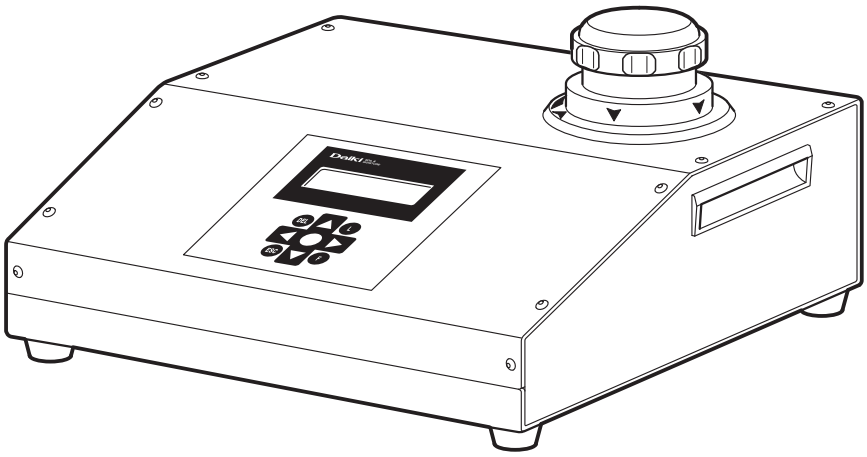
Daiki SOIL & MOISTURE

Digital Actual Volumenometer

MODEL :

DIK-1150

Instruction Manual



Be sure to read this manual before using the equipment.
After reading the manual, keep it handy so that you can refer to it whenever necessary.

Daiki Rika Kogyo Co., Ltd.

Website : https://www.daiki.co.jp/

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Introduction

Thank you for purchasing the DIK-1150 Digital Actual Volumenometer. Please read this instruction manual thoroughly in order to use this equipment correctly and obtain full performance from it. After reading this manual, keep it handy for future reference.

Notes on This Manual

■ Read and understand this manual thoroughly before using the product.

■ Keep this manual handy so that you can refer to it whenever necessary.

■ Observe the correct, intended usage of this product and the operation method specified in this manual.

■ Observe the safety instructions described in this manual.

■ The contents of this manual may change without prior notice in order to improve the performance and functions of the product.

■ If this manual is lost, contact your local dealer or the store from which the product was purchased.

■ This manual has been written with the utmost care, but if you find any unclear items, errors or omissions, please contact your local dealer.

⚠ Safety Precautions

Be sure to observe the following instructions.

■ Before using this product, always check each component for damage or other problems. Never use the product if there is any problem.
■ Please be sure to use an AC100V 10A or above outlet or DC12V battery for the power supply.
■ Never modify this product.

■ NOTICE ■

⚠ DANGER

Failure to observe will result in severe personal injury or death.

⚠ WARNING

Failure to observe could result in severe personal injury or death.

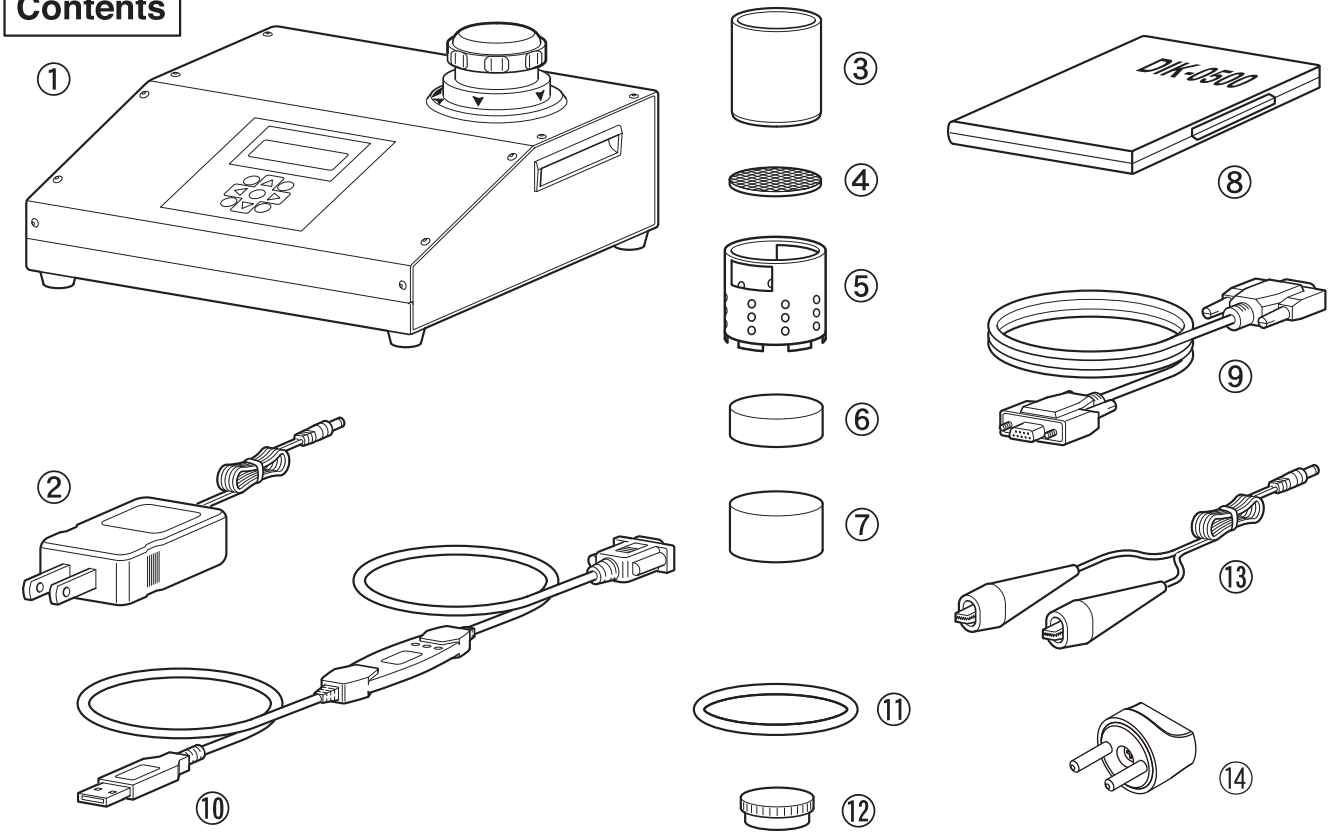
⚠ CAUTION

Failure to observe could result in personal injury, or product or property damage.

Inspection on Receiving

After unpacking, make sure that everything shown in the figure below is included in the package.

Contents



Model No.	Description	Qty	Item No.	Check
DIK-1150	Digital Actual Volumenometer	1 set		
	(Breakdown)			
DIK-1150-11	Digital actual volumenometer	1	①	
1150-14	AC adapter	1	②	
1801-03	Stainless sampling tube - 100 ml	1	③	
DIK-4001-19	Mesh plate	1	④	
1121-15	Sampling tube holder	1	⑤	
1150-16	Test piece 30ml by SUS	1	⑥	
1150-06	Test piece 50ml by SUS	1	⑦	
DIK-0500-14	Daiki Download Software (*)	1	⑧	
1150-08	Data communication cable (*)	1	⑨	
1150-09	Serial/USB conversion cable (*)	1	⑩	
1150-10	Spare O-ring for sampling chamber	1	⑪	
1150-11	Silicon grease	1	⑫	
1150-07	DC Cable	1	⑬	
1150-12	Rubber mat	1		
YBD00993	Conversion adapter	1	⑭	
DIK-1150-12	Storage case (For Digital Actual Volumenometer) (*)	1		
	Easy Measurement Procedure	1		
	Instruction Manual	1		

Note: The components marked with an asterisk (*) are not provided for customers who purchase only the main unit of the Digital Actual Volumenometer. They must be purchased separately if necessary.

Specifications

Digital Actual Volumenometer	
Dimensions	Approx. 350 W x 300 D x 180 H mm
Weight	Approx. 7 kg
Power source	100VAC or 12VDC (Maximum 1A)
Measurement range	Volume of measurement sample: 0 to 100 ml
Measurement precision	±1.0% of FS (±1 ml) at 25℃ (*2)
Reproducibility	±0.50% of FS (±0.5 ml) at 25℃ (*2)
Operating temp. range	5 to 40℃
Operating humidity range	0 to 90% RH (no condensation)
Memory capacity	Maximum 1000 data items
Display panel	LCD: 20 columns x 4 lines
Internal protection	Dust-proof structure
Serial communication	8-pin connector and serial communication port Baud rate: 19200 bps
Accessories	AC adapter / DC-use cable (one of each) Stainless steel sampling tube - 100 ml (×1) Sampling tube holder (×1) Mesh plate (×1) Test piece 30ml by SUS (×1) Test piece 50ml by SUS (×1) Spare O-ring for sampling chamber (×1) Rubber mat (×1) Silicon grease (×1)

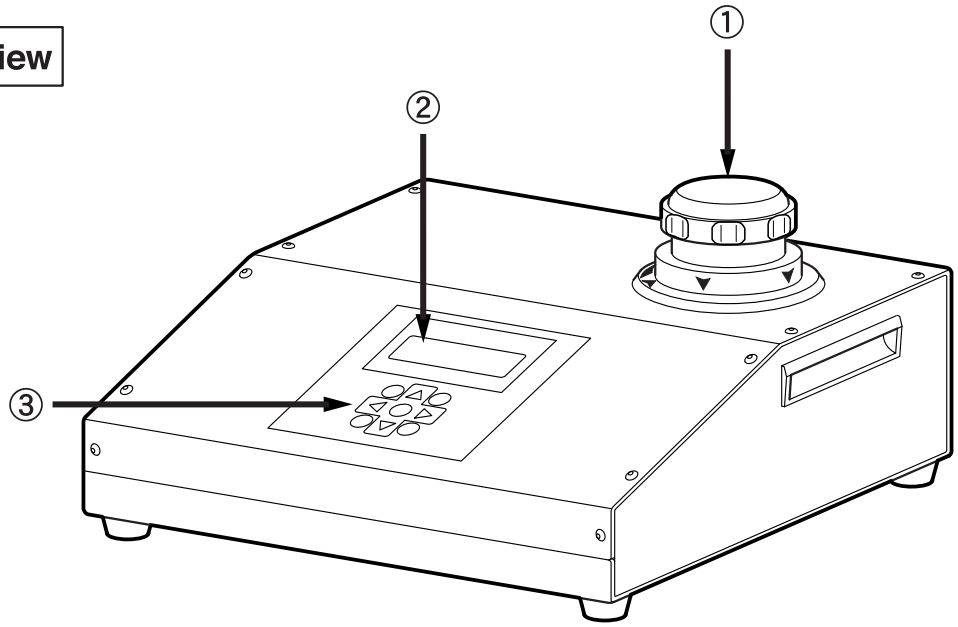
Daiki Download Software (*1)	
Functions	1. Display details of the measured data
	2. Data storage folder specification
	3. Set, display or delete linked files
	4. Display and print graphs of measured data
	5. Download data from the measuring device
	6. Save/read as a CSV file
	7. Electronic balance data acquisition (only machines configured by this company)
Supported operating system	Microsoft Windows 7/Vista/XP Internet Explorer 6 or higher
Operating environment	Intel Pentium III 600 MHz or higher (1 GHz or higher recommended) Memory: 256 MB or more (512 MB or higher recommended) Monitor: 1024 768 pixels, True Color 24-bit or higher recommended

*1: These components are not provided for customers who purchase only the main unit of the Digital Actual Volumenometer. They must be purchased separately if necessary.

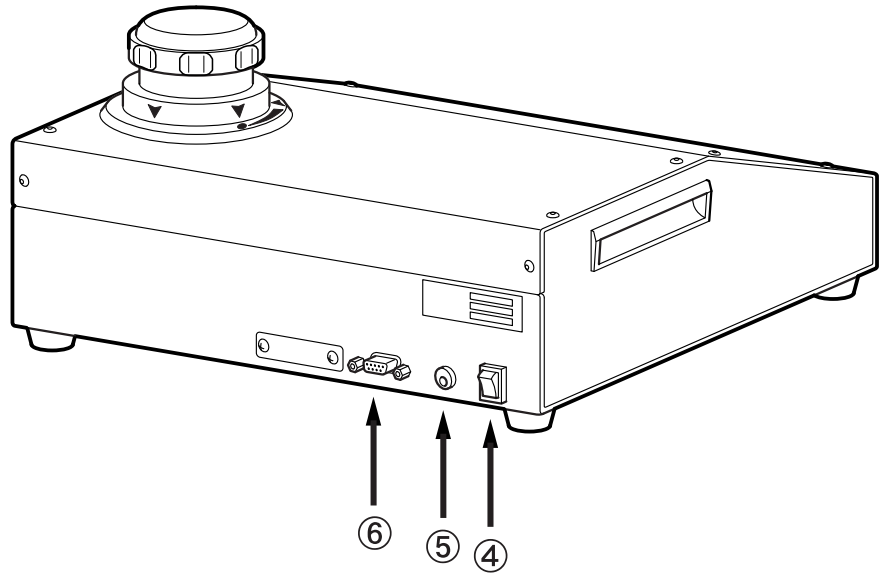
*2: This data can be obtained by measuring the same test piece five times after calibration has been performed using the test piece.

Configuration Diagram

Front view



Rear view



① Sample chamber
Stores the measurement sample.

② Display panel
Displays settings and measured values.

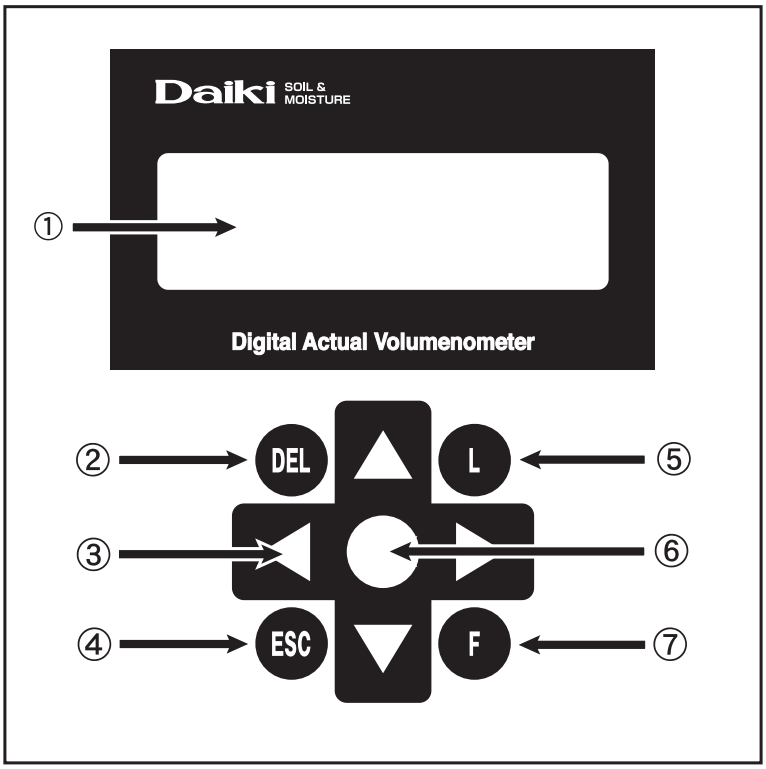
③ Operation panel
Operates the main unit.

