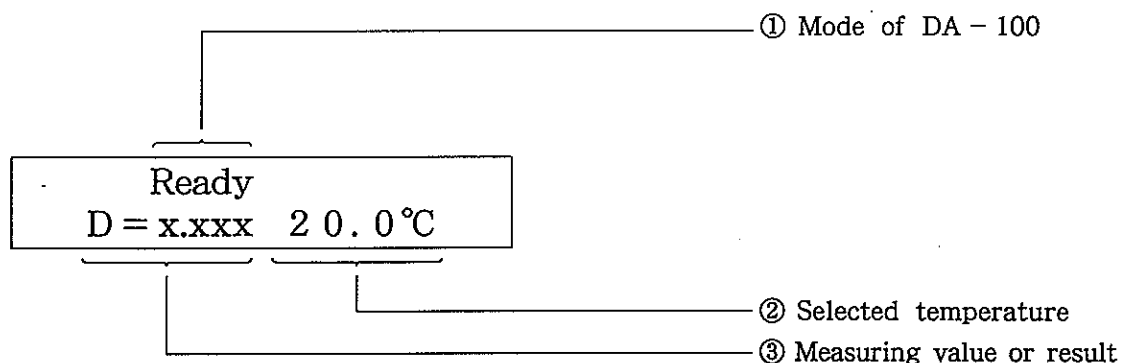
 key

This key is used to input parameters or numerals selected by the cursor key for storage in memory.

If a parameter is unchanged, press  key to skip and go to the next parameter.

4 - 2. Main screen display and key operation

3 kinds of information are shown on DA - 100 Main display.



1. ① mode shows the followings :

Display	Message
Please Wait	Wait until temperature is stable.
Ready	It is ready for measurement.
Purge Check	It is checking dryness of the cell.
Measurement	It is measuring now.
Result	Measurement result is displayed.
Purge OK ?	It is asking if the cell is dry.
Calib. Air	It is calibrating by air.
Set Water	Inject water for calibration after air.
Calib. Water	It is calibrating by water.
Calib. OK	Factor calibration OK.
Calib. NG	Factor calibration No Good.

2. Regarding ② Selected temperature, please see 3 - 5. 2.
"Initial display and Main display".

3. ③ Measuring value or result :

【 Measuring value 】

Ready
D = x.xxx 20.0 °C

Measuring value

Dimension of value

D = : Density (g/cm³)

S = : Specific gravity

C = : Concentration

4

Dimension D =, S = or C = can be selected by Δ , ∇ key.

【 Measured result 】

Ready
D = x.xxx 20.0 °C

Measured result

Dimension of measured result :

D = : Density (g/cm³)

S = : Specific gravity

C = : Concentration

Dimension of D =, S = or C = can be selected by Δ , ∇ key.

(Measurement result remains on display unless **RESET** key is pressed.)

(note) C = is parameter for concentration calculation of Function 2, and can be set by selecting ON of "Calculation ON or OFF" on display.

If OFF is selected, D = or S = will be displayed.

Specific gravity of S = is the value against

S. gravity of water at the selected temperature.

4 - 3. Input of parameters

All parameter entries are guided by dialog message.

Input of parameters is made by cursor key and key.

Parameter entry is made by two ways according to the message appearing on the display.

- (1) Option entry
- (2) Constant (number) entry

1. Option entry

Option entry is guided by " ↑ " symbol at the end of a message.

Select by , key and input by key.

(example)

To change RS - 232C baud rate from 4800 to 600 :

```
RS - 232C
Baud Rate : 4800 ↑
```

Display changes from 4800 → 9600 → 300 → 600 by key.

Display changes from 4800 → 2400 → 1200 → 600 by key.

Select 600 and input by key.

(note)

Selected parameters cannot be input unless key is pressed.

If more than two parameters are available, the preceding parameter can be displayed by key.

2. Constant (number) entry

Both message and parameters are displayed for entry.

Change the blinking parameter by Δ , ∇ key.

Parameter number to blink can be shifted by \triangleleft , \triangleright key.

After all the numbers are selected, input by ENTER key.

(example)

Change temperature from 20 to 35 °C.

```
Meas. Parameter
Temp. ? 20.0°C
```

Press Δ key one time to change 2 to 3.

Then, press \triangleright key to shift the blinking digit to the place next right and press Δ key 5 times to change 0 to 5.

```
Meas. Parameter
Temp. ? 35.0°C
```

Input by ENTER key.

(note)

Selected numbers and numerals cannot be input unless ENTER key is pressed.

If a number exceeding numeral range is attempted by ENTER key, inhibiting beep sounds out. Enter a correct number.

Where more than two parameters are available on menu,

the display can go back to the preceding display by \triangleleft key if a number in the highest place is blinking.

4 — 4. Inhibited key operation

1. If selected temperature is not stable yet , neither **MEAS** key nor **CALIB** key will work.

Temp Not Stable

(Temperature is not stable yet.)

The above message appears for 2 seconds with beeps.

2. Factor cannot be corrected by **CALIB** key while measuring.
A sample cannot be measured by **MEAS** key while calibrating.
If either of the above is attempted, inhibiting beep sounds out.
3. Temperature cannot be changed while measuring or calibrating.
("Busy!" sign appears on display.)
4. If Function 7 (Initialization of All Parameters) is executed, be sure to correct the cell factor.
Measurement cannot be performed by **MEAS** key prior to factor measurement.

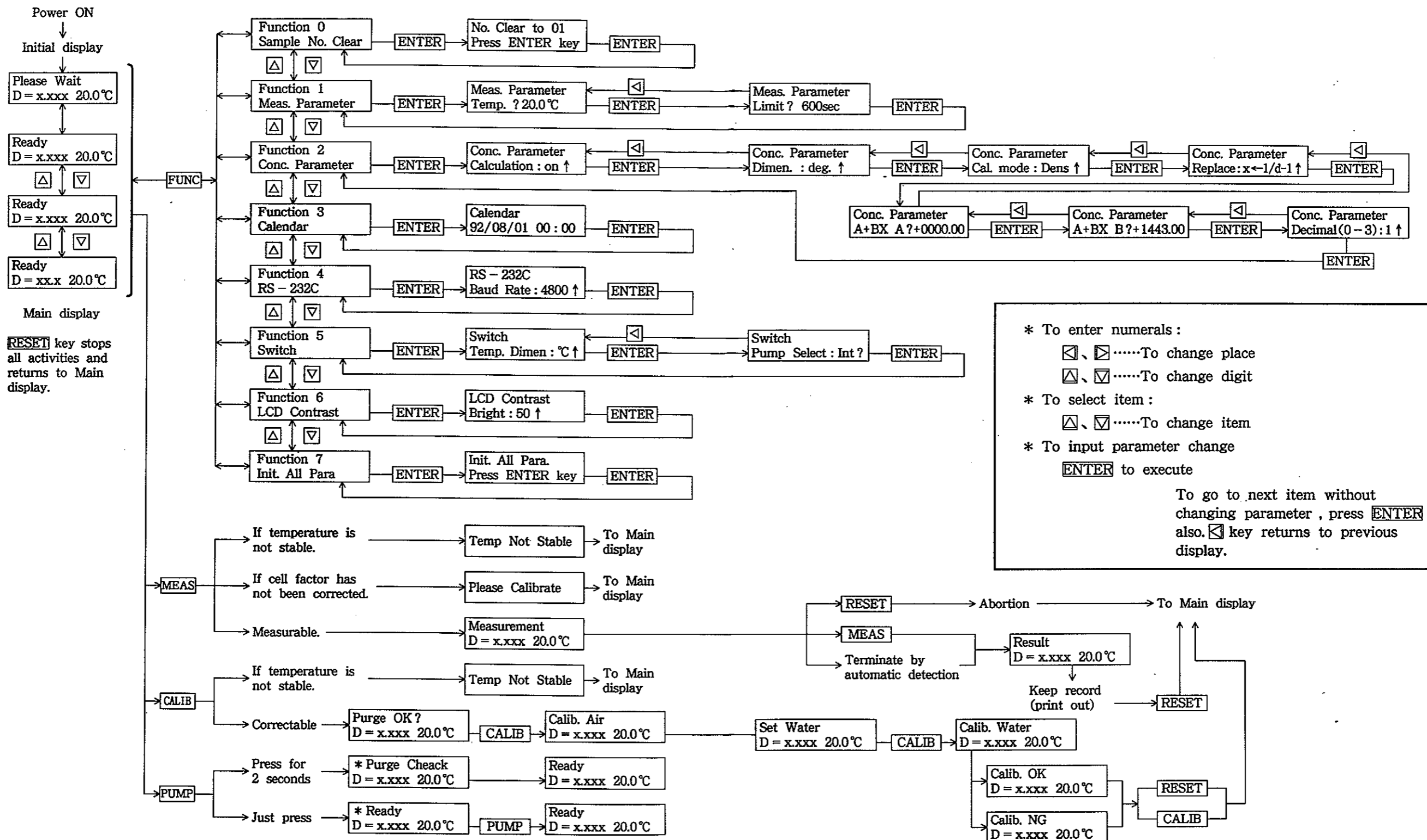
Please calibrate

(Please correct the measuring cell factor.)