④ Power switch
Turns the power on or off.

⑤ Power connector
Connect with the AC adapter or DC-use cable.

⑥ Data connector
Connects the data communication cable.

Display Panel



① LCD panel
Displays the settings and measured values.

② "Delete" key
Used for deleting data and for other purposes.

③ "Up/Down/Right/Left" key
Each of the "△" symbols signifies respective cursor movements.

④ "Escape" key
Returns to the previous screen.

⑤ "Light" key
Lights the backlight for approximately five seconds.

⑥ "Set" key
Use the "◯" key in the center to apply the settings.

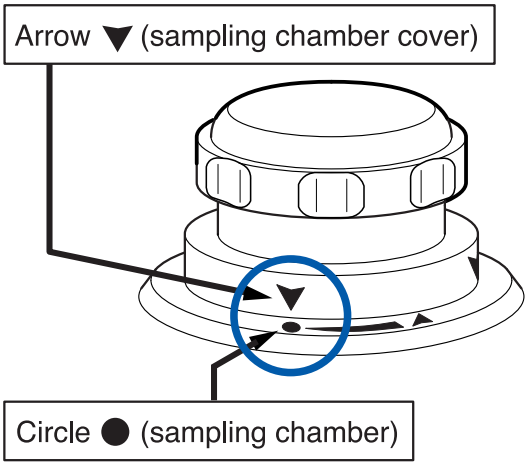
⑦ "Function" key
Not used.

Note: A thin protective sheet is affixed to the surface of the display panel before shipping – remove it before using this device.

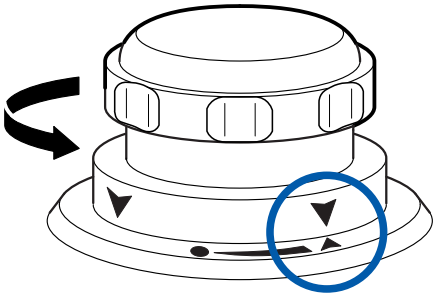
⚠ CAUTION

Always press the key gently and properly.
Pressing the key with a pointed object (such as a fingernail or the tip of a pen) may damage the key sheet.
Always press the key with the tip of a finger.

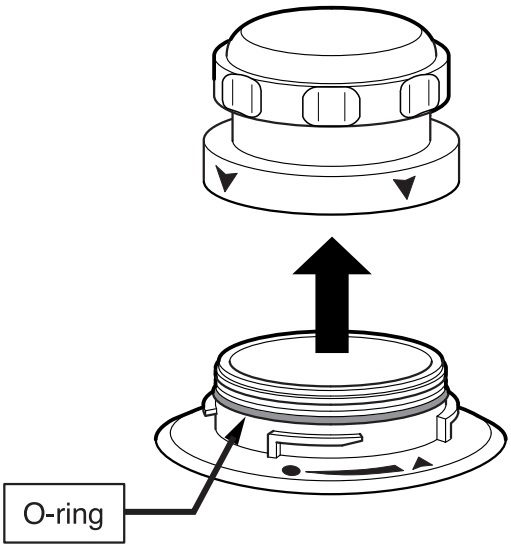
How to Open the Sampling Chamber Cover



1. Confirm the position of the arrow ▼ on the sampling chamber cover, and the circle ● on the sampling chamber.



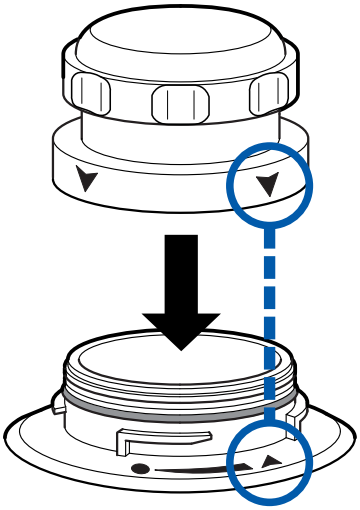
2. Turn the sampling chamber cover counterclockwise, such that the arrow ▼ on the sampling chamber cover is lined up with the arrow ▲ on the sampling chamber itself.



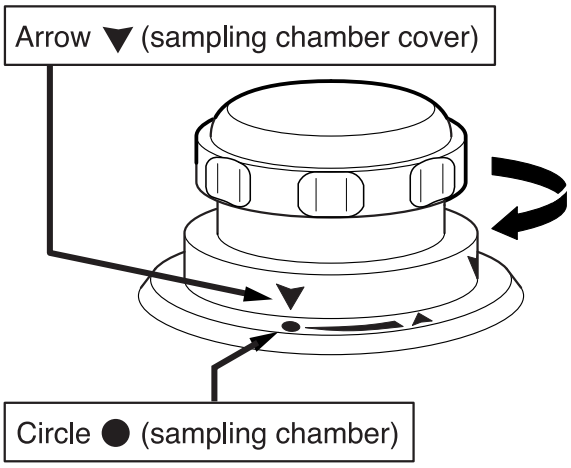
3. Lift the cover off the sampling chamber.

- Because the sampling chamber is tightly sealed up with the cover, the cover may feel tight.
- If the cover is tight, apply the silicon grease provided onto the O-ring before opening or closing the cover.
- Soil easily adheres to the O-ring during measurement. So, after measurement is complete, always clean the O-ring properly and apply silicon grease to it.

How to Close the Sampling Chamber Cover



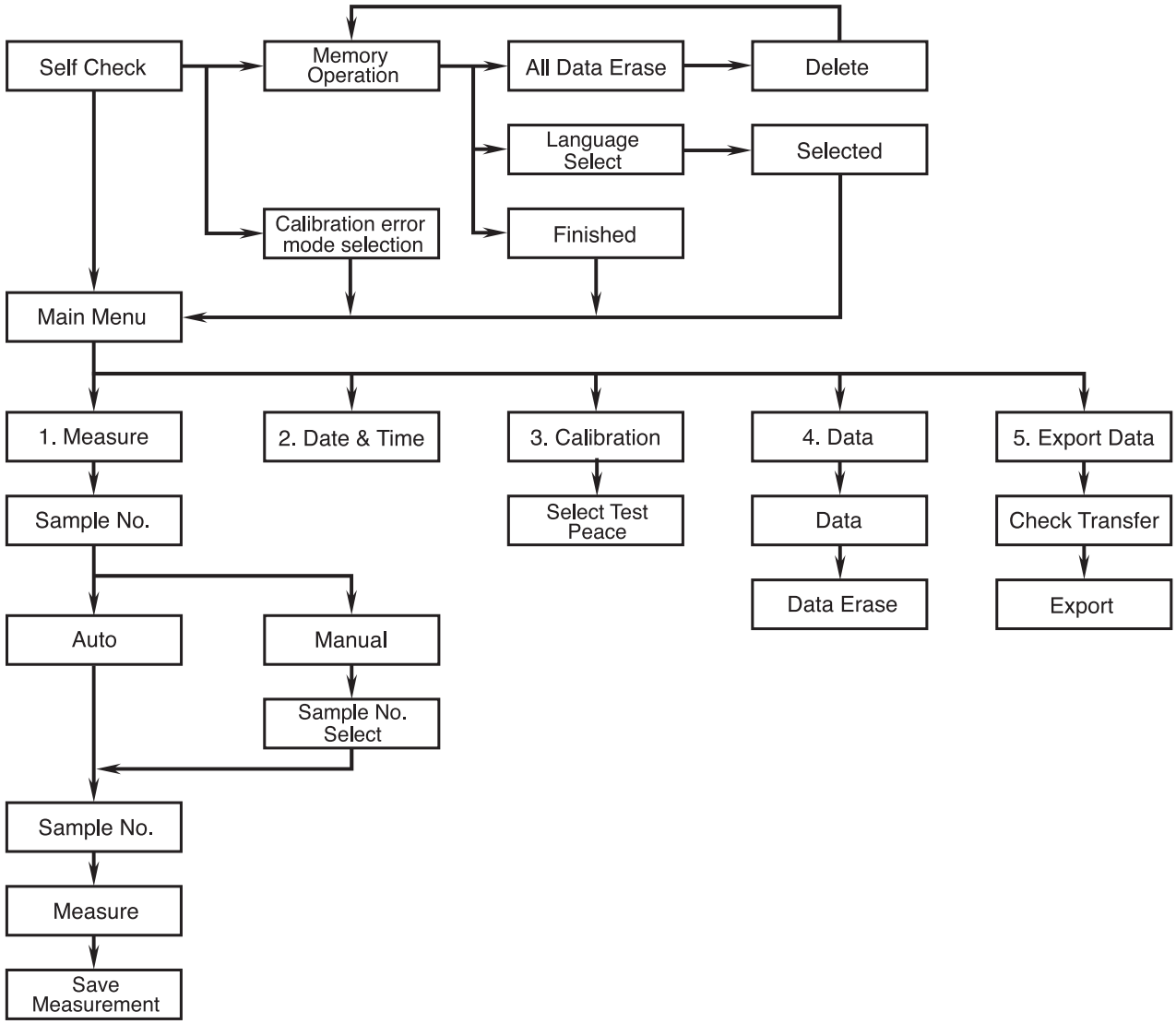
1. Line the arrow ▼ on the sampling chamber cover up with the arrow ▲ on the sampling chamber, and push the cover in.



2. Rotate the cover clockwise until it is tight.

• When conducting measurement or calibration, close the sampling chamber cover firmly. Otherwise, a measurement error may result.

Menu structure



A Note on This Instruction Manual

The Digital Actual Volumenometer displays the version information of this device approximately three seconds after the power switch is turned on, and then "Main Menu" remains displayed. In this state, pressing the Up or Down arrow key displays the screen which shows one of the following strings: "Measure", "Date & Time", "Calibration", "Data", or "Export Data". In this manual, the above screen is referred to as the "**menu**".

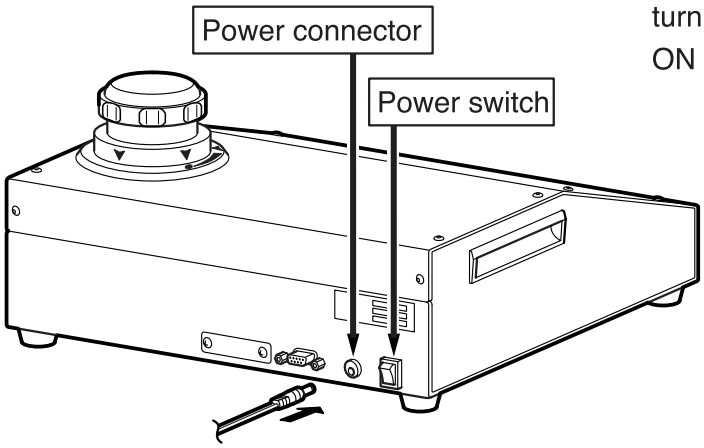
Attention

This manual describes how to use the DIK-1150 Digital Actual Volumenometer. For information about data communications from the Digital Actual Volumenometer to the computer and data analysis using the Daiki Download Software, refer to the DIK-0500-14 Daiki Download Software Operation Manual.

Chapter 1 Initial Setup for the Main Unit

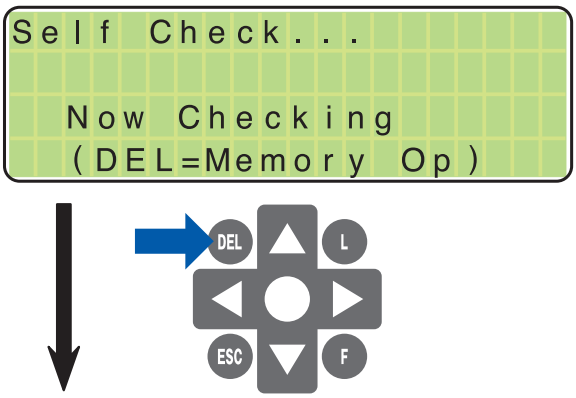
The initial setup for the main unit is completed before shipping. After connecting the power supply to the main unit, proceed to Chapter 2. Refer to Chapter 1 only if you need to delete measurement data, set the language, Calibration error mode selection, or adjust the clock.

1. Connecting the Power Supply to the Main Unit

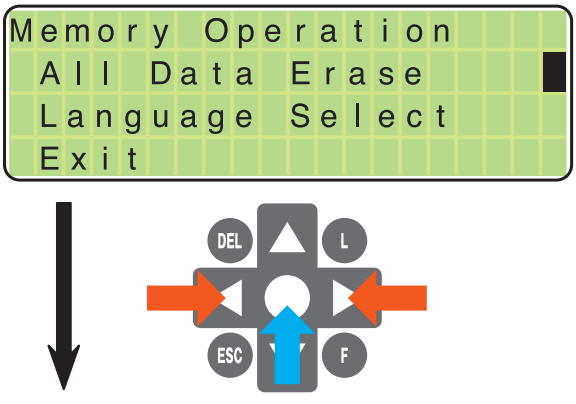


1. Connect the AC adapter or DC-use cable to the power connector at the rear of the unit and connect to an AC outlet or DC12V battery. After connecting, turn the power switch at the rear of the unit to the ON position. The unit will then be powered up.

2. Memory Operation during Startup

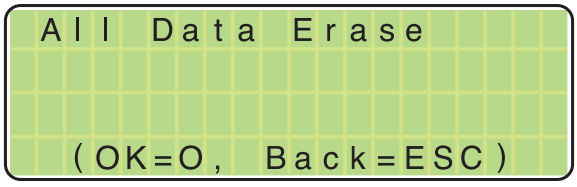


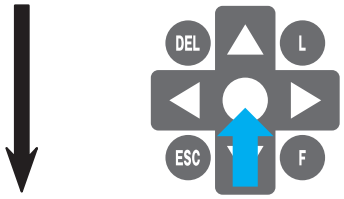
1. When the power is turned on, the startup screen will be displayed for approximately three seconds. Then, press the DEL key (➡) to move to the memory operation screen.



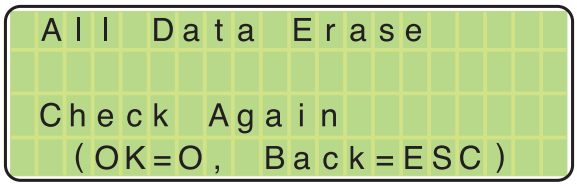
2. Use the Right or Left arrow key (➡⬅) to select the appropriate memory operation, and then press the Set key (⬆).

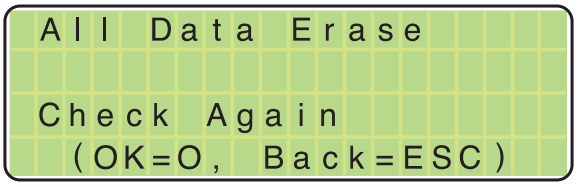
2-1 Deleting all Data from the Main Unit

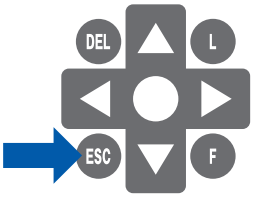




1. All data can be deleted from the main unit. When you attempt to delete data, a deletion confirmation screen appears twice. Press the Set key (⬆) each time the confirmation screen appears.



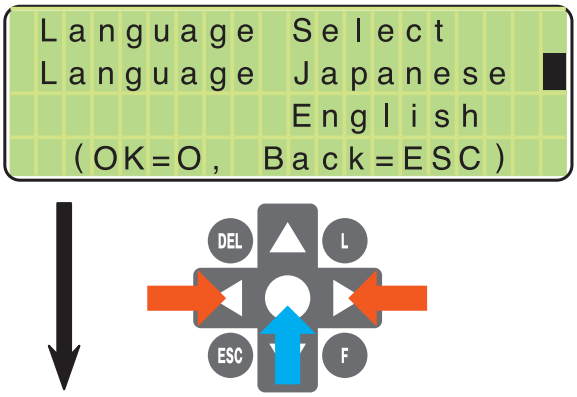




2. Press the ESC key (➡) to return to the memory operation menu without deleting data.

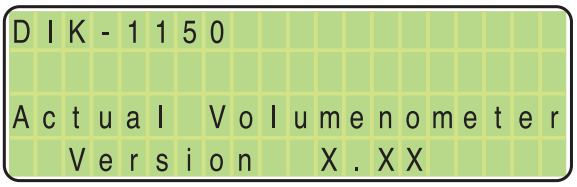
2-2 Setting the Language

The language displayed on the display panel can be switched between Japanese and English



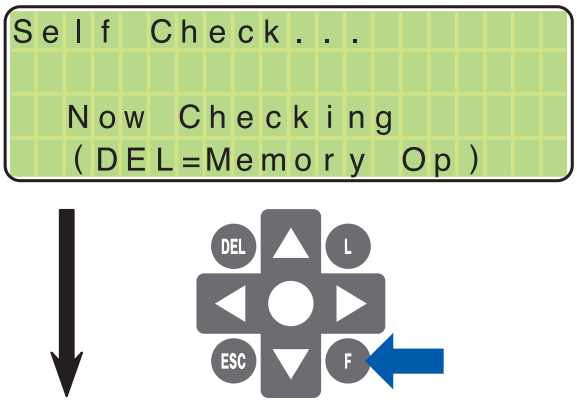
1. Use the Right or Left arrow key (➡⬅) to select the appropriate language, and then press the Set key (⬆) to apply the setting.

2-3 Finishing the Memory Operation

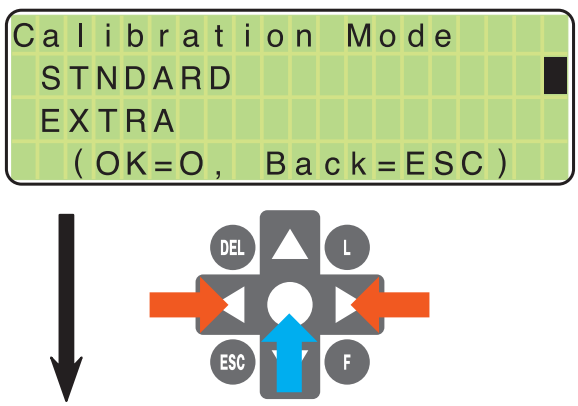


1. After "Actual Volumenometer" or the language has been selected, the screen automatically displays the model and switches to the menu.

3. Calibration error mode selection



1. After powering up, the startup screen will be displayed for approximately three seconds. Pressing the F key ⬅ will transfer you to the Calibration Mode Selection Screen.

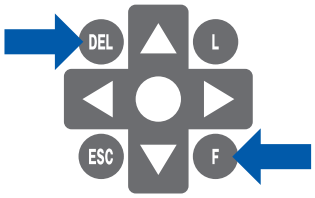


2. You can select the calibration mode using the Left and Right arrow keys ➡⬅ . Press the Set key ⬆ to confirm your selection.
   * STANDARD: Calibration error
     EXTRA: No calibration error

3. Pressing the Set key ⬆ will automatically display the model and transfer you to the Menu Screen.

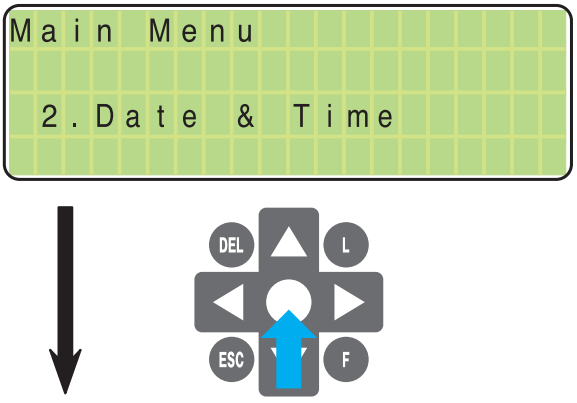
* Please refer to "Chapter 2. Measurement procedure: 1. Calibration error modes" for details concerning the calibration error modes

⚠ CAUTION

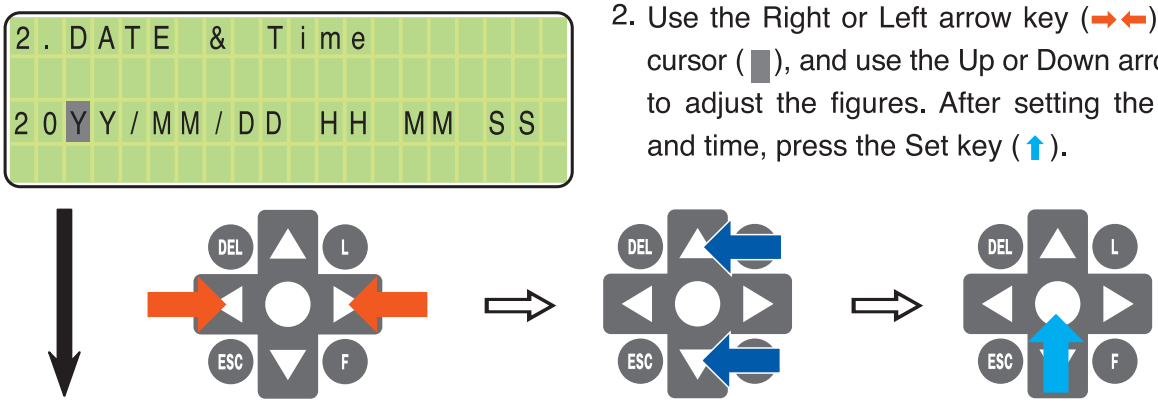


Pressing the F key ⬅ or the Del key ➡ during power up will transfer you to the "Calibration Error Mode Selection" or "Memory Operation" screens respectively.
Accordingly, if carrying out both "calibration error mode selection" and "memory operation", you should complete one operation first, turn of the unit and then power up the unit once again to complete the other operation.

4. Setting the Clock



1. Next, set up the clock.
Select "2. Date & Time" from the menu.
Press the Set key (⬆) and go to the next step.



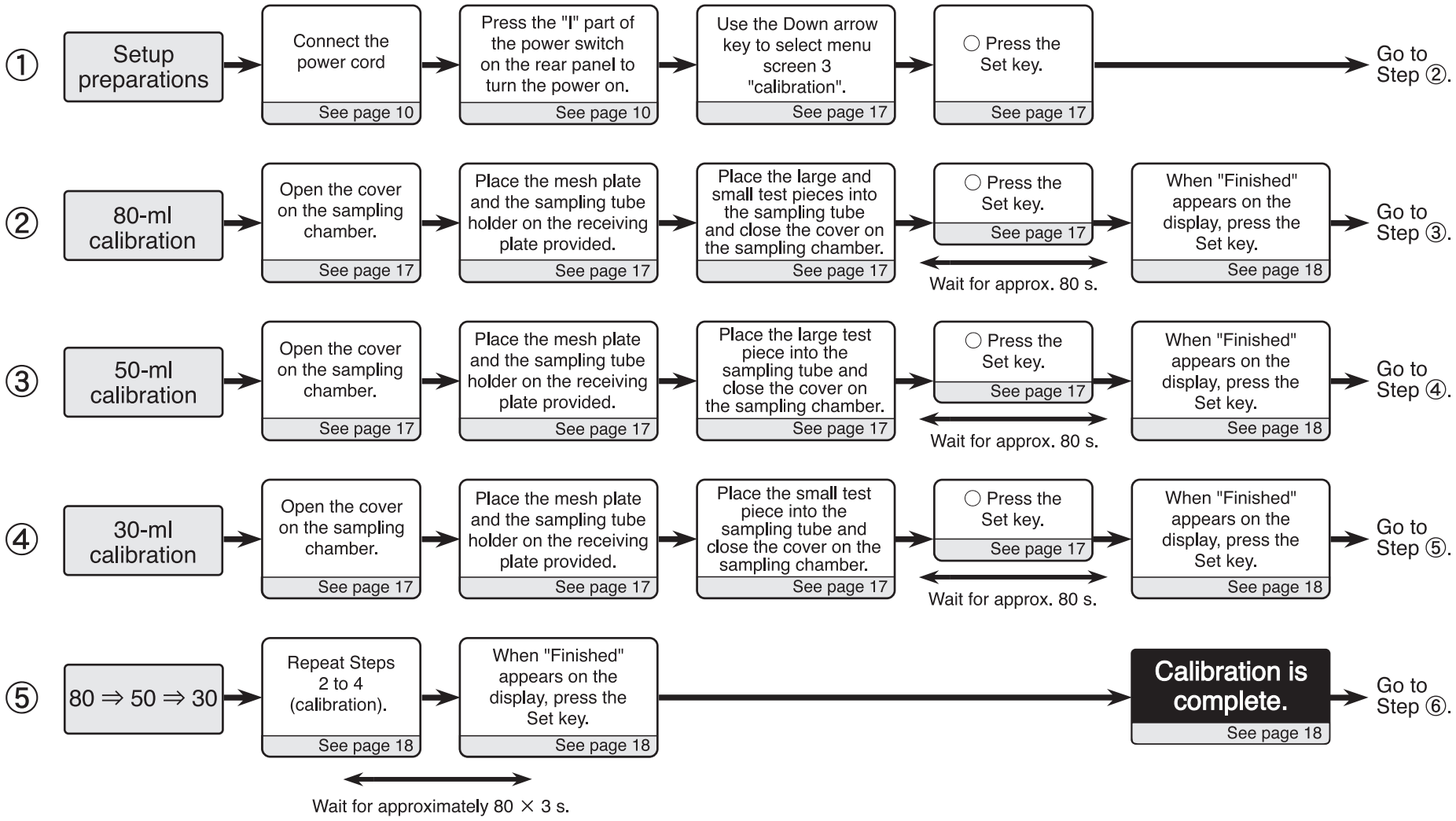
2. Use the Right or Left arrow key (➡⬅) to move the cursor (▮), and use the Up or Down arrow key (⬅⬅) to adjust the figures. After setting the correct date and time, press the Set key (⬆).

• The clock must be set in the format "20YY/MM/DD HH:MM:SS".

The detailed measurement procedure is described on the following pages.

● Calibration is required every time the main unit is turned on ●

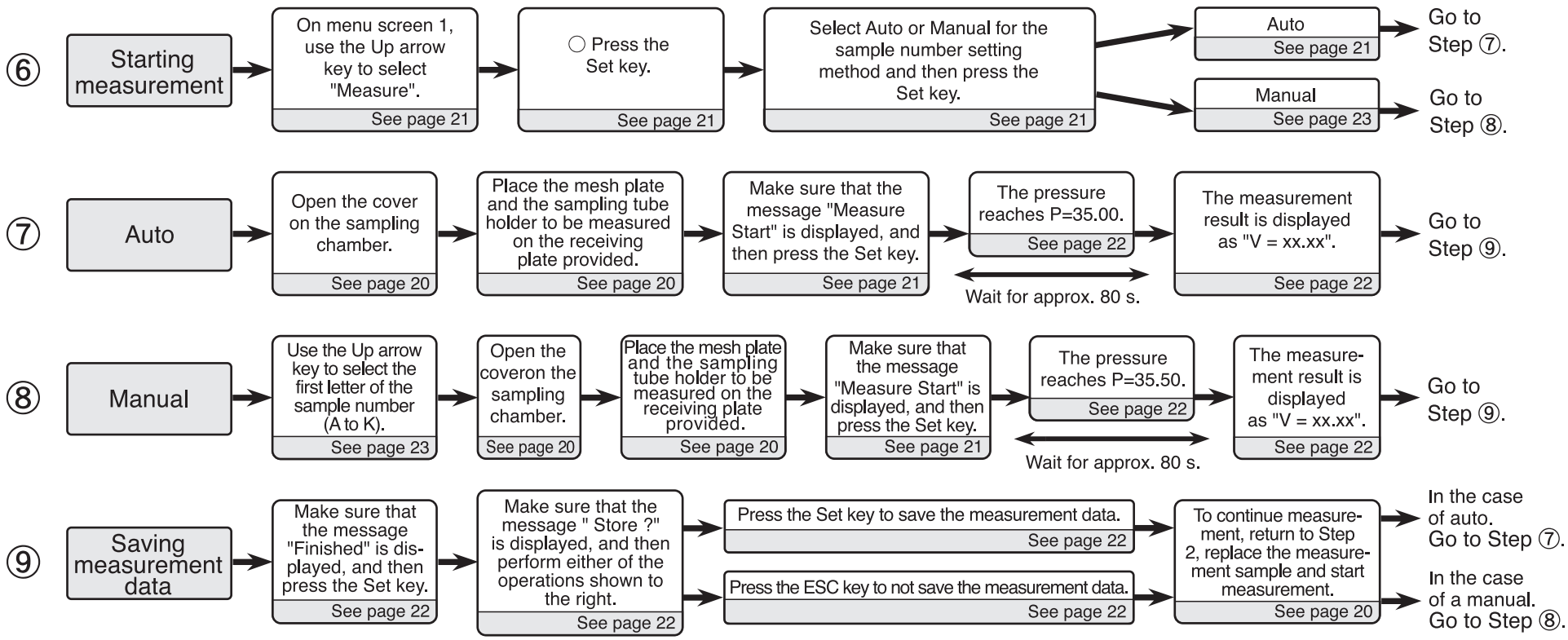
Easy measurement procedure (From Setup preparations to Calibration is complete)



The detailed measurement procedure is described on the following pages.