The above sign appears for 2 seconds with beeps.

5. All other inhibited key entry is indicated by beep sound.

4-5. A list of key operation and displays

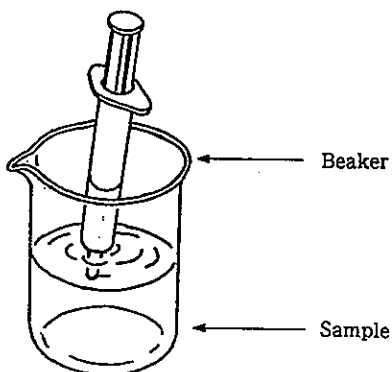


5. WHAT TO KNOW PRIOR TO ANALYSIS

5 - 1. Sampling

Before starting measurement of a sample, make sure the measuring cell is dry. If it is not dry, follow the instruction 5 - 2 and 5 - 3 for rinsing and drying.

1. Aspirate a sample by the syringe.

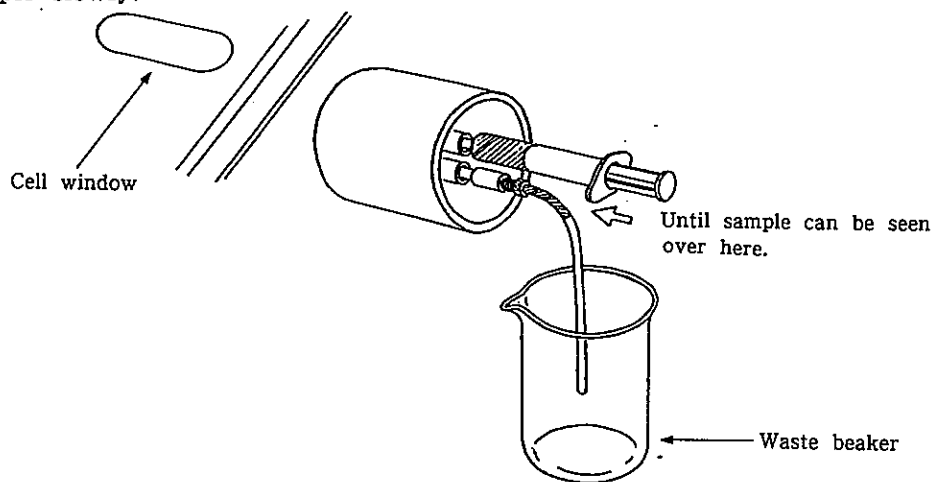


5

2. Insert the syringe into the tube nozzle, and inject the sample slowly into the cell while looking at the the cell through the window.

Avoid any bubble mixed into the sample in the cell.

Inject the sample slowly.

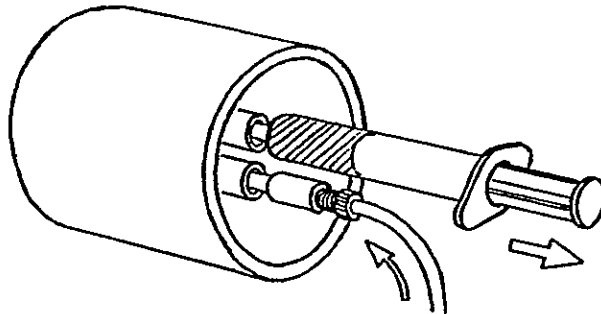


(The syringe and drain tube can be connected in other way. Connect them either way for better handling.)

3. After the sample is injected, leave the syringe in the tube nozzle, and start measurement by **MEAS** key.

5 - 2. How to drain a sample and rinse the measuring cell

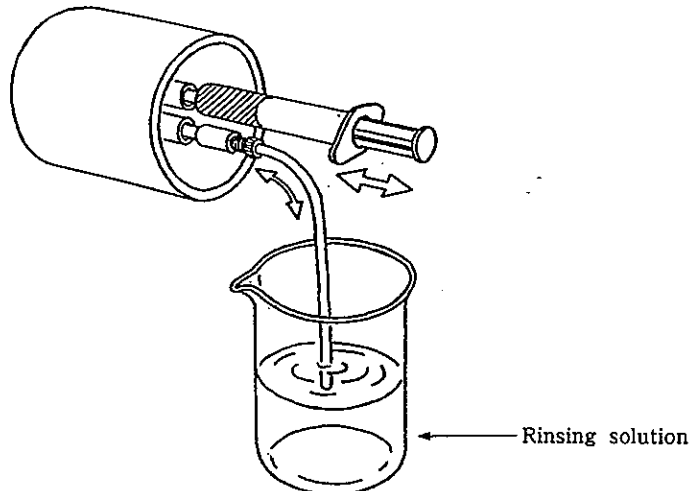
1. In order to drain the measured sample, aspirate the sample inside the cell by the syringe in the reverse way of Instruction 5 - 1. 2.



2. Prepare a new syringe for rinsing.

Prepare rinsing solution in a beaker.

Aspirate the solution all the way through the cell 5 to 6 times up to the syringe.



3. The measuring cell must be dried if another sample is to be measured after rinsed.

(note)

If continuous measurement of the same type of sample is performed, the cell can be rinsed by the following sample solution (called "self-cleaning").

Make sure the measuring value is not affected by self-cleaning.

5 - 3. How to dry the measuring cell

Before drying the measuring cell, be sure to rinse it. (see Instruction 5 - 2).

If the measuring cell is dried without rinsing, nonvolatile residue will remain and may affect measurement, causing false density reading.

1. Prepare ethanol and a syringe for ethanol only.

Be sure to rinse with ethanol to dry the measurement cell completely.

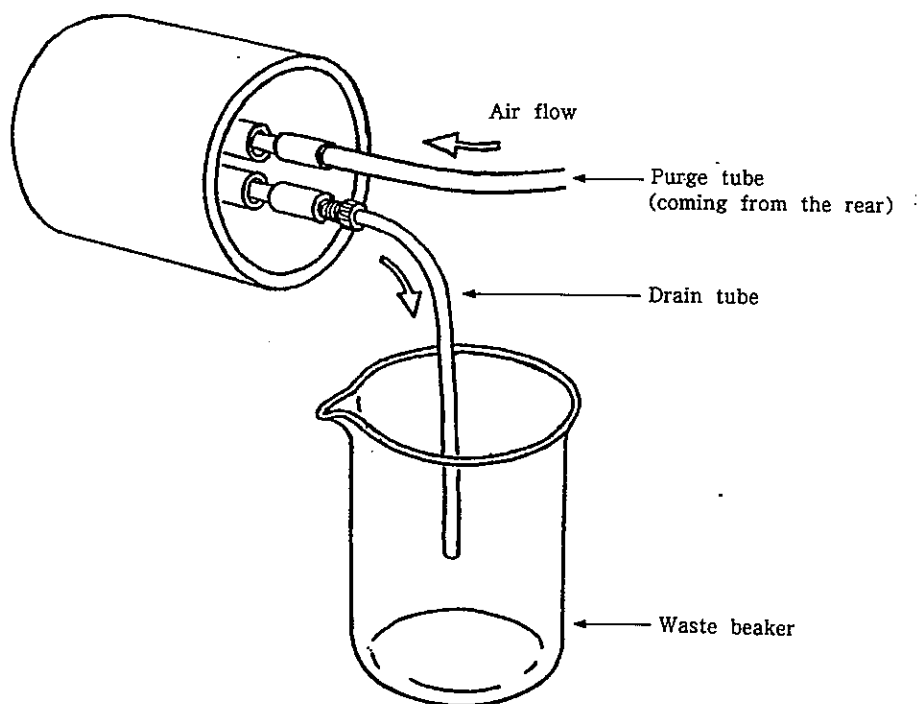
2. Inject ethanol into the cell in the same way as in Instruction 5 - 1, and rinse the cell 2 - 3 times, draining ethanol into a waste beaker.