● The usual measurement ●

Easy measurement procedure (From Starting measurement to Saving measurement)



After the measurement is all complete, remove the sample and press the "O" part of the power switch to turn the power off.

1. Calibration error mode

1-1. STANDARD mode and EXTRA mode selection

In STANDARD mode, the Error Screen may be displayed at high altitudes, etc. where there are atmospheric pressure fluctuations even when calibration has been carried out with test pieces of the correct volume.

In this case, it is possible to complete calibration by switching to the EXTRA mode where the error screen is not displayed. EXTRA mode can be used at altitudes of up to approximately 1,000m*.

* However, there are cases where calibration may not be possible even at altitudes below 1,000m due to atmospheric pressure fluctuations.

1-2. STANDARD mode

The Error Screen will be displayed if a test piece of a differing volume is entered during calibration.

1-3. EXTRA mode

The Error Screen will be not be displayed even if a test piece of a differing volume is entered during calibration. While the Error Screen will be not be displayed, calibration with test pieces of the correct volume will be deemed to have been carried out and calibration will be completed normally. However, accurate measurement will not be possible if calibration has been completed with a test piece of a differing volume.

Confirmation method

In order to confirm whether calibration has been carried out correctly, please perform measurements of test pieces with volumes of 80ml, 50ml and 30ml. If each test piece is measured with values within the accuracy range, calibration has been completed with the correct test pieces.

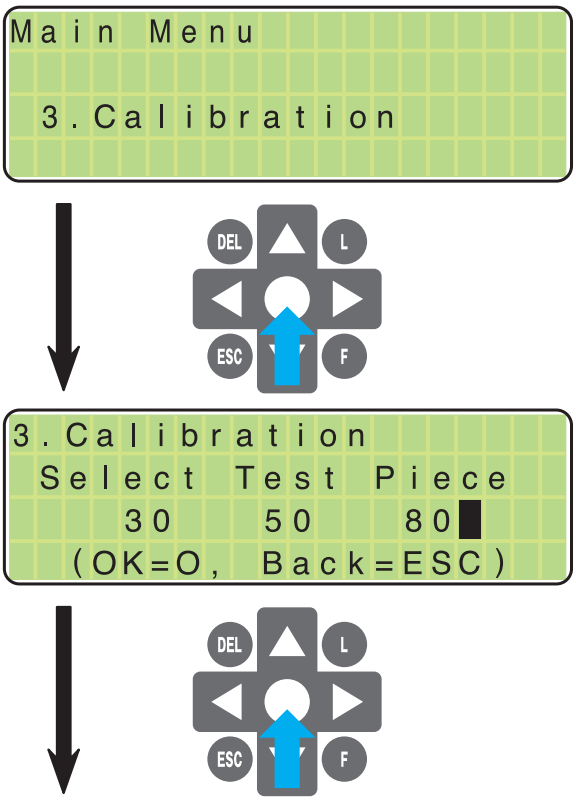
If the measurement value of one of the test pieces with a volume of 80ml, 50ml or 30ml is outside the accuracy range, it is possible that calibration has been completed with a test piece of a differing volume. In this case, please carry out re-calibration.

Test piece (ml)	Measurement value	
	If calibration has been completed correctly	If calibration has been completed with a test piece of a differing volume
80	80±1ml	One of the test pieces will be measured with values outside the accuracy range (in excess of ± 1 ml)
50	50±1ml	
30	30±1ml	

Test results of calibration that has been completed correctly and calibration has been completed with a test piece of a differing volume

2. Calibration Method

Always perform calibration before measuring the sample after the main unit has been turned on.



⚠ CAUTION

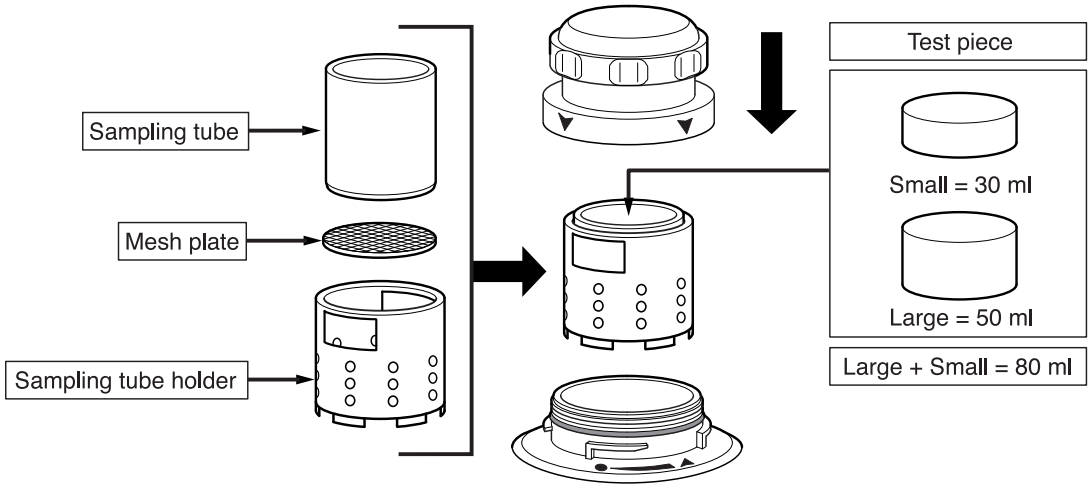
Handle the test pieces carefully. If a test piece is deformed or scratched, its volume may change.

1. Select "3. calibration" from the menu.
   Press the Set key (⬆) and go to the next step.

2. Perform calibration in the following order (80-->50-->30-->80-->50-->30). Check that the cursor is positioned on the right of "80" on the display panel. Open the cover on the sampling chamber and place the test piece into the chamber according to the procedure described below, and then press the Set key (⬆) to perform calibration starting from the 80-ml test piece.

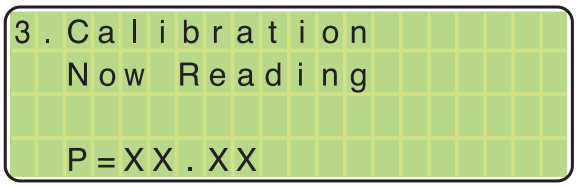
How to place a test piece

Place the mesh plate on the sampling tube holder, slide the sampling tube holder onto the receiving plate, and then put the test piece to be calibrated into the tube.



⚠ CAUTION

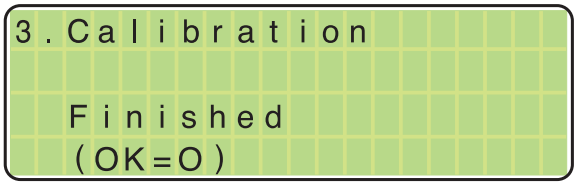
When performing calibration, be careful not to place the wrong test piece into the sampling chamber. The small test piece is 30 ml, the large test piece is 50 ml, and combining them together produces an 80-ml test piece (30 ml + 50 ml). If calibration is performed by placing a test piece with a different volume in the sampling chamber, an error message screen will be displayed.



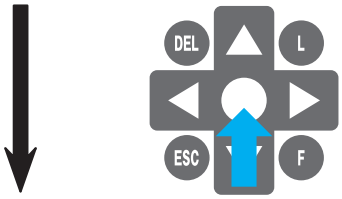
• No key operation is accepted during calibration.

⚠ WARNING

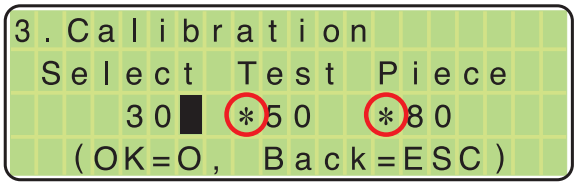
Never open the cover on the sampling chamber during calibration.
Doing so may cause the cover to fly off at you, resulting in injury.



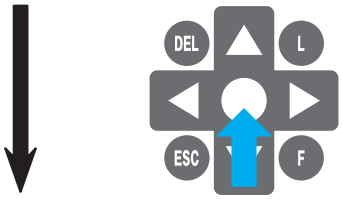
3. Upon the completion of calibration, press the Set key (⬆), replace the test piece and continue calibration.

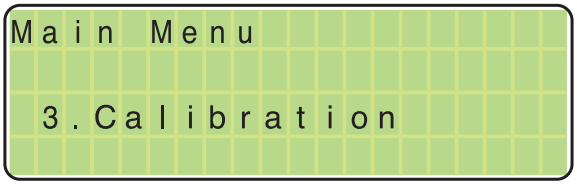


• **Perform calibration in the following order:**
80 → 50 → 30 → 80 → 50 → 30.



4. When the second calibration is complete, an asterisk (*) appears on the left of the test piece numbers.





5. Once the calibration for all the test pieces is complete, the screen will automatically return to the menu display.

2-1 When is Calibration Required?

1. Before starting measurement after the power has been turned on . . . . . Yes
2. When the ambient environment (such as temperature) fluctuates significantly after calibration has been performed . . . . . Yes
3. When no asterisk (*) appears on the right of "Measure" on the measurement startup screen . . . . . Yes
4. When a long time has elapsed during measurement since calibration was performed . . . . . Recommended
5. When measurement is paused and then restarted . . . . . Recommended

We recommend performing calibration as above to ensure more precise measurement.
In the situations where "Recommended" is shown, perform recalibration if the measurement results of any of the test pieces go beyond the permissible precision range (±1 ml).

⚠ CAUTION

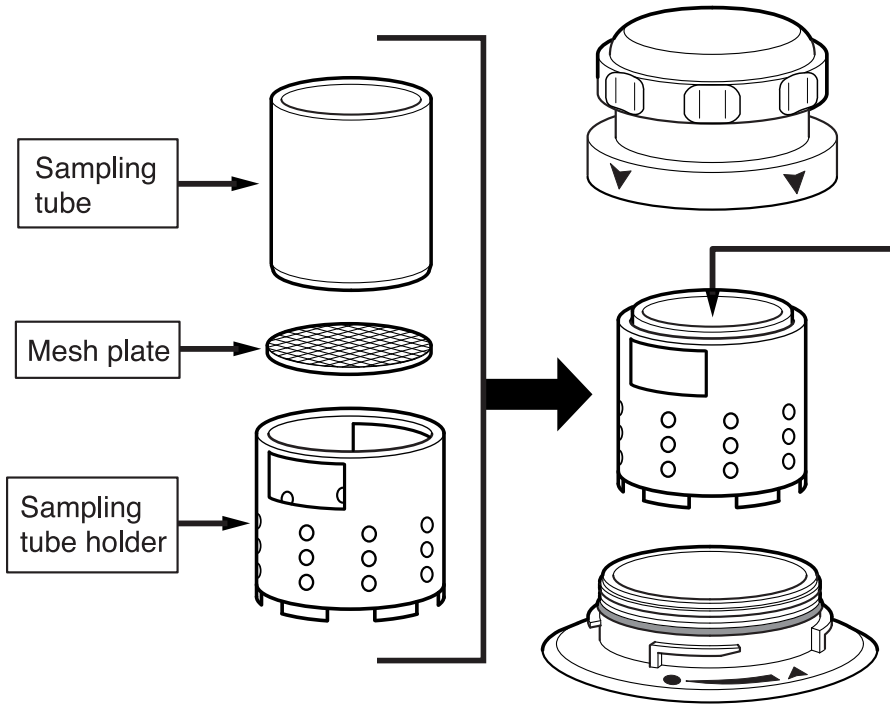
If measurement results still deviate from the permissible precision range (±1 ml) even after calibration has been performed a number of times, contact your local dealer.
Please note that the warranty does not apply if you have opened the casing or disassembled the device.

- Even immediately after calibration, measurement results may deviate from the permissible precision range (±1 ml) if measurement is taken in places where the ambient temperature fluctuates significantly (e.g., when measurement is taken in winter, when the device is brought from a place with a different temperature, or when measurement is taken under direct sunlight).

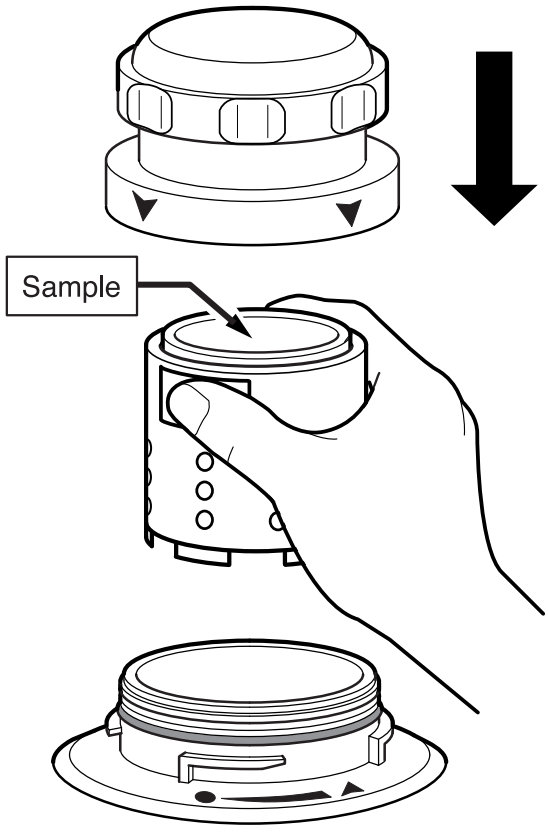
3. Sample Measurement Method

After calibration is complete, measure the sample.

How to place the measurement sample



To prevent soil in the sampling tube from spilling into the sampling chamber, place the sample into the sampling chamber so that the mesh plate and the sampling tube holder are located on the bottom.