3. Remove the ethanol syringe, and leave the drain tube and the waste beaker as they are.

Insert the purge tube into the tube nozzle.

The measuring cell is now ready to be dried.

5



4. Press **RESET** key to make DA - 100 in "Ready" mode.

Pass dry air into the cell by pressing **PUMP** key.

Two pumping modes (Auto or Manual) are available.

Auto mode is recommended.

【 AUTO mode 】

Press **PUMP** key for 2 seconds.

Pumping is indicated by * mark on display, and "Ready" turns to blinking "Purge Check" message.

Auto mode checks dryness of the cell and stops the pump automatically when it determines the drying is complete.

The display returns to "Ready" message.

Ready
D = x.xxx 20.0 °C

Keep pressing **PUMP** for 2 seconds.

* Purge Check
D = x.xxx 20.0 °C

Dryness is checked automatically.

Ready
D = x.xxx 20.0 °C

When the cell is dry, the pump stops automatically.

(note)

Auto mode works only at "Ready" on display.

It takes approximately 2 minutes to complete drying.

To stop Auto drying, press **PUMP** key.

The pump stops and checking dryness also is aborted.

【 MANUAL mode 】

Press **PUMP** key just for a touch.

Pumping starts and * mark appears on display.

("Ready" message remains on display.)

Keep pumping for any desired length of time.

To stop, press **PUMP** key once again.

Ready
D = x.xxx 20.0 °C

Press **PUMP** key for a second.

* Ready
D = x.xxx 20.0 °C

Pumping continues.

Ready
D = x.xxx 20.0 °C

To stop, press **PUMP** key.

5

5 - 4. The purpose of factor correction and how to calibrate

[Factor correction]

● In order to measure density correctly, the measuring cell must be calibrated by standards of which density is known.

This process is called factor correction or calibration

For standards, use dry air and degassed water.

● The measured result of factor correction is stored in memory, and remains even after the power is turned off.

If the selected temperature is changed, cell factor will also change.

Therefore, factor correction is necessary each time the temperature is changed.

[How to calibrate]

For factor correction both dry air and degassed water are necessary.

Factor correction measures air and then water. After calibration is finished, check the factor by measuring the same pure water to make sure the measured result comes to 1.000 Specific Gravity.

5

1. Screen display when **CALIB** key is pressed :

Purge OK ?
D = x.xxx 20.0 °C

Asking if the cell is dry

If the cell is not dried, press **RESET** key and return to Main display. See Instruction 5 - 3 "How to dry the measuring cell", and dry the cell first.

If the cell is dry, start calibrating air by pressing **CALIB** key.

2. Screen display while air is calibrated :

Calib. Air
D = x.xxx 20.0 °C

"Calib. Air" message blinks on display showing calibration of air is on.

Calibration of air finishes in 1 minute.

3. Screen display when calibration of air is finished :

Set Water
D = x.xxx 20.0 °C

Requesting to inject degassed pure water.

Slowly inject degassed pure water.

(Do not allow any bubbles in the cell.)

After the cell is full of the water, press **CALIB** key.

4. Screen display while calibrating water :

Calib. Water
D = x.xxx 20.0 °C

"Calib.Water" message blinks showing water is being calibrated.

Calibration of water finishes in 2 minutes.

5. After water is calibrated, the measurement result appears on display :

① If factor was measured correctly :

Calib. OK
D = x.xxx 20.0 °C

Both air and water were calibrated correctly.

Press **CALIB** key once more and return to "Ready".

Proceed to check the cell factor according to the next instruction of 5 - 5.

② If factor correction resulted incorrectly :

Calib. NG
D = x.xxx 20.0 °C

Factor measurement resulted negative.

Negative results are caused by the followings :

(1) The measurement cell was not dry.

Remedy : Press **RESET** key and dry the cell.

(2) The water was not degassed pure water or it contained bubbles.

Remedy : Press **RESET** key and dry the cell for re - calibration.

5

5 - 5. How often to calibrate and to check

[How often]

- Calibrate cell factor when first installed.
- Calibrate whenever selected temperature is changed.
- Calibrated cell factor is kept in memory by DA - 100 even after the power is turned off.

Therefore, when power is turned on for measurement at the same temperature, factor measurement will not be necessary.

- Make sure the cell factor is correct before beginning analysis after the power is first turned on.

It is recommended to confirm cell factor value each time before sampling.
(See below "How to check")

Cell factor can be checked by measuring dry air and degassed pure water as follows.

[How to check]

1. Check air

After the cell is dried, measure air by **MEAS** key.

If the measured result is within $\pm 0.001 \text{ g/cm}^3$ of density value in the chart (see Chart 1 on next page), it was measured correctly.

If not within the range, calibrate again.

2. Check water

After air is measured, inject pure water and measure by pressing **MEAS** key.

Compare the measured result with the density value in Chart 2.

If it is within $\pm 0.001 \text{ g/cm}^3$, factor was measured correctly.

If not within the range, re - calibrate.

(Chart 1. Density of Air)

Temp (°C)	Density (g/cm ³)
15	0.00123
16	0.00122
17	0.00122
18	0.00121
19	0.00121
20	0.00120
21	0.00120
22	0.00120
23	0.00119
24	0.00119
25	0.00118
26	0.00118
27	0.00118
28	0.00117
29	0.00117
30	0.00116
31	0.00116
32	0.00116
33	0.00115
34	0.00115
35	0.00115
36	0.00114
37	0.00114
38	0.00113
39	0.00113
40	0.00113

(Chart 2. Density of Water)

Temp (°C)	Density (g/cm ³)
15	0.99910
16	0.99894
17	0.99878
18	0.99860
19	0.99841
20	0.99821
21	0.99799
22	0.99777
23	0.99754
24	0.99730
25	0.99705
26	0.99679
27	0.99652
28	0.99624
29	0.99595
30	0.99565
31	0.99534
32	0.99503
33	0.99471
34	0.99437
35	0.99404
36	0.99369
37	0.99333
38	0.99297
39	0.99260
40	0.99222

6. SAMPLE MEASUREMENT

6 - 1. Measurement parameter selection

1. Use **FUNC** key and **△**, **▽** key to display Function menu.
Screen display of Function 1 :

```
Function 1
Meas. Parameter
```

2. Press **ENTER** key to display temperature to select.

```
Meas. Parameter
Temp.? 20.0 °C
```

Use the cursor key to select temperature and input by **ENTER** key.

3. The display turns to "Measuring Limit Time".

```
Meas. Parameter
Limit? 600 sec
```

* When a number in the highest place is blinking, the display goes back to the previous parameter display if **◀** key is pressed.

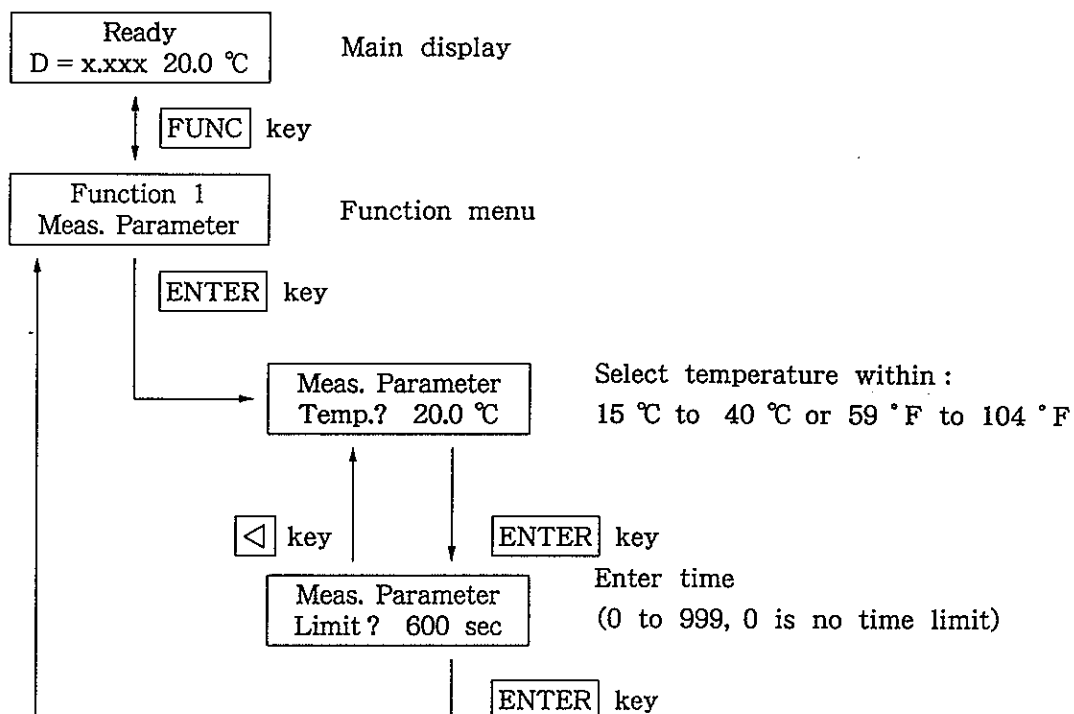
Select time by cursor and input by **ENTER** .

(Normal measuring time is 600 seconds.)

After this, display goes back to Function menu.

6

【 Example of Measurement parameter 】



If different temperature is selected, the temperature on Main display blinks.
 When the temperature stops blinking, the DA - 100 has reached equilibrium at the new temperature.
 Be sure to correct cell factor before measurement.

6 - 2. To start measurement

There are the following sequential steps to observe before and after measurement :

1. The measuring cell must be dry before a sample goes into the cell.
If any residue remains inside the cell, correct measurement result cannot be expected.
Be sure to rinse and dry the cell if it is not dry.
(See Instruction 5 - 2 for rinsing and 5 - 3 for drying)

2. Inject sample by a syringe into the cell
(See Instruction 5 - 1 for sampling)

3. Start measurement by **MEAS** key.
Screen display when **MEAS** key is pressed.

Measurement D = x.xxx 20.0 °C

"Measurement" message blinks while measuring.

4. When the instrument detects equilibrium point, the blinking "Measurement" turns to blinking "Result" message , and displays the result.
(It also outputs data through RS - 232C)
If a printer is not connected, record the measured results manually.

Result D = x.xxx 20.0 °C

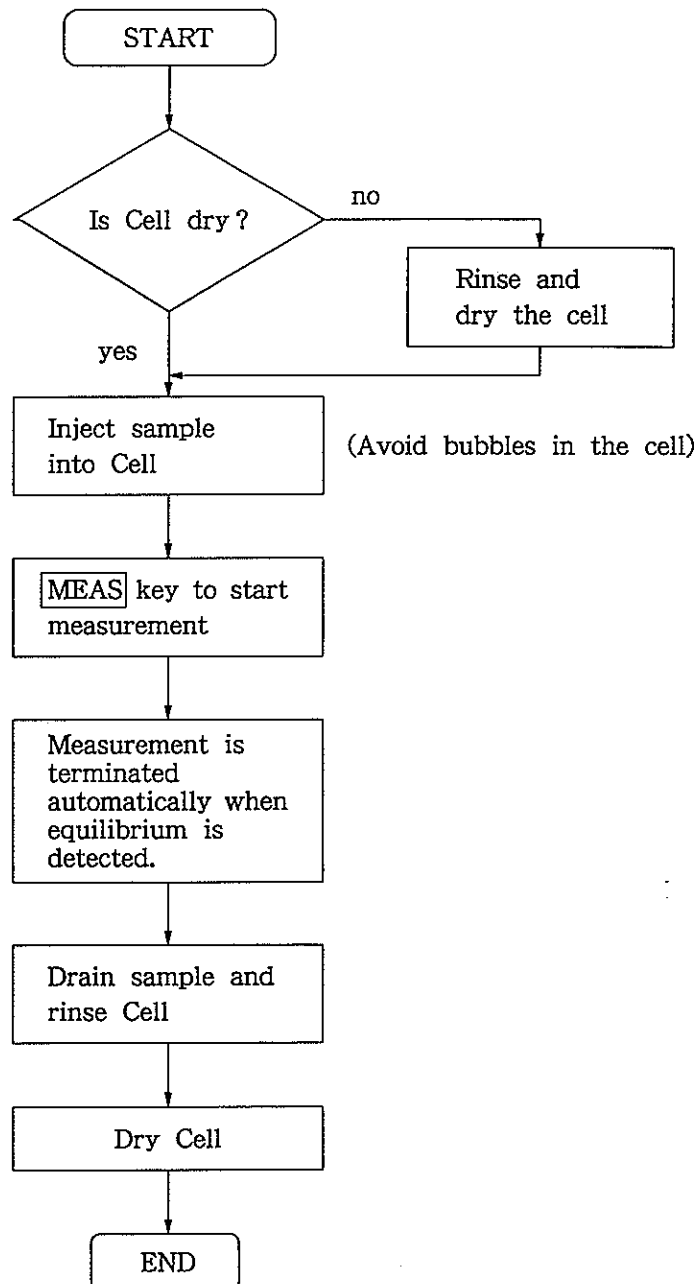
Unit of value (D or S) can be changed by **△**, **▽** key.

5. Drain the measured sample and rinse the cell.
(See Instruction 5 - 2 for drain and rinse)
6. After the cell is rinsed, it must be dried.
(See Instruction 5 - 3 for drying)
7. After the cell is dried, a sample can be measured.

6

6 - 3. Measurement sequence

【 Flow chart of measurement sequence 】



SKIP Function

If **MEAS** key is pressed again after measurement has begun, the measurement stops immediately and the measured value at that point is displayed before equilibrium has been detected.

6

7. HOW TO CONVERT DENSITY(SPECIFIC GRAVITY)TO CONCENTRATION

7-1. Description of conversion calculation

Measured density (specific gravity) can be converted by linear expression and displayed :

$$\text{Concentration value} = \underset{\substack{\downarrow \\ \text{(c) Coef. A}}}{A} + \underset{\substack{\downarrow \\ \text{(d) Coef. B}}}{BX} \quad \left\{ \begin{array}{l} \text{(b) } X = d \\ X = d - 1 \\ X = 1/d - 1 \end{array} \right.$$

$$\text{(a) } \left\{ \begin{array}{l} d = \text{Dens} \\ d = \text{S. G.} \end{array} \right.$$

(a) Select Dens (density) or S.G.(specific gravity) for d. (Definition of d)

(b) Select a definition of X (3 kinds) for use in the expression.

$$X = d$$

$$X = d - 1$$

$$X = 1/d - 1$$

(c) Select coefficient A.

(d) Select coefficient B.

Concentration value can be obtained automatically by selecting the appropriate parameter instead of manual computation using conventional Hydrometer.

Concentration	Equation	Parameter				
		Measuring temp.	Definition of d	Definition of X	A + BX	
					A	B
Baume (H)	$(1/d - 1) \times (-144.3)$	15.0°C	Dens	$1/d - 1$	0	-144.3
Baume (L)	$(1/d - 1) \times 144.3 + 10$	15.0°C	Dens	$1/d - 1$	10	144.3
Sake wine	$(1/d - 1) \times 1443$	15.0°C	Dens	$1/d - 1$	0	1443
API	$(1/d - 1) \times 141.5 + 10$	15.56°C	S.G.	$1/d - 1$	10	141.5
Twaddell	$(d - 1) \times 200$	—	Dens	$d - 1$	0	200
Milk deg.	$(d - 1) \times 1000$	—	Dens	$d - 1$	0	1000

(note) Though theoretically Dens value is Specific gravity to the density of water at 4 °C, calculation result will not be affected by using Density value because reading by DA - 100 is 3 digits after decimal.

7 - 2. Parameter setting for concentration measurements

1. Display Function menu by **FUNC** key and **△**, **▽** key.

Function 2
Conc. Parameter

Press **ENTER** key.

2. Select ON for concentration calculation.

Conc.Parameter
Calculation : on ↑

(ON or OFF)
(ON for calculation)

Select "on" and press **ENTER** key.

Screen display will appear as follows in sequence.

3. Select one of 12 concentration units by **△**, **▽** key.

Conc.Parameter
Dimen. : deg. ↑

(no dimension , degree , % , ppm , mg/g , mg/ml ,
mg/l , g/l , mEq/l , N , mol/l , g/cm³)

Input by **ENTER** key.

4. Select definition of d (density or s.gravity) by **△**, **▽** key.

Conc.Parameter
Cal.mode : Dens ↑

Dens or S.G.

Input by **ENTER** key.