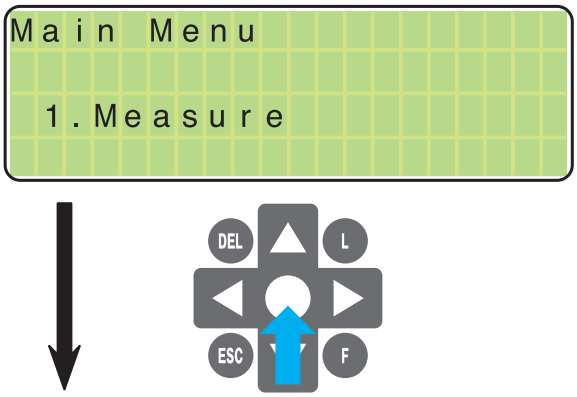


1. Open the cover on the sampling chamber, place the sample, and close the cover.

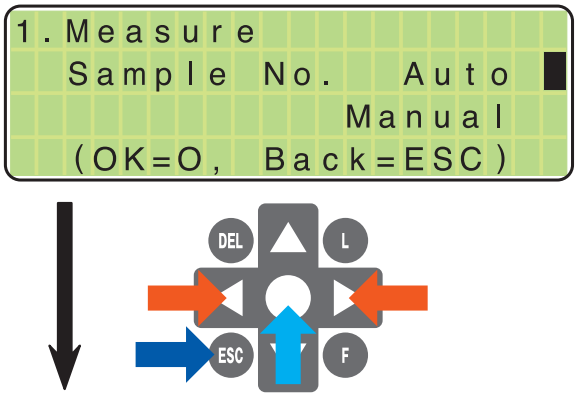
⚠ CAUTION

When inserting a sampling tube containing a measurement sample into the sample chamber, do not hold the sampling tube directly. Instead, hold the sampling tube holder firmly and insert it into the sample chamber.

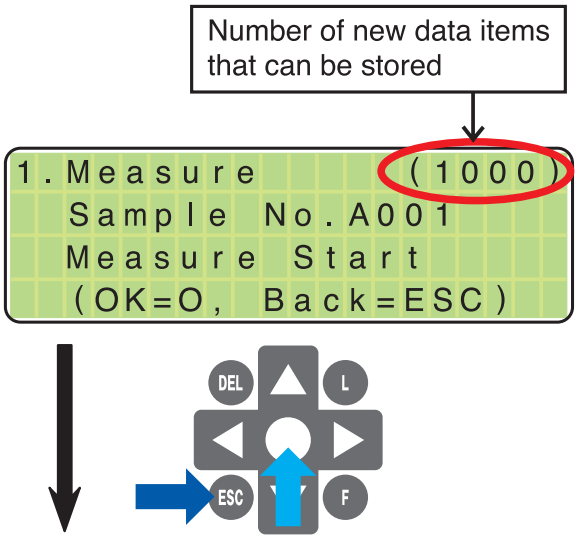
• Refer to Appendix 2 (page 35) for information about how to sample soil and how to measure the weight of measurement samples.



2. Select "1. Measure" from the menu.
   Press the Set key (⬆) and go to the next step.



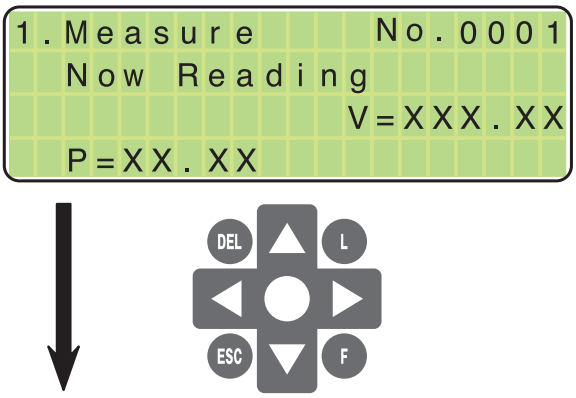
3. Select either Auto or Manual for the sample number setting method. Use the Right or Left arrow key (➡ ⬅) to select the setting and then press the Set key (⬆) to apply the setting, or use the ESC key (➡) to return to the previous screen.
4. For Manual, refer to "2-1 How to Set the Number of Samples Manually (See page 23)."



5. For Auto, the measurement start message will be displayed.

6. Make sure that the cover on the sampling chamber is closed completely, and then start measurement. Press the Set key (⬆) to start measurement, or the ESC key (➡) to return to the previous screen.

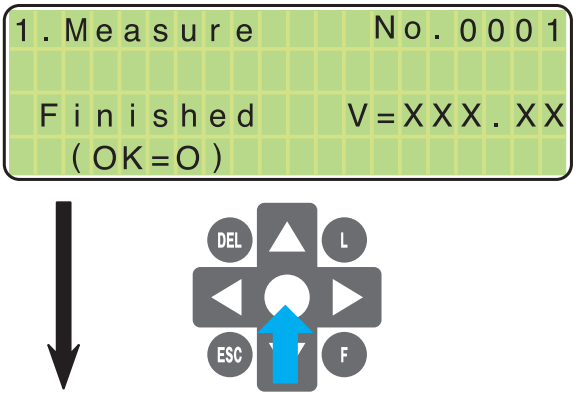
- The number in parentheses that is shown on the upper right of the screen indicates the number of new data items that can be stored. Note that if this number reaches "0" no more data can be stored: refer to "2-2 When the Number of Stored Data Items Reaches 1000" (See page 23) for details.



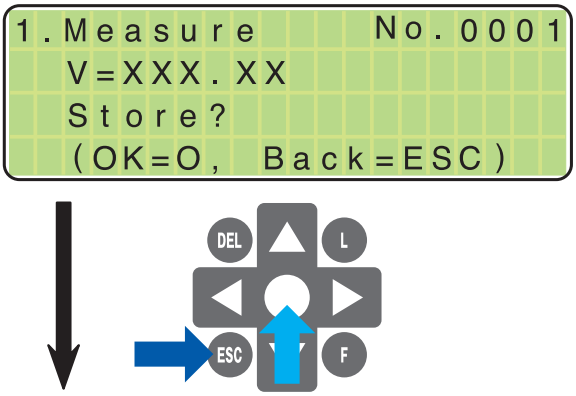
• No key operation is accepted during measurement.

⚠ WARNING

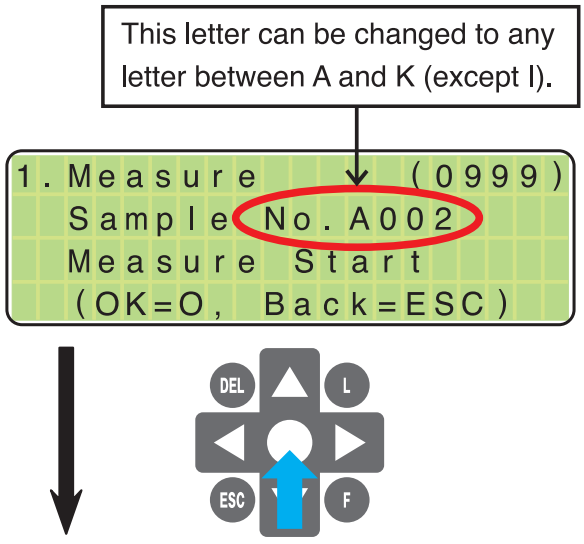
Never open the cover on the sampling chamber during calibration.
Doing so may cause the cover to fly off at you, resulting in injury.
The pressure reaches P=35.50.



7. Measurement finishes, and the result is displayed.
V=XXX.XX is the measured value of actual volume.

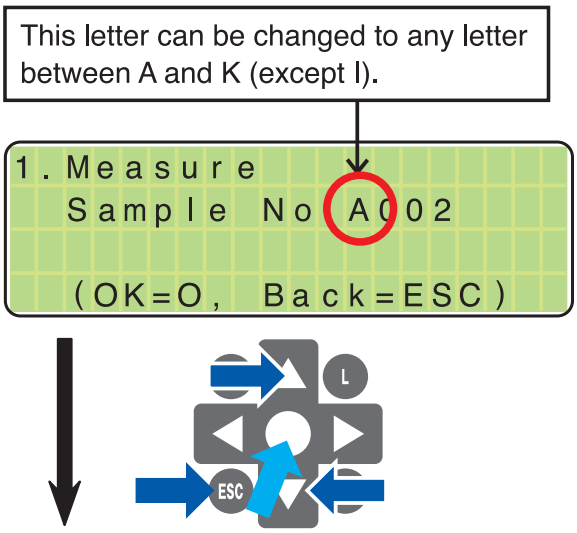


8. Select whether to save the measurement result. Press the Set key (⬆) to save the result, or the ESC key (➡) to not save the result.



9. If the data is saved, the next sample number will be displayed automatically, and next measurement will start when the Set key (⬆) is pressed. If the data is not saved, the sample number will remain the same as the previous number.

3-1 How to Set the Number of Samples Manually

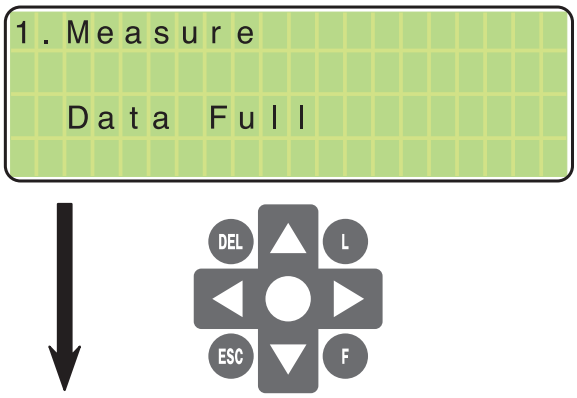


If "Manual" has been selected as the method of setting the number of samples, the letter in the fourth digit can be changed to any letter between A and K (except "I") by using the Up and Down arrow keys (➡⬅). Pressing the Set key (⬆) applies the setting and displays the screen shown in Step 5 on the previous page (page 21). Press the ESC key (➡) to select the method of setting the number of samples (Auto or Manual) again.

Hint: If "Manual" has been selected, graphs will be conveniently displayed in alphabetical order when Location Manager conducts a three-phase distribution analysis.

• Only the letter part of the sample number can be changed in Manual mode.

3-2 When the Number of Stored Data Items Reaches 1000

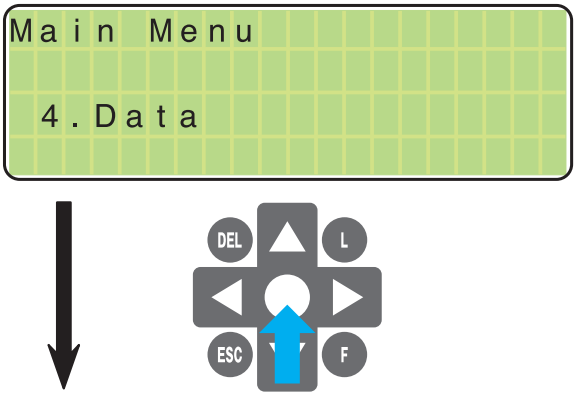


If the number of measurement data items reaches 1000, the screen shown to the left will be displayed when measurement is started from the menu or after data is stored. In such a case, delete unnecessary data and then restart measurement.

Hint: Before deleting data, use Location Manager to transfer the data to the COMPUTER and save it (please refer to Chapter 1, Section 2-1 "Deleting all memory in the main unit", P. 11)

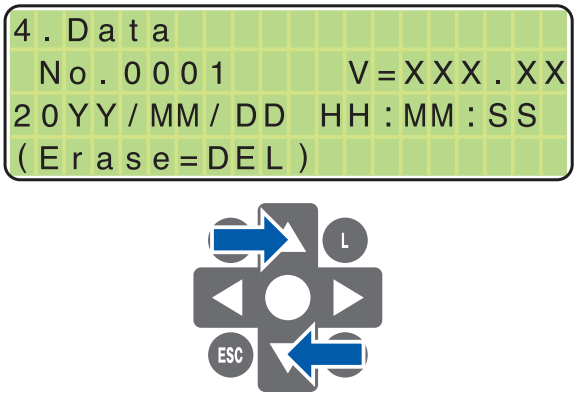
1. Data Management Using the Main Unit

The data that can be browsed within the main unit is (1) sample numbers, (2) the date and time of storage, and (3) measured values of actual volume.



1. Select "4. Data" from the menu, and press the Set key (⬆).

1-1 Displaying Data

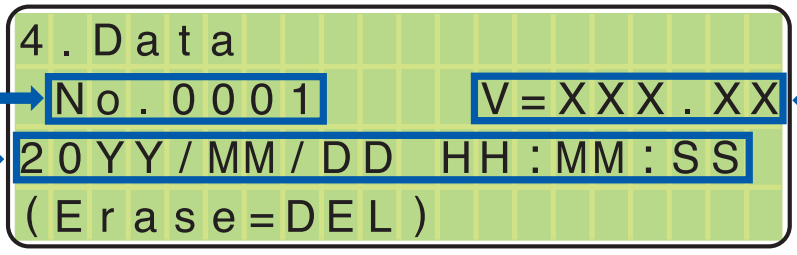


2. Stored data is displayed in ascending order. Pressing the Up or Down arrow key (➡⬅) can change the data to be displayed.

How to view stored data

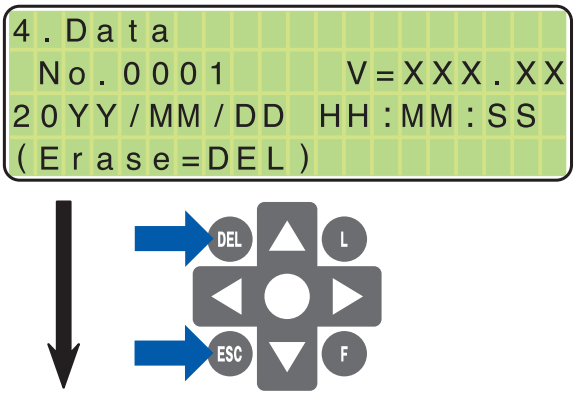
This is a sample number. The first digit is a letter (A to K), which is used for grouping.

This is the measured value of actual volume (ml).

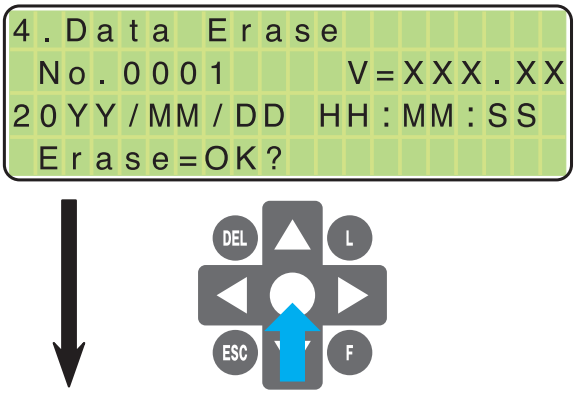


This is the date and time that data was stored. It is displayed in the format "20YY/MM/DD HH:MM:SS".

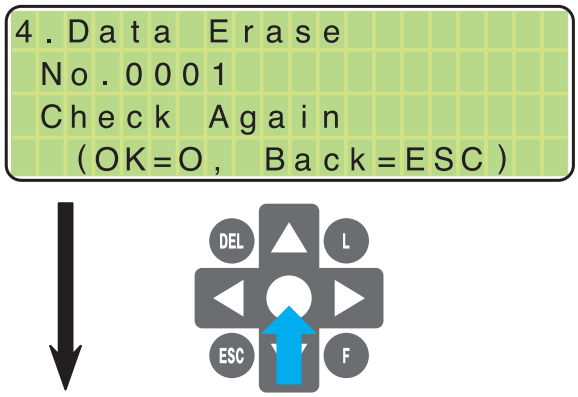
1-2 Deleting Data



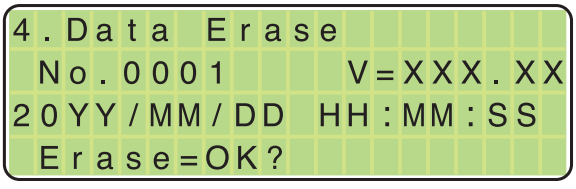
1. Pressing the DEL key (➡) on the data display screen moves to the deletion confirmation screen, or pressing the ESC key (➡) moves to the menu.