5. Select definition of X of A + BX by **△**, **▽** key.

Conc.Parameter
Replace: X ← 1/d - 1 ↑

(d, d - 1, 1/d - 1)

Input by **ENTER** key.

6. Input value A of A + BX by the cursor key.

Conc.Parameter A + BX A? + 0000.00	(- 9999.99 to + 9999.99)
---------------------------------------	--------------------------

Input by key.

7. Input value B of A + BX in the same way as 6. above.

Conc.Parameter A + BX B? + 1443.00	(- 9999.99 to + 9999.99)
---------------------------------------	--------------------------

Input by key.

8. Select number of place after decimal by , key.

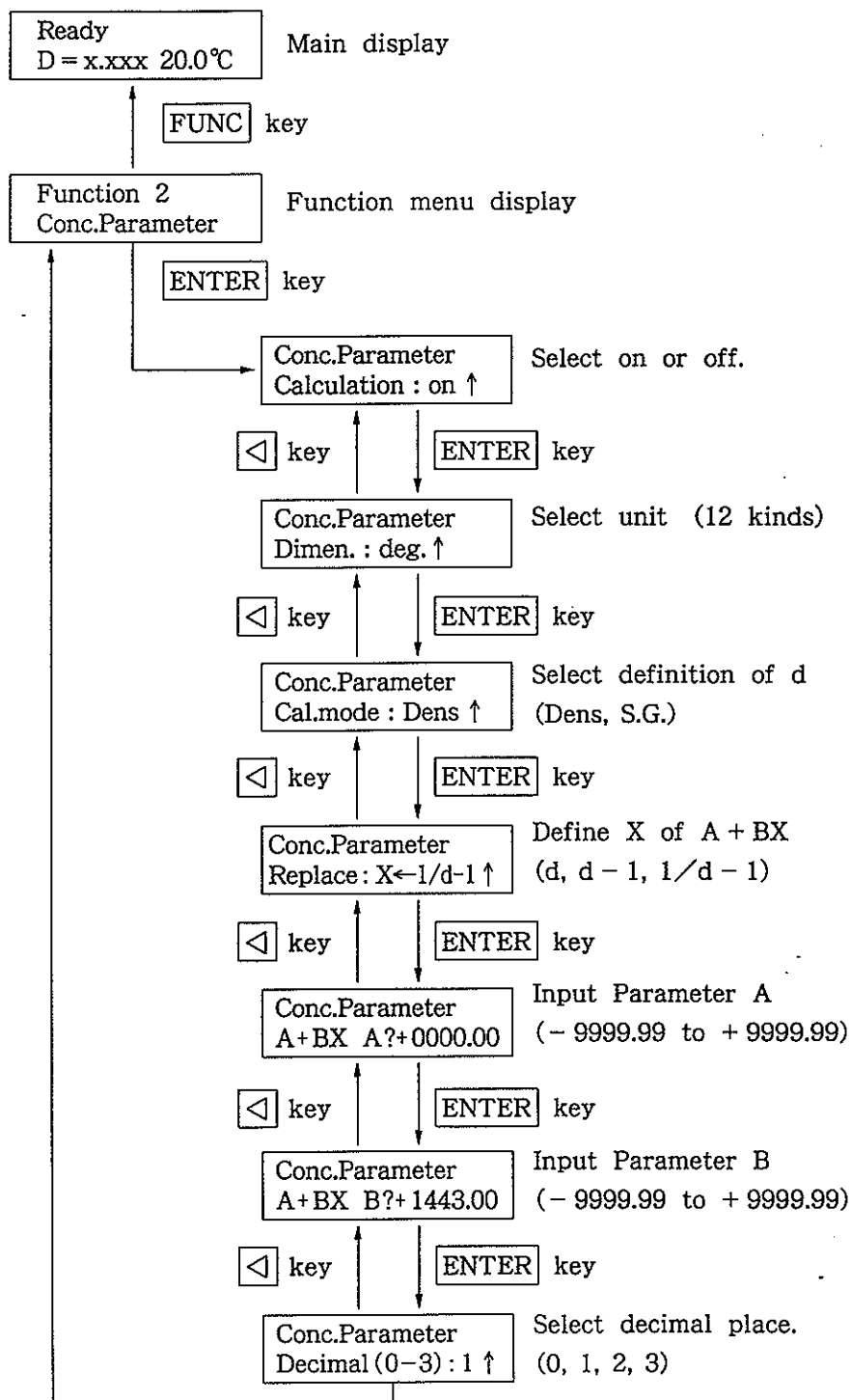
Conc.Parameter Decimal (0 - 3) : 1 ↑	(0, 1, 2, 3)
---	--------------

Input by key.

(note) Concentration value of calculated result will appear on display without dimension, but can be printed out with dimension through RS - 232C.
(see 8 - 1. "External format and pin configuration")

7

【 Sequence of parameter setting for concentration calculation 】



(note) Press **FUNC** key to return to Main display.

8. DESCRIPTION OF OTHER FUNCTIONS

8 - 1. External output format and pin configuration

Immediately after equilibrium is determined by the detection processor, measurement result is output through RS - 232C. The output data can be printed out by a printer (optional) or can be transferred to a personal computer.

1. Interface specification

Spec. to RS - 232C :

Connector	D - Sub 25 pin female
Baud rate	300, 600, 1200, 2400, 4800, 9600
Start bit	1 bit (fixed)
Data length	8 bit (fixed)
Stop bit	1 bit (fixed)
Parity	No parity (fixed)

(note) Only baud rate can be changed. Others are fixed.

2. Pin configuration

Pin No.	Signal name	Direction
1	FG (Frame Ground)	
2	$\overline{\text{TXD}}$ (Trasmit Data)	OUT
3	$\overline{\text{RXD}}$ (Receive Data)	IN
5	CTS (Clear to Send)	IN
7	SG (Signal Ground)	
20	DTR (Data Terminal Ready)	OUT
Other	NC	

(note) Data signal for $\overline{\text{TXD}}$ and $\overline{\text{RXD}}$ is negative logic.
control signal of CTS and DTR is positive logic.
Direction is from DA - 100.

3. Connection to DA - 100

Use Cable (#032 - 5305) specially designed for connecting DA - 100 to NEC PC - 9801.
The optional printer comes with a special cable for connection to DA - 100.

4. Output format

Below is the dump list of output data :

(note) Number of output data varies according to whether concentration calculation is selected or not.

```
Sample No. 38
Date 92/08/04 07:23
Temp 15.0 C
Dens 1.003 g/cm3
S.G. 1.004
Conc - 4.32 deg.
Meas Time 00:00:19
```

```
02 20 20 53 61 6D 70 6C 65 20 4E 6F 2E 20 33 38 . Sample No. 38
0D 0A 20 20 20 20 44 61 74 65 20 39 32 2F 30 38 .. Date 92/08
2F 30 34 20 30 37 3A 32 33 0D 0A 20 20 20 20 54 /04 07:23.. T
65 6D 70 20 20 20 20 20 31 35 2E 30 20 43 0D 0A emp 15.0 C..
20 20 20 20 44 65 6E 73 20 20 20 20 31 2E 30 30 Dens 1.00
33 20 67 2F 63 6D 33 0D 0A 20 20 20 20 53 2E 47 3 g/cm3.. S.G
2E 20 20 20 20 31 2E 30 30 34 0D 0A 20 20 20 20 . 1.004..
43 6F 6E 63 20 20 20 2D 20 34 2E 33 32 20 20 64 Conc - 4.32 d
65 67 2E 0D 0A 20 20 20 20 4D 65 61 73 20 54 69 eg... Meas Ti
6D 65 20 30 30 3A 30 30 3A 31 39 0D 0A 0D 0A 04 me 00:00:19.....
```

(Data Number = 160)

5. Example of printout :

```
Sample No. 01
Date 92/08/01 12:00
Temp 15.0 C
Dens 1.003 g/cm3
S.G. 1.004
Conc 4.32 %
Meas Time 00:00:32
```

Conc is printed out when concentration calculation is on.

8-2. Selection of RS-232C baud rate

Select baud rate out of 300, 600, 1200, 2400, 4800, 9600.