2. Pressing the Set key (⬆) with "4. Data Erase" displayed moves to the deletion confirmation screen, which prompts you to decide whether to delete the data for the sample number that is currently being displayed.



3. Pressing the Set key (⬆) deletes the data for the sample number that is currently being displayed.



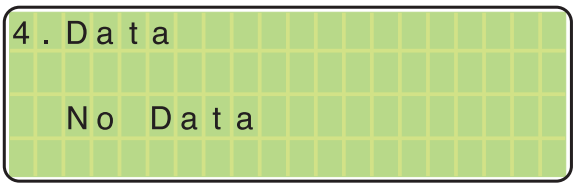
4. Once the data has been deleted, the data for the next sample number will be displayed.

Notes on data deletion and the number of data items that can be stored

1. Even if the above data is deleted, the same sample number cannot be used.
2. Also, the number of data items that can be stored will not increment.
3. The memory that stores the data items will be cleared to zero only when all data is erased as a batch.

• To erase all data from the main unit, perform memory operation from the startup screen.
(please refer to Chapter 1, Section 2-1 "Deleting all memory in the main unit", P. 11)

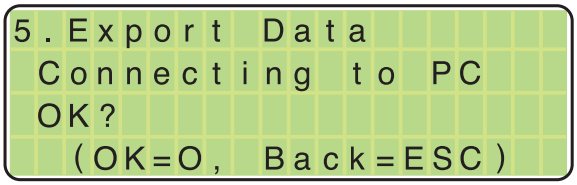
1-3 When No Data is Stored

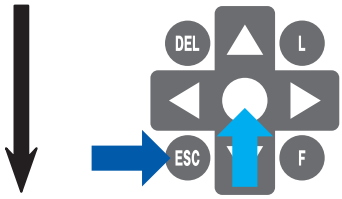


The screen shown to the left is displayed when no data is stored in the main unit (e.g., when all data has been erased).

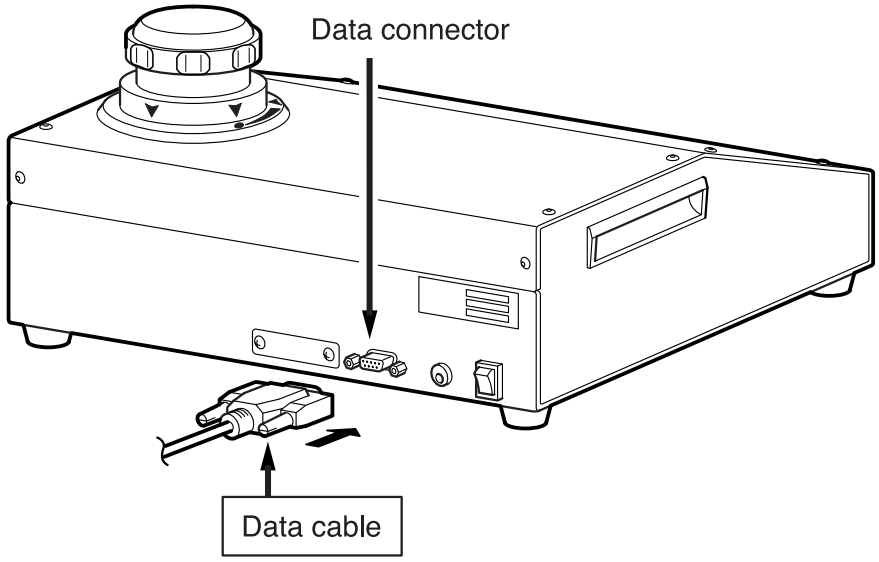
2. Data Management Using a Computer

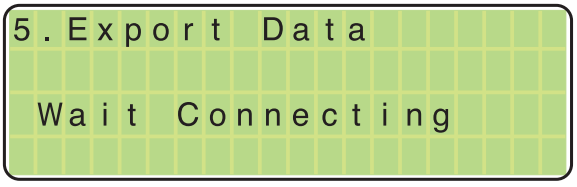
This device can use the dedicated software "Location Manager" to transfer data to the computer and manage it.



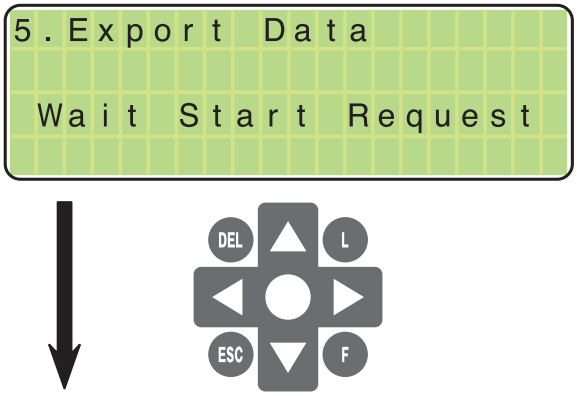


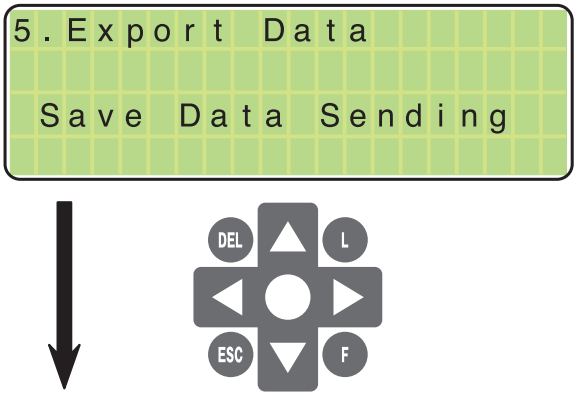
1. Select "5. Export Data" from the menu and press the Set key (⬆) to display the screen shown to the left.
2. Connect the main unit and the computer.
3. After they have been connected, press the Set key (⬆) to start data transfer.
4. Press the ESC key (➡) to return to the menu.



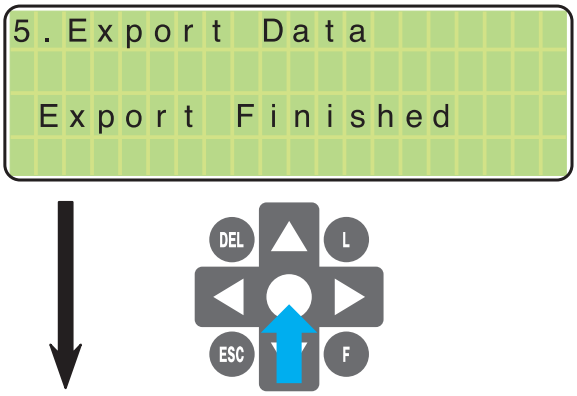


5. Once the screen shown to the left is displayed, operation can be performed on the computer. Refer to the Location Manager Instruction Manual for details.





6. Data is being transferred. No key operation is accepted during data transfer.

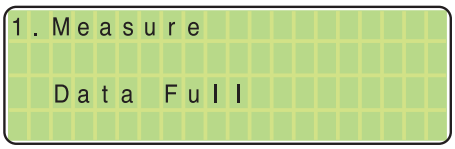
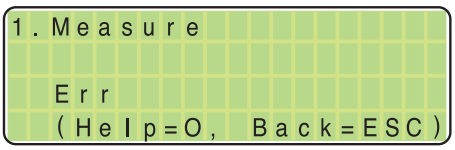
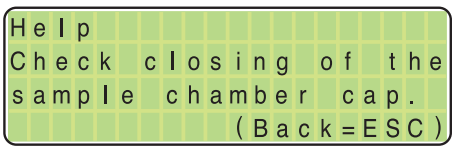
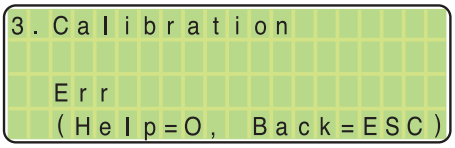
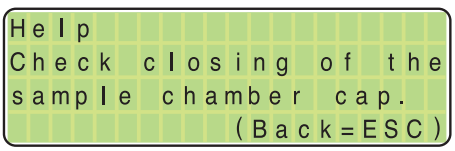
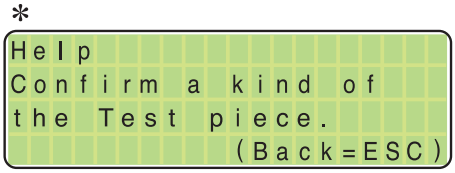


7. If data transfer is completed successfully, "Export Finshed" will be displayed on the screen.

8. Press the Set key (⬆) to return to the menu.

Chapter 4 Error Message

In the event any of the following error messages appear, please confirm the cause before applying for repair.
If there is still defect or abnormality, please consult the sales distributor.

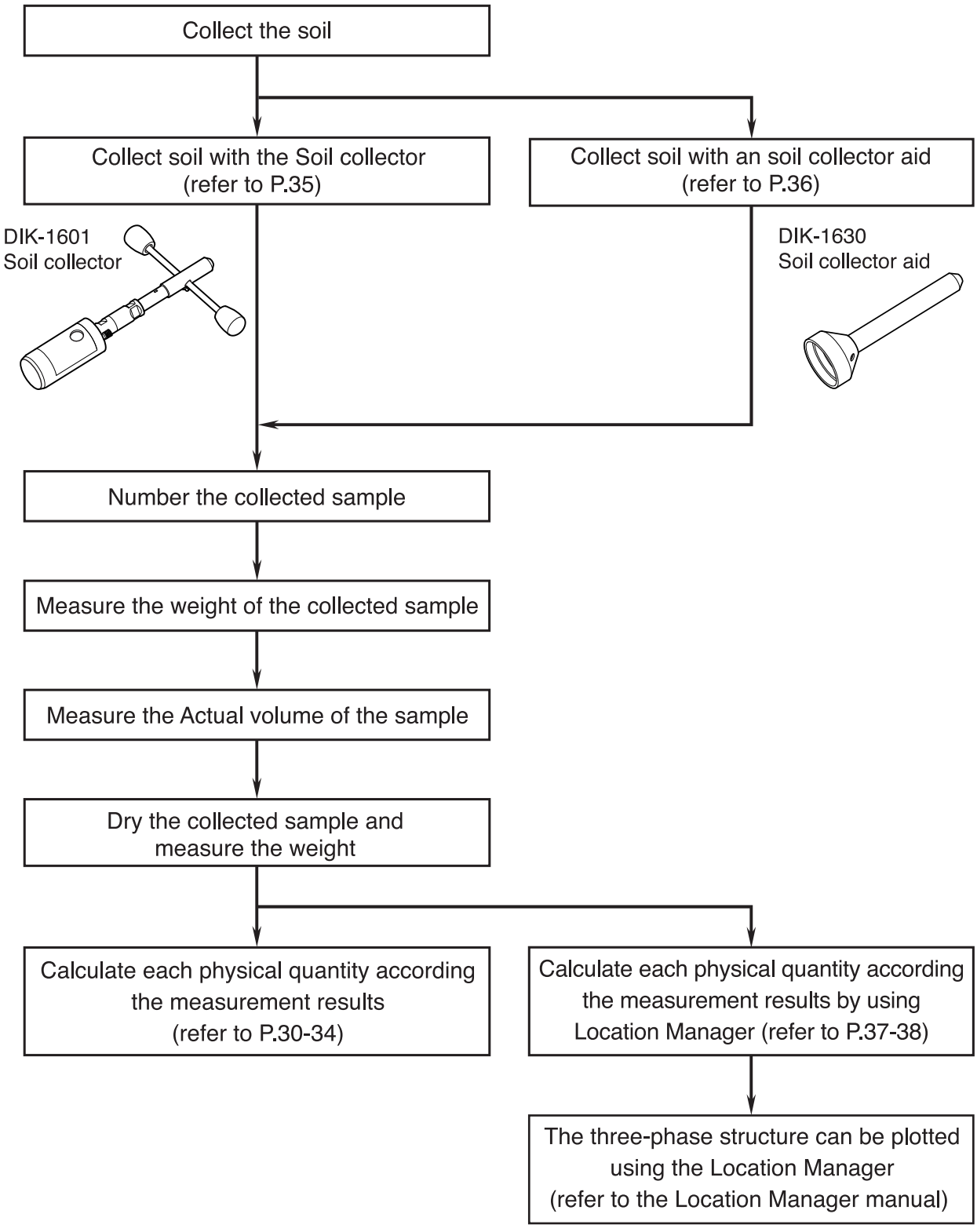
Error Message	Contents	Solution
	The maximum amount of 1000 cases of stored memory has been reached.	Transfer data to a computer using the Location Manager. After saving please delete all data (please refer to Chapter 1, Section 2-1 “Deleting all memory in the main unit”, P. 11)
	Data has not been saved in the memory of the main unit	
 ＊ 	① The cap of the test chamber is open ② Pressure is leaking because dust has gathered in the seal (o-ring) of the test chamber.	① Correctly close the cap of the test chamber. ② Remove the dust from the seal (o-ring), check for cracks due to deterioration, etc. Then apply silicone grease, and try to close the cap again. If the error message re-appears, replace the seal with the spare seal, and after applying silicone grease, close the cap again.
 ＊  ＊ 	① The cap of the test chamber is open ② Pressure is leaking because dust has gathered in the seal (o-ring) of the test chamber. ③ There may be a large change in temperature ④ The wrong test piece has been inserted	① Correctly close the cap of the test chamber. ② Remove the dust from the seal (o-ring), check for cracks due to deterioration, etc Then apply silicone grease, and try to close the cap again. If the error message re-appears, replace the seal with the spare seal, and after applying silicone grease, close the cap again. ③ Put the equipment in the use environment, then wait for a little while before calibrating again. ④ Insert the correct test piece

After displaying the error message, the ＊mark will continue to be displayed if the comment is selected.