1. Display Function menu by **FUNC** key and **△**, **▽** key.

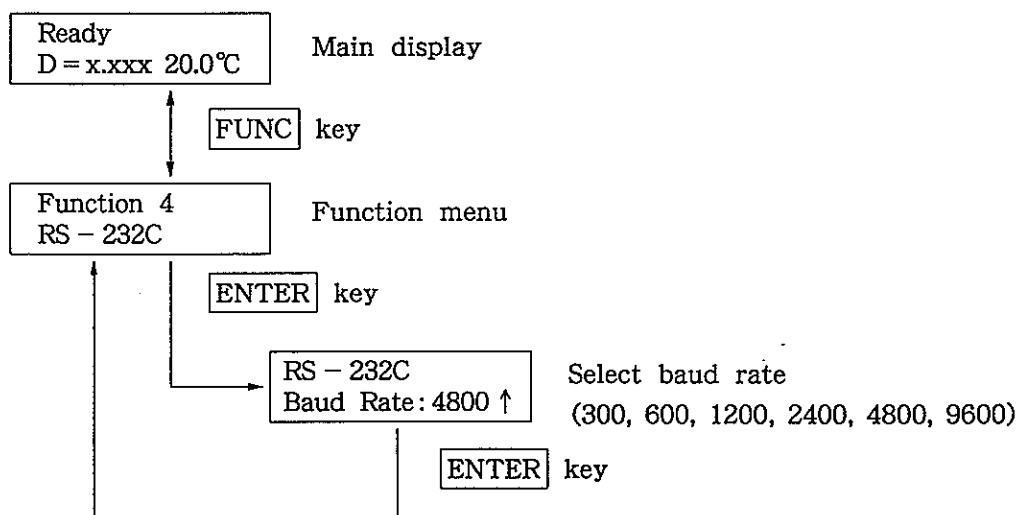
Function 4
RS - 232C Press **ENTER** key.

2. Select baud rate by **△**, **▽** key.

RS - 232C
Baud Rate: 4800 ↑ (300, 600, 1200, 2400, 4800, 9600)

Input by **ENTER** key.

【 Sequence of parameter of RS-232C baud rate 】



8 - 3. How to clear the sample number

Sample number will be output together with data of measurement result.

Sample number starts from 01 up to 99.

(number recycles from 99 to 01).

Sample number returns to 01 after it is cleared.

1. Display Function menu by **FUNC** key and **△**, **▽** key.

Function 0
Sample No.Clear

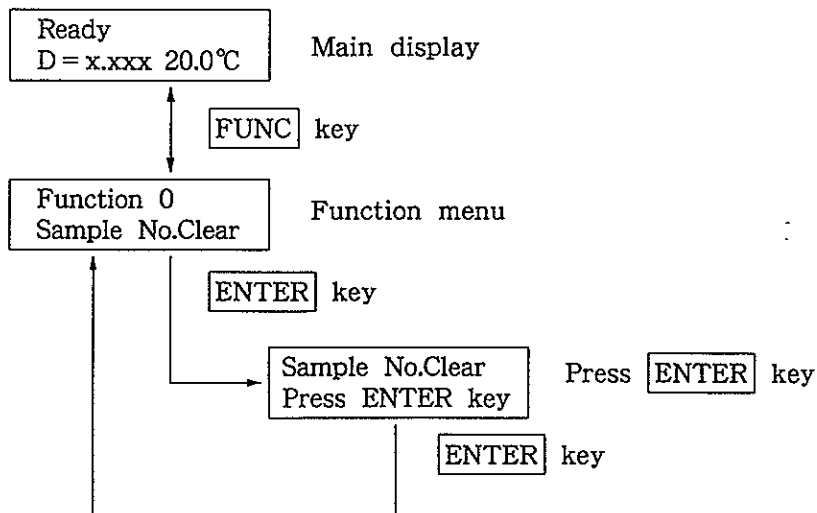
Press **ENTER** key.

Sample No.Clear
Press ENTER key

Screen display when **ENTER** key is pressed.

Press **ENTER** key again, and sample number will be cleared to 01 and screen display returns to Function menu.

【 Sequence of clearing sample number 】



8 - 4. Calendar function (date and time)

Date and time of measurement will be printed out when measurement result is output.

Current year, month, day and time can be set as follows :

1. Display Function menu by **FUNC** key and **△**, **▽** key.

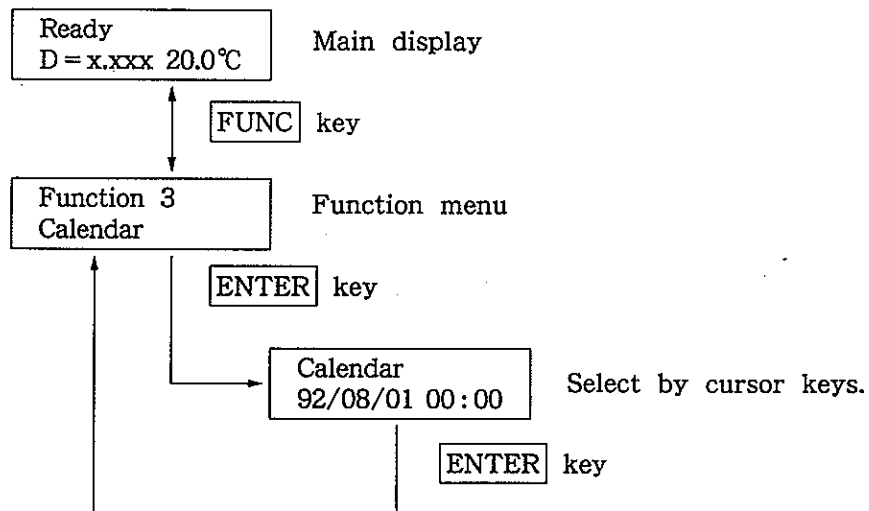
Function 3
Calendar Press **ENTER** key.

2. Select date and time by cursor keys.

Calendar
92/08/01 00:00

After date and time are selected, press **ENTER** key to input.

【 Sequence of calendar setting 】



8 – 5. How to select temperature dimension and pump

- Temperature unit °C or °F can be selected.
(temperature at the selected unit is printed out when measurement result is output).
- DA – 100 has a built – in air pump to purge the measuring cell.
This pump is called "Int" (internal) pump.

Optional sampling unit is available ("Ext" pump),
which can be controlled by DA – 100 through the cable
connected to the rear signal outlet.

Select "Int" pump when Sampling Unit is not used.

Select "Ext" pump when Sampling Unit is connected.

key can control either "Int" or "Ext" pump.

key cannot control both pumps at the same time.

1. Display Function menu by key and , key.

Press key.

2. Select temperature unit by , key.

(°C, °F)

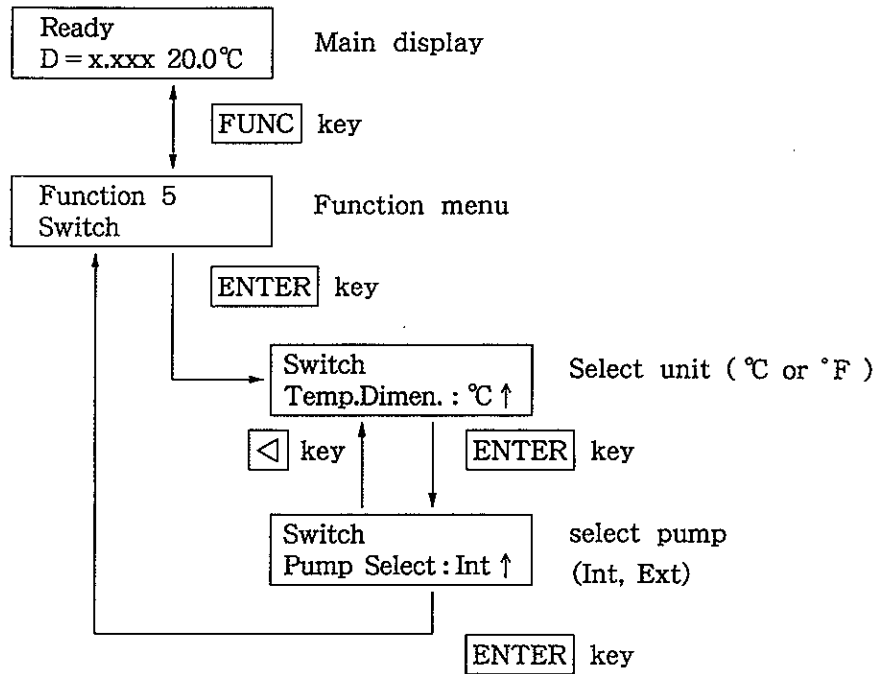
Input by key.

3. Screen display after temperature unit is selected and entered :

Select pump (Int. or Ext.)

Input by key.