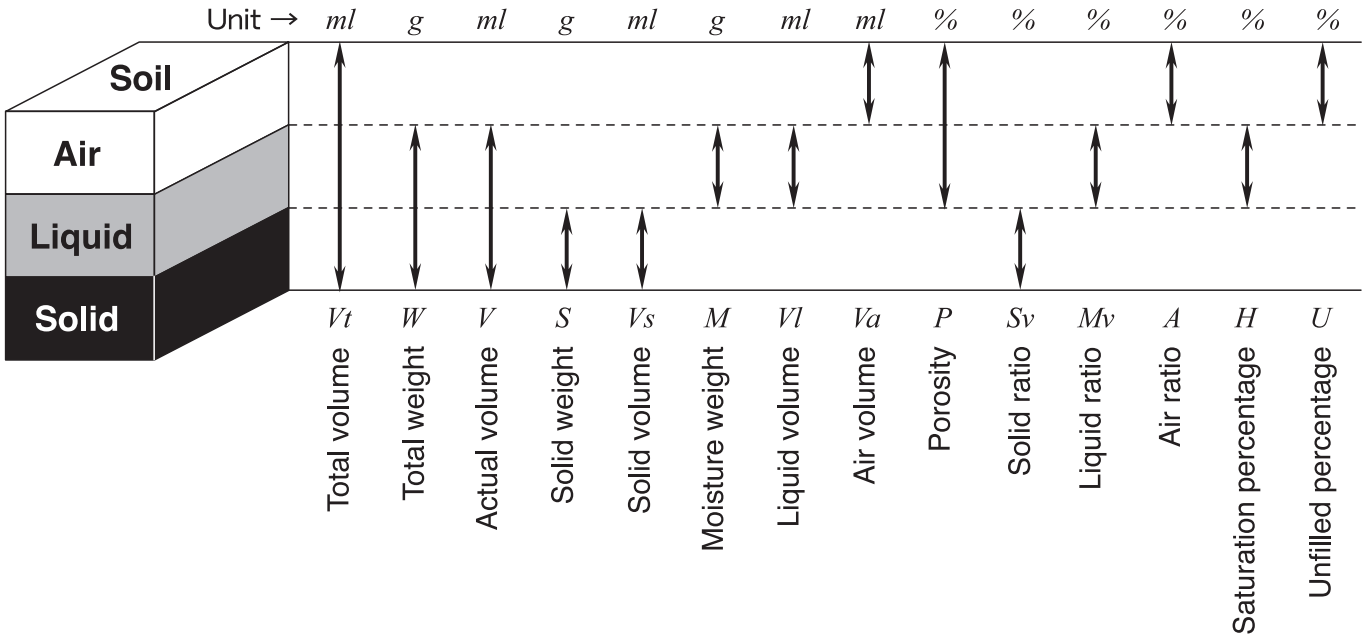
Procedures for Actual volume measurement
(reference material for first time users)

1. Procedures of Actual volume measurement

Measurement procedures are briefly described persons to measure the three-phase soil, and each physical quantity of the soil from the measurement of the Actual volume of soil.
Please refer to the following flow chart when carrying out measurements.



2. How to Determine the Physical Parameters of Soil



Soil model and terminology

The following table shows the calculation formulas. Note that the total volume is $100\ ml$.

1. Air volume	$Va = 100 - V$	Air ratio	$A = Va$
2. Solid volume	$Vs = (W - V) / (d - 1)$	Solid ratio	$Sv = Vs$
3. Liquid volume	$Vl = V - Vs$	Liquid ratio	$Mv = Vl$
4. Moisture weight	$M = Vl$		
5. Solid weight	$S = W - M$		
6. Porosity	$P = 100 - Vs$		
7. Water content (total weight)	$Mm = M / W \times 100$		
8. Water content (water weight)	$Mo = M / S \times 100$		
9. Saturation percentage	$H = Mv / P \times 100$		
10. Unfilled percentage	$U = 100 - H$		
11. True density	$d = S / Vs$		
12. Bulk density	$da = S / 100$		
13. Real density	$dm = W / V$		
14. Moisture, solid ratio	$Ls = Vl / Vs$		

3. Calculation of Physical quantities

If four quantities, namely Total volume Vt, Total weight W, Actual volume V, and True density d can be determined, the physical volume related the three-phase soil can be successively calculated.

The order of calculating the physical volume varies slightly depending on the purpose of measurement and differences in measuring methods, but the calculation order commonly used is described below.

The digital Actual volume measuring device measures Actual Volume (V) in the soil physical volumes in Section 2.

3-1. After completing measurement of actual volume (V) of the sample, measure the weight by each sample tube with the scale.

The full volume of a sample under normal measuring methods is $100ml$.

3-2. Known Quantity

Measurement Order

1) Total volume	Vt	100 (Capacity of the sample tube)
2) Total weight	W	weight minus the sample tube (from the gross weight which includes the sample tube),
3) Actual volume	V	The numerical value measured by the digital actual volume measurement device
4) True density	d	When not known, follow the method below

How to calculate the True density

If the true density (d) is not known,

Put the measured sample in the dryer and dry for 24 hours in $105\,^{\circ}C$.

The difference in weight before drying and after drying is the Moisture weight (M).

Water density = $1g/cm^3$, so $Vl = M$.

Formula

$$\text{True density} = \frac{\text{Gross weight}^{*} - (\text{Weight before drying} - \text{Weight after drying}) - \text{Weight of the sample tube}}{\text{Actual volume } (V) - (\text{Weight before drying} - \text{Weight after drying})}$$

* Gross weight = The weight including the sample tube

How to calculate Solid ratio according the numerical table

If True density is known, Solid ratio can be calculated from the numerical table on P.34,.

① Total weight − *100ml* tube weight − *V* (actual volume) = farthest left column on the numerical table.

② The True density (*d*) column on the second line

The numerical value where line ① and column ② cross is the Solid ratio ③.

If the solid ratio is on the table, Liquid volume can be calculated by the formula below.

V (Actual capacity) (*V*) − Solid Ratio (*Sv*) = Liquid volume (*Vl*)

Total weight - Actual Volume (*W - V*)	True density (*d*)			
	2.48	2.5	2.52	2.54
	Solid Ratio (*Sv=Solid Ratio*)			
30.0	20.3	20.0	19.7	19.5
31.0	20.9	20.7	20.4	20.1
32.0	21.6	21.3	21.1	20.8
33.0	22.3	22.0	21.7	21.4
34.0	23.0	22.7	22.4	22.1
35.0	23.6	23.3	23.0	22.7

① ② ③

3-3 Three-Phase Soil Volume

1) Air volume $Va=100-V$
2) Solid volume $Vs=(W-V)/(d-1)$
3) Liquid volume $Vl=V-Vs$

*To measure Liquid volume before solid volume,

2) Liquid volume $Vl=(d \cdot V-W)/(d-1)$
3) Solid volume $Vs=V-Vl$

3-4 Weight of Three-Phase Soil

1) Moisture weight $M=Vl$
2) Solid weight $S=W-M$

3-5 Volume Fraction of Three-Phase Soil

1) Solid ratio $Sv=Vs$
2) Moisture ratio $Mv=Vl$
3) Air ratio $A=Va$

3-6 Volume weight, Bulk density, and Real density

1) Volume weight $S_{100}=S$
2) Volume weight of moisture soil $W_{100}=W$
3) Bulk density $da=S_{100} / 100$
4) Bulk density of moisture soil $dw=W_{100} /100$
5) Real density $dm=W / V$

3-7 Pore volume, Porosity, and Void ratio

1) Pore volume $p=100-Vs$
2) Porosity $P= p$
3) Void ratio $e= p/Vs$

3-8 Moisture density, Moisture rate and Moisture, Solid ratio

1) Moisture density $Mo=M/S\times 100$
2) Water content $Mm =M / W\times 100$
3) Moisture, solid ratio $Ls=Vl / Vs$

3-9 Saturation percentage and Unfilled percentage

1) Saturation percentage $H=Mv / P\times 100$
2) Unfilled percentage $U=100-H$

4. Mathematical Table

W = Total Weight
V = Actual Volume
d = True Density
Sv = Solid Ratio

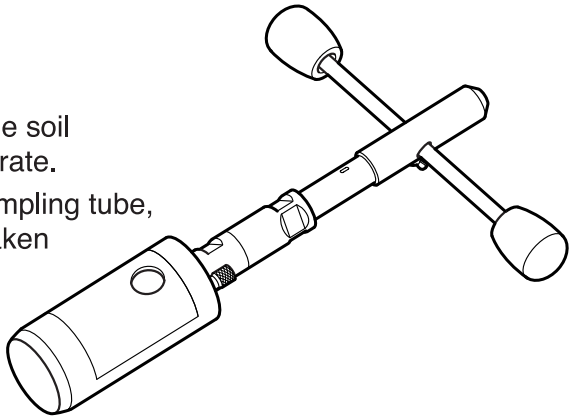
Total Weight - Actual Volum (W - V)	*True Density (d)*										
	2.48	2.5	2.52	2.54	2.56	2.58	2.6	2.62	2.64	2.66	2.68
	Sv=Solid Ratio										
30.0	20.3	20.0	19.7	19.5	19.2	19.0	18.8	18.5	18.3	18.1	17.9
31.0	20.9	20.7	20.4	20.1	19.9	19.6	19.4	19.1	18.9	18.7	18.5
32.0	21.6	21.3	21.1	20.8	20.5	20.3	20.0	19.8	19.5	19.3	19.0
33.0	22.3	22.0	21.7	21.4	21.2	20.9	20.6	20.4	20.1	19.9	19.6
34.0	23.0	22.7	22.4	22.1	21.8	21.5	21.3	21.0	20.7	20.5	20.2
35.0	23.6	23.3	23.0	22.7	22.4	22.2	21.9	21.6	21.3	21.1	20.8
36.0	24.3	24.0	23.7	23.4	23.1	22.8	22.5	22.2	22.0	21.7	21.4
37.0	25.0	24.7	24.3	24.0	23.7	23.4	23.1	22.8	22.6	22.3	22.0
38.0	25.7	25.3	25.0	24.7	24.4	24.1	23.8	23.5	23.2	22.9	22.6
39.0	26.4	26.0	25.7	25.3	25.0	24.7	24.4	24.1	23.8	23.5	23.2
40.0	27.0	26.7	26.3	26.0	25.6	25.3	25.0	24.7	24.4	24.1	23.8
41.0	27.7	27.3	27.0	26.6	26.3	25.9	25.6	25.3	25.0	24.7	24.4
42.0	28.4	28.0	27.6	27.3	26.9	26.6	26.3	25.9	25.6	25.3	25.0
43.0	29.1	28.7	28.3	27.9	27.6	27.2	26.9	26.5	26.2	25.9	25.6
44.0	29.7	29.3	28.9	28.6	28.2	27.8	27.5	27.2	26.8	26.5	26.2
45.0	30.4	30.0	29.6	29.2	28.8	28.5	28.1	27.8	27.4	27.1	26.8
46.0	31.1	30.7	30.3	29.9	29.5	29.1	28.8	28.4	28.0	27.7	27.4
47.0	31.8	31.3	30.9	30.5	30.1	29.7	29.4	29.0	28.7	28.3	28.0
48.0	32.4	32.0	31.6	31.2	30.8	30.4	30.0	29.6	29.3	28.9	28.6
49.0	33.1	32.7	32.2	31.8	31.4	31.0	30.6	30.2	29.9	29.5	29.2
50.0	33.8	33.3	32.9	32.5	32.1	31.6	31.3	30.9	30.5	30.1	29.8
51.0	34.5	34.0	33.6	33.1	32.7	32.3	31.9	31.5	31.1	30.7	30.4
52.0	35.1	34.7	34.2	33.8	33.3	32.9	32.5	32.1	31.7	31.3	31.0
53.0	35.9	35.3	34.9	34.4	34.0	33.5	33.1	32.7	32.3	31.9	31.6
54.0	36.5	36.0	35.5	35.1	34.6	34.2	33.8	33.3	32.9	32.5	32.0
55.0	37.2	36.7	36.2	35.7	35.3	34.8	34.4	34.0	33.5	33.1	32.8
56.0	37.8	37.3	36.8	36.4	35.9	35.4	35.0	34.6	34.1	33.7	33.3
57.0	38.5	38.0	37.5	37.0	36.5	36.1	35.6	35.2	34.8	34.3	33.9
58.0	39.2	38.7	38.2	37.7	37.2	36.7	36.3	35.8	35.4	34.9	34.5
59.0	39.9	39.3	38.8	38.3	37.8	37.3	36.9	36.4	36.0	35.5	35.1
60.0	40.5	40.0	39.5	39.0	38.5	38.0	37.5	37.0	36.6	36.1	35.7
61.0	41.2	40.7	40.1	39.6	39.1	38.6	38.1	37.7	37.2	36.7	36.3
62.0	41.9	41.3	40.8	40.3	39.7	39.2	38.8	38.3	37.8	37.3	36.9
63.0	42.6	42.0	41.4	40.9	40.4	39.9	39.4	38.9	38.4	38.0	37.5
64.0	43.2	42.7	42.1	41.6	41.0	40.5	40.0	39.5	39.0	38.6	38.1
65.0	43.9	43.3	42.8	42.2	41.7	41.1	40.6	40.1	39.6	39.2	38.7
66.0	44.6	44.0	43.4	42.9	42.3	41.8	41.3	40.7	40.2	39.8	39.3
67.0	45.3	44.7	44.1	43.5	42.9	42.4	41.9	41.4	40.9	40.4	39.9
68.0	45.9	45.3	44.7	44.2	43.6	43.0	42.5	42.0	41.5	41.0	40.5
69.0	46.6	46.0	45.4	44.8	44.2	43.7	43.1	42.6	42.1	41.6	41.1
70.0	47.3	46.7	46.1	45.5	44.9	44.3	43.8	43.2	42.7	42.2	41.7
71.0	48.0	47.3	46.7	46.1	45.5	44.9	44.4	43.8	43.3	42.8	42.3
72.0	48.6	48.0	47.4	46.8	46.2	45.6	45.0	44.4	43.9	43.4	42.9
73.0	49.3	48.7	48.0	47.4	46.8	46.2	45.6	45.1	44.5	44.0	43.5
74.0	50.0	49.3	48.7	48.1	47.4	46.8	46.3	45.7	45.1	44.6	44.0
75.0	50.7	50.0	49.3	48.7	48.1	47.5	46.9	46.3	45.7	45.2	44.6
76.0	51.4	50.7	50.0	49.4	48.7	48.1	47.5	46.9	46.3	45.8	45.2
77.0	52.0	51.3	50.7	50.0	49.4	48.7	48.1	47.5	47.0	46.4	45.8
78.0	52.7	52.0	51.3	50.6	50.0	49.4	48.8	48.1	47.6	47.0	46.4
79.0	53.4	52.7	52.0	51.3	50.6	50.0	49.4	48.8	48.2	47.6	47.0
80.0	54.1	53.3	52.6	51.9	51.3	50.6	50.0	49.4	48.8	48.2	47.6
81.0	54.7	54.0	53.3	52.6	51.9	51.3	50.6	50.0	49.4	48.8	48.2
82.0	55.4	54.7	53.9	53.2	52.6	51.9	51.3	50.6	50.0	49.4	48.8
83.0	56.1	55.3	54.6	53.9	53.2	52.5	51.9	51.2	50.6	50.0	49.4
84.0	56.8	56.0	55.3	54.5	53.8	53.2	52.5	51.9	51.2	50.6	50.0
85.0	57.4	56.7	55.9	55.2	54.5	53.8	53.1	52.5	51.8	51.2	50.6
86.0	58.1	57.3	56.6	55.8	55.1	54.4	53.8	53.1	52.4	51.8	51.2
87.0	58.8	58.0	57.2	56.5	55.8	55.1	54.4	53.7	53.0	52.4	51.8
88.0	59.5	58.7	57.9	57.1	56.4	55.7	55.0	54.3	53.7	53.0	52.4
89.0	60.1	59.3	58.6	57.8	57.1	56.3	55.6	54.9	54.3	53.6	53.0

Way of Sampling

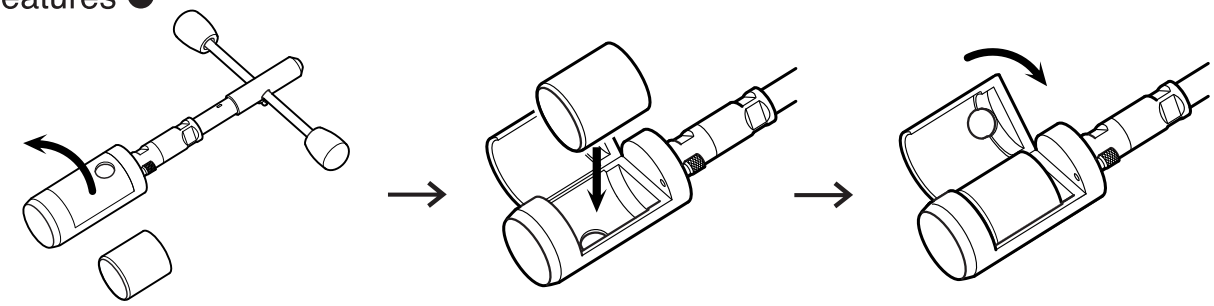
DIK-1601

Soil Sampler

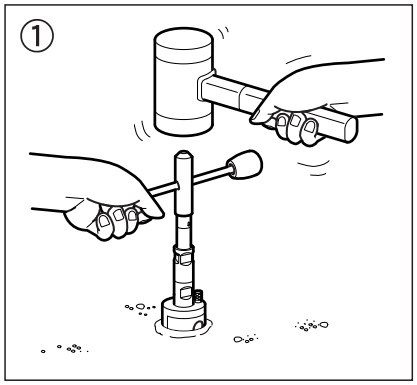
- As a soil sample is taken in the sampling tube directly, the soil structure is not destroyed, and the volume of soil is accurate.
- The next sampling can be done by only changing the sampling tube, and it is so easy to operate that many samples can be taken promptly/
- This is so portable and simple to assemble that is very convenient to carry.



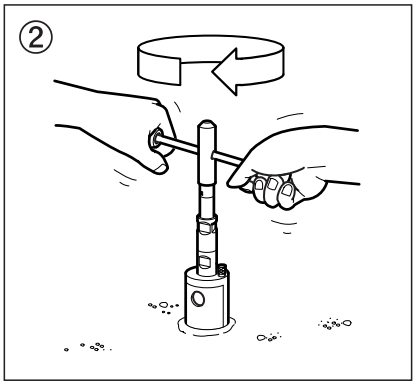
● Features ●



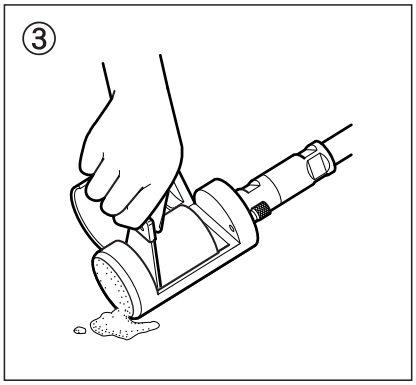
Way of Sampling



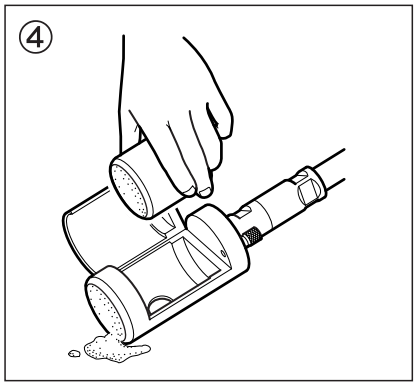
1. Set the soil sampler straight to the ground.
   Beat the head little by little with a hammer.



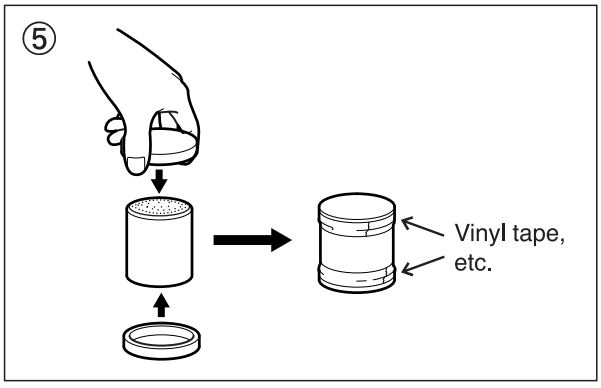
2. After beating to the depth of sampling, pull it up slowly, turning the handle to one direction.



3. Laying the sampler and cut the bottom of the sample tube with the attached knife.



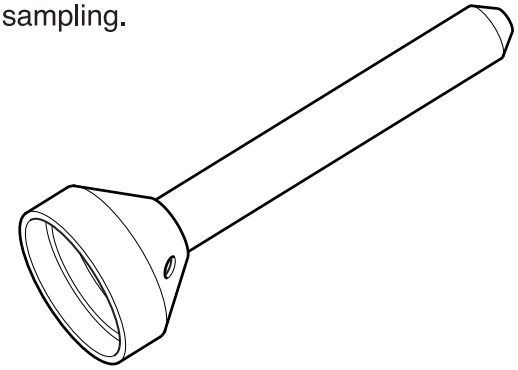
4. Remove the sample tube slowly.



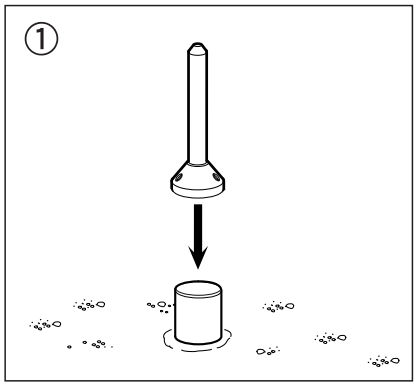
5. Put lids on the top and bottom of the sample tube and seals them with tape.

DIK-1630
Supplemental Soil Sampler

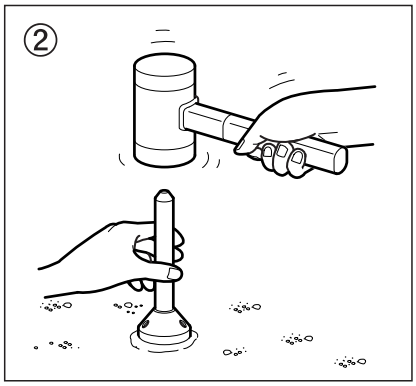
■Supplemental Soil Sampler (100ml) is used for surface soil or compact soil sampling.



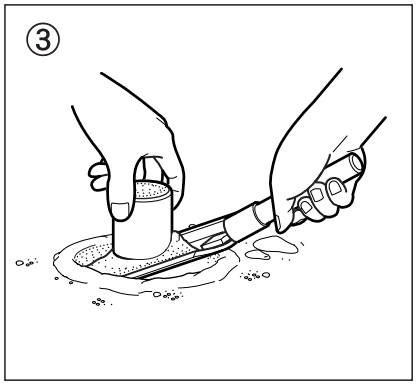
Way of Sampling



1. Set the sample tube on the soil and put the supplemental soil sampler on it.

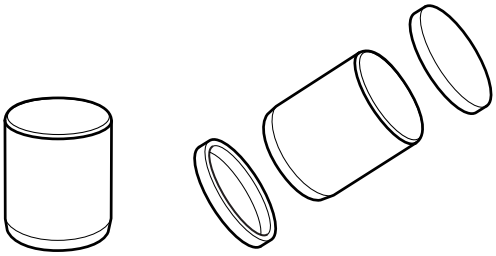


2. Then beat the head by a hammer.



3. Dig the sample tube with a hand shovel.

DIK-1801
Stainless Sampling Tube, 100ml



How to Determine Three-phase Distribution (Actual Volume) Using Location Manager

1. Sampling soil

(1) Use the DIK-1601 Soil Sampler or the DIK-1630 Supplemental Soil Sampler to collect soil into the DIK-1801 100-ml Stainless Sampling Tube so as not to damage the soil structure in the natural state.

(2) Place the covers (attached to the sampling tube) on the top and bottom of the sampling tube, and secure the covers with adhesive plastic tape. This will not only hold the covers in place, but also retain the moisture of the soil that has been collected.

(3) Write the sampling location, sampling depth, date and time of sampling, and other necessary information for each sample on the tape securing the cover or sampling tube.

2. Measurement using the Actual Volumenometer

(1) Remove the adhesive plastic tape from the covers on the sampling tube, orientate one of the covers until it faces up, and then remove it. Place the mesh plate (to be used for actual volume measurement) on the top of the sampling tube, put the sampling tube holder onto the mesh plate, and turn the sampling tube upside down so that the other cover faces up.

(2) Remove the other cover.

(3) Firmly hold the sampling tube with the two claws on the sampling tube holder so as not to drop the sampling tube holder, and place it into the sampling chamber.

(4) Measure the actual volume of the soil with the Actual Volumenometer according to the measurement procedure, and store the measurement data.

3. Measuring the weight of the soil sample

(1) Download the measurement results of the actual volume to the computer using Location Manager.

(2) Use an electronic balance or similar device to measure the total weight of the soil sample with the covers of the sampling tube in place.

(3) Next, read the measurement data from Location Manager, and enter the total weight of the measured sample into Location Manager.

* Refer to the Location Manager Instruction Manual for details.

(4) The weight of the sampling tube is scribed on the surface of the tube (the weight is shown to the nearest 0.1 g), so add the weight of the covers and enter the total weight into the sampling tube weight field of Location Manager. The weight of the soil can be determined by subtracting the weight of the sampling tube from the total weight measured in Step (3).

(5) Enter the sampling location, sampling depth, date and time of sampling, and other necessary information for each sample into Location Manager.

4. Drying the measurement sample

(1) Allow enough time (normally, 24 hours or more) for the sample soil to dry at 105℃.

(2) Read the data from Location Manager, enter the weight of the dried sample soil, and press the Recalculate button. The values of the physical parameters for soil (shown in Appendix 1) will be automatically calculated and displayed.

(3) If the true density of the sample soil is already known or has been determined using another method, the values of true density can be directly entered into Location Manager. Simulation for the physical parameters for soil (shown in Appendix 1) can be performed by entering approximate values into Location Manager.

5. Three-phase distribution analysis

(1) Location Manager can display a triphasic distribution for up to 1000 points of three-phase distribution graph.

Warranty Period

Our warranty is valid for one year from the delivery date, which is stamped on the shipment check list enclosed in the package of the product. However, we will not warrant the silicon grease or other consumable parts unless the user finds the defective parts upon opening the package. Please be sure to read the Warranty Rules at the end of this Instruction Manual.

Our Contacts

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525-0032, Japan
Telephone number : 077-565-1750
Facsimile number : 077-510-1755

Warranty Rules

If the user assembles and operates a product of Daiki Rika Kogyo Co., Ltd. (“Daiki”) following the instructions given in the Instruction Manual enclosed in the product package but cannot make it operate properly, Daiki will repair the defective product free of charge or will replace it with an equivalent product free of charge provided that the user notifies Daiki within one year from the date of shipment, which is stamped on the shipment check list enclosed in the package of the product. Even for products and parts defined as Non Warranty items in the Instruction Manual, we will repair them free of charge or replace them with equivalent products/parts free of charge if the user finds any them to be defective while it is a new product or part. “Defective new product/part” herein means a product or part which the user finds is clearly defective or does not work when tried for the first time upon opening the package. The user can receive repair or replacement of the defective product or part only if the user notifies Daiki within one month from the date of shipment, which is the date stamped on the shipment check list enclosed in the package of the product. Daiki will not repair or replace defective new products/parts after one month has passed. Furthermore, the warranty offered by Daiki does not apply to products or parts which the user has purchased secondhand or purchased from an individual.

Daiki hereby makes no warranties that Daiki’s product in the hands of the user is free from defects in workmanship or that there are no defective lots attributable to defective parts.

Scope of Warranty

- Daiki will repair the defective product or products/parts according to the rules set forth above. (Daiki may replace the defective product or product/part with their equivalents if the company finds a product or part to be beyond repair.)
- Daiki makes no warranties other than those set forth in the Warranty Rules above, regardless of the reasons for the claims made by the user.
- Regardless of the types of legal claims, the warranties offered by Daiki are limited to those that are set forth in the Warranty Rules presented above. That is, in no event will Daiki take any responsibility for any other damages which the user may suffer due to the use or improper operation of the product, including, but not limited to, loss of corporate profit, business interruption, or other monetary losses.
- Daiki takes no responsibility for a negative impact on other devices connected to the product or other equipment which may be affected by the use of the product.

No Warranty

Even within the Warranty Period, the user is required to pay for repair or replacement in any of the following events:

- The products/parts are defined in the Instruction Manual as “not applicable to warranty” or as consumable items.
- The user cannot present to Daiki the shipment check list that was enclosed in the product package.
- The shipment check list, which was enclosed in the product package, does not bear the stamp of shipment date, and the user cannot provide other evidence of the date of purchase.
- The user has modified any of the entries in the shipment check list without the approval of Daiki.
- Breakdown/damage was caused by improper handling of the product by the user, including, but not limited to, dropping the product or giving a shock to it when the user transported or moved it.
- Breakdown was caused by using the product other than as instructed in the Instruction Manual, incorrect assembling of parts, mistake, remodeling, improper installation, or breakdown attributable to connection parts such as a power supply outlet or CPU, or the product is damaged by any other external factor. Daiki will also request payment by the user for repair and replacement of peeled-off or damaged model number seals pasted on parts.
- Breakdown or damage was caused by a fire, environmental pollution, excessive voltage, earthquake, lightning, strong wind, flood, or other natural disasters.
- The product is used overseas. (Requests for repair from overseas cannot be accepted.)

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