【 Sequence of Switching parameter 】



8 - 6. How to control brightness of LCD screen

Brightness of LCD screen can be controlled.

(Brightness of the backup light is fixed).

Control range is from 0 to 100 by steps of 5 digits.

The screen darkens when higher number is selected.

1. Display Function menu by **FUNC** key and **△**, **▽** key.

Function 6
LCD Contrast

Press **ENTER** key.

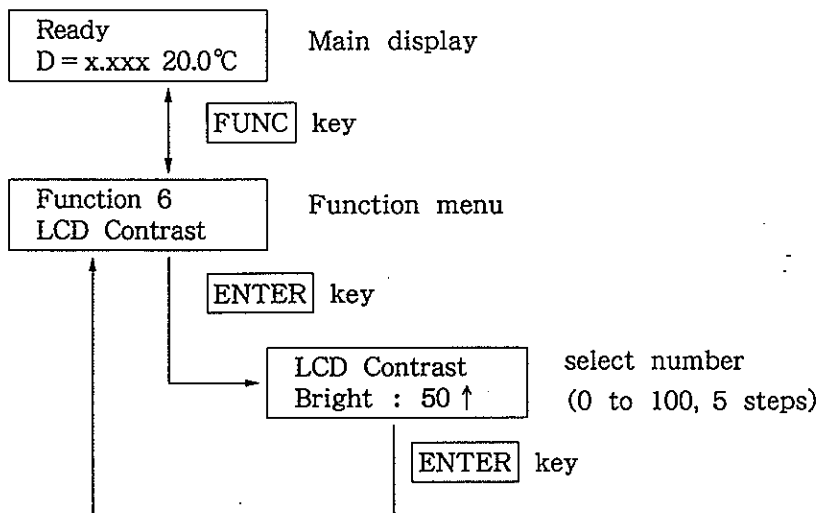
2. Select brightness number by **△**, **▽** key.

LCD Contrast
Bright : 50 ↑

(0 to 100 each 5 digits)

Input by **ENTER** key.

【 Sequence of parameter for changing brightness 】



8-7. Initial values of parameters and initialization

- All the parameters and cell factors are stored and will remain in memory of DA-100 even after power is turned off.

INITIAL VALUES OF EACH PARAMETER :

Item	Parameter	Contents	Initial value
Function 0	Sample No.	Sample number	01
Function 1	Temp.?	Temperature to select	20.0
	Limit?	Measuring time to limit	600
Function 2	Calculation :	Concentration calculation	off
	Dimen. :	Dimension of concentration	deg.
	Cal. mode :	Definition of D	Dens
	Replace :	Definition of X	$X \leftarrow 1/d - 1$
	A + BX A?	Coefficient of A	+ 0000.00
	A + BX B?	Coefficient of B	+ 1443.00
	Decimal (0 - 3) :	Number of place after decimal	1
Function 3	Calendar	Date and time	92/08/01 00:00
Function 4	Baud Rate :	Baud rate	4800
Function 5	Temp. Dimen. :	Temperature unit	°C
	Pump select :	Selection of air pump	Int
Function 6	Bright :	Control of screen contrast	50

【 INITIALIZATION OF ALL PARAMETERS 】

All the parameters including cell factors are initialized by this procedure.
Therefore, cell factor must be corrected after initialization.

1. Function menu by **FUNC** key and **△**, **▽** key.

**Function 7
Init.All Para.** Press **ENTER** key.

**Init.All Para.
Press ENTER key** Screen display

Input by pressing **ENTER**.

2. The screen goes to Main display by beep.
(parameters are not yet initialized at this step).

**Ready
D = x.xxx 20.0°C**

Screen goes to Main display.

Turn OFF power and then turn ON. All parameters will be initialized by this operation.

(note) If any key is pressed before power is OFF, parameters will not be initialized.

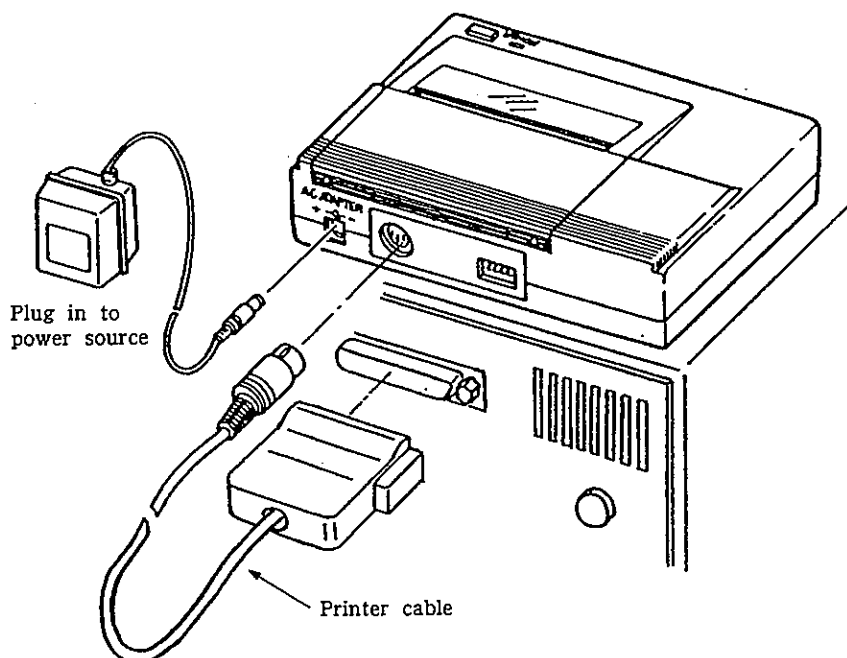
8 — 8. How to know version number of the instrument

Version number of the instrument appears on display when power is turned on, however, it can be displayed by key entry without turning power off.

Press **RESET** key while pressing **ENTER** key. The version number will be displayed for approximately 2 seconds.

9. HOW TO CONNECT A PRINTER (optional)

1. Connect the printer cable to RS - 232C port on the rear panel of DA - 100.
Connect the AC Adaptor to the printer.



2. Select 4800 baud rate on DA - 100.
(Baud rate of Printer is set to 4800 in plant before shipment).

If baud rate of Printer needs to be changed, see the Instruction Manual of the printer.
A printer will not work unless the same baud rate is selected.

3. Turn on power of the printer

(note) Turn on power of DA - 100 first, and then turn on the printer.

If power for Printer is turned on before DA - 100, the first character may be printed out in wrong position on the printing roll.

4. Measurement results will be printed out automatically after measurement initiated by MEAS key is completed.

10. TROUBLESHOOTING

10 – 1. Error messages and remedies

If erroneous key entry is made, an error message will appear on display with beep.

Message	Contents	Remadies
Busy !	Inhibited key entry. For example, temperature change is attempted during metering or calibrating.	Enter after measurement or calibration is finished.
Temp Not Stable	Metering or calibration is attempted before temperature is stable.	Wait until "Please wait" message turns to "Ready".
Please Calibrate	Masurement is attempted without calibration.	Correct the cell factor first.
Calib. NG	Cell factor was not measured correctly.	Correct cell factor according to 5 – 4. Instruction

10 – 2. Error numbers and remedies

If an electrical malfunction occurs, alarm beep sounds continuously and the appropriate error code is displayed.

↓ A number is displayed here.

■ Ready
D = x.xxx 20.0°C

Error No.	Trouble	Remedies
0, 1	Thermistor Resistor for calibration is broken.	Turn off power and contact your local dealer.
2, 3, 4	Thermistor is broken.	Turn off power and contact your local dealer.
5	Measuring cell is defective or cable is broken.	Turn off power and contact your local dealer.
6	Temperature is not stable in an hour.	Temperature range of DA – 100 is 5°C to 35°C If temperature is within the range, turn off power and contact your local dealer.
7	Backup battery runs down.	Turn off power and contact your local dealer.

11. MAINTENANCE

1. Replacement of silica gel in the desiccator

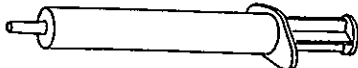






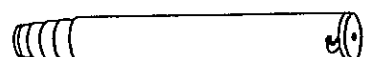

When half of the silica gel becomes reddish, replace all of it with fresh material.

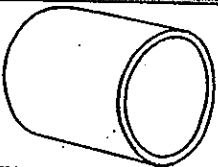
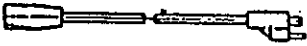
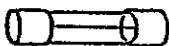
2. Be sure to clean and dry the measuring cell before power is turned off after the days' routine.

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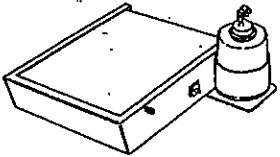
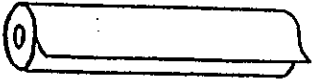

12. PARTS LIST

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Part code	Part name	Number	Remark	Sketch
#500-6411S	Sampling syringe (10 pcs 1 set)	1 set	2ml polyethylene	
#550-6564	Tube nozzle A - 2	1 pce		
#552-6469	Tube joint A	1 pce		
#552-6470	Tube joint	1 pce		
#444-6540	Sample In/Out tube joint	1 set	1 set includes: #550-6564 #552-6469 #552-6470	
#521-6413S	Sampling/drain tube (2 pcs)	1 set	BT tube 250mm	
#434-6815	Desiccator tube	1 pce	with a joint	
#433-3116	Desiccator	1 pce		
#820-3269	Silica gel	1 pce	500g	

Part code	Part name	Number	Remark	Sketch
#550-6561	Protective tube	1 pce		
#320-3198	Power code AC 100V/120V	1 pce		
#320-3438	Power code AC 220V/240V			
#338-3240S	Tube fuse (5 pcs)	1 set	T2.5A/250V (Time-lag Type)	

Optional units

Part code	Part name	Remark	Sketch
DP-500-01	Thermal Printer	with AC Adapter and cable	
ASU-100	Sampling unit	with a drain pot	
#820-6611S	Printing roll (10 roll/set)	for DP-500-01 1 set	
#032-5305	RS-232C cable	for Personal Computer 1 pce	

13. SPECIFICATIONS

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Measuring method	Resonant frequency
Measurement range	0 to 3 g/cm ³
Measuring accuracy	± 0.001 g/cm ³
Measurement temperature range	15°C to 40°C (0.1°C step) 59°F to 104°F (1°F step)
Temperature accuracy	± 0.5°C
Temperature control precision	± 0.1°C
Measurement time	30 sec to 4 min
Minimum sample required	1 ml (manual sampling by syringe)
Display function	16 characters 2 lines Liquid crystal display
	Display contents :
	(1) density, specific gravity x.xxxx
	(2) selected temperature xx.x°C or xxx °F
	(3) concentration value x.xxxx to xxxxxx Number of places after decimal changeable 0 to 3
Sampling	Manual by syringe (Sampling unit is optional)
Equilibrium detection	Built - in microprocessor
Calibration method	By dry air and degassed pure water
External output	RS - 232C (1 channel)
Printer	Optional (via RS - 232C)
Ambient condition	5°C to 35°C below 85%RH
Outside dimensions	275 (W) × 350 (D) × 165 (H) mm
Power	Voltage adjusted in plant.(AC100 - 120V or AC200 - 240V) 50 or 60 Hz
Power consumption	30 Watts
Weight	6 Kg

15. DA – 100 Q & A

Q 1. Tell me what is Density and what is Specific (or Relative) Gravity?

【Density】 : Density is the mass of a material per unit cubic volume.

It is specified by g/cm^3 , kg/m^3 or other combination of unit.

DA – 100 reads and displays by g/cm^3 .

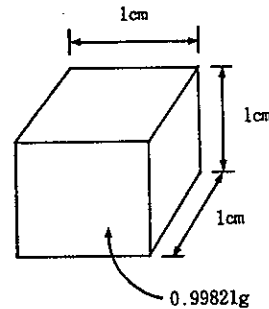
【Specific Gravity】 :

Specific (or Relative) gravity is the ratio of density of a material against the density of water.

There is no unit.

Relative gravity by DA – 100 is the ratio against the density of water at the selected temperature.

Density



Density of water at
20 °C is : $0.99821 \text{ g}/\text{cm}^3$

15

Specific Gravity

If density of a sample is $d_s \text{ g}/\text{cm}^3$ at 20°C, relative gravity = $d_s / \text{density of water at } 20^\circ\text{C}$.

Q 2. Tell me how to convert temperature by °C (degree Centigrade) to °F (degree Fahrenheit).

The relation between °C and °F is :

$$^\circ\text{C} \times 9/5 + 32 = ^\circ\text{F}$$

For example, 20°C is 68°F as follows :

$$20 \times 9/5 + 32 = 68$$

Q 3. When temperature changes, will density change?

Density will change because the volume of a material changes (expand or shrink) with temperature changes.

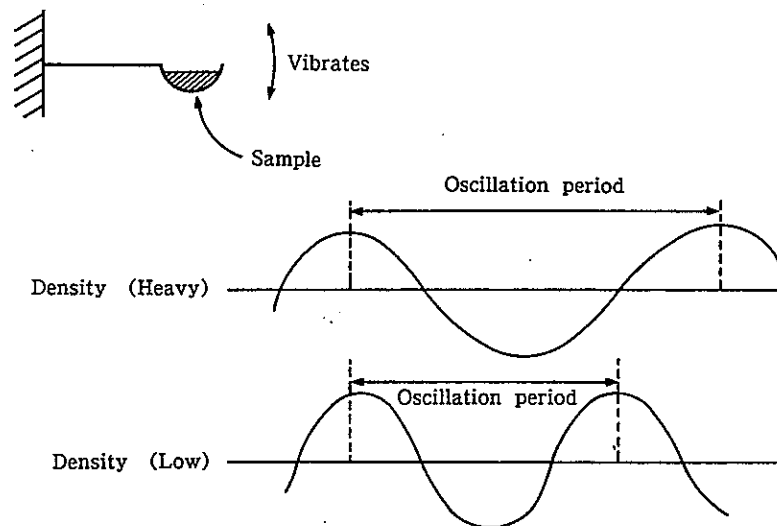
Generally, when temperature goes up, density will become smaller and when temperature goes down, density will become larger.

Therefore, control of temperature is very important.

DA – 100 has a built – in thermostat to control temperature of the measuring cell to make density metering accurate.

Q 4. Please explain briefly the measuring principle of density by DA – 100 and how to correct the measuring cell factor.
 When a measuring cell is filled with a liquid or gas, its natural vibration period varies depending on the density of a sample.

【 Graphic form of measuring cell 】



It is known that there is the following relation between vibrating period T and density d :

$$d = A \times T^2 + B$$

A and B are Constant determined by mass, structure and temperature of the cell.

Before density of a sample is measured using the above equation, Constant A and B must be obtained.

This process is called "Factor calibration of measuring cell".

Constant A and B can be easily obtained by using air and water whose densities are known.

Constant A and B change with temperature. Therefore, when the selected temperature is changed, Cell factor needs to be corrected.

To perform factor calibration, just follow the message for factor correction on display screen of DA – 100.

Constant A and B will be obtained automatically by DA – 100 which calculates the factor.

Q 5. How often is cell factor corrected?

1. When the set temperature is changed, the cell factor must be recalibrated after the selected temperature is stable.
2. Even if the temperature is not changed, cell factor must be checked when stability is reached after power is turned on.
3. To secure accurate measurement, factor checking is recommended at intervals.

Q 6. Please tell me about cautions when a highly volatile sample is going to be measured.

Density of volatile sample changes with time.

- Do not keep such sample in a container like beaker.

Such sample needs to be stored in an Erlenmyer flask with stopper.

Q 7. What will happen if a sample contains impurity material or dust?

Accurate measurement cannot be expected if there exists impurity or dust which will influence the density.

Please clean the sample if such materials can be removed by filter.

Q 8. Can density be measured if air bubbles are mixed in a sample?

Correct measurement cannot be performed if air bubbles are blended into the sampling cell.

Avoid air bubbles when sampling into the cell. Sample slowly.

Q 9. Printer does not print out. How is it fixed?

1. Is the power of Printer in ON position?
2. Is a printing roll set in the printer?
3. Is the connecting cable securely plugged in?
4. Is Baud rate of DA - 100 and Printer of the same rate?
5. Is Printer provided as below?

Start bit	1 bit
Data length	8 bit
Stop bit	1 bit
Parity	No parity

Q 10. What other optional peripherals available?

1. Thermal printer (DP-500-01)
2. Sampling unit (ASU-100)
3. Cable for Personal computer (#032-5305)

Printer and P. computer cannot be connected at the same time.
Measurement results can be transferred to Personal computer for data processing through RS-232C cable of the above 3.
Sampling unit enables sampling without syringe by only key touch on DA-100.