

DIK-4056 / 4060

Digital Permeameter

1 / 5 Fold Type

Instruction Manual

Please read the instruction manual before using the product. After reading the manual, keep it in the safe place for further reference.

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INTRODUCTION

Thank you for purchasing DIK-4056 / 4060 Digital Permeameter 1 / 5 Fold Type. Before use, please read the instruction manual carefully so as to obtain the best performance and proper use. Please keep it handy for further reference.

OUTLINE

Pore of soil is so continuous that water can flow in it, such nature as water is running through soil is called `Permeability`. It can be obtained by Darcy's law that water flows through soil whose pore saturated by water. Measurement of permeability has constant head method and falling head method, constant head method is used for soil of much permeability and falling head method is used for soil of little permeability. This product can be measured saturated water permeability, with using Falling Head Method out of two measurement methods.

Method of measuring	Kind of soil	Permeability coefficient K(cm/sec)
Constant head method	Soil of much permeability	$K = 10^{-2} \sim 10^{-3}$
Falling head method	Soil of little permeability	$K = 10^{-3} \sim 10^{-6}$

NOTES ON INSTRUCTION MANUAL

- Be sure to read the manual before use.
- Keep it in a safe place where you can bring in need.
- Follow the operating directions in the manual.
- Be sure to follow the instructions on safety notes in the manual.
- Contents of the manual are subjects to change for improvement in quality or function without notice.
- Please contact us when you may lose the manual.
- If you find doubts, errors, and omissions in the manual, please contact us soon.

BASIC MATTERS ON THIS MANUAL

This instruction manual is explaining about the way to use of the components for DIK-4056 / 4060 Digital Permeameter 1 / 5 Fold Type. Please refer to the instruction manual for "DIK-4026 / 4030 Digital Permeability Monitor", when you need the specifications or the usage for the monitor.



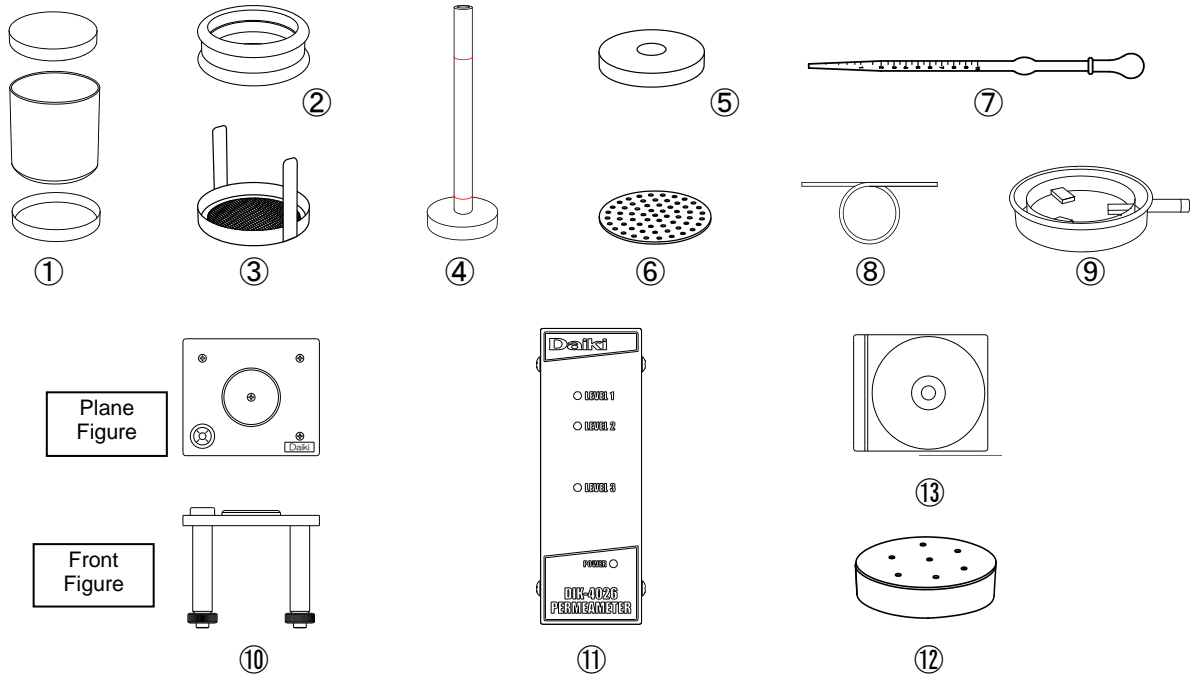
SAFETY NOTES

- Inspect it carefully to have no damage on parts before use. If damage is evident, never use it.
- As the pipette is made of glass, be careful not to injure you for its breakage.
- Install the product on a safe and level place. Otherwise, it would tilt or fall.

COMPONENTS CHECKLIST

When unpacking, check contents and quantity of components.

Assembly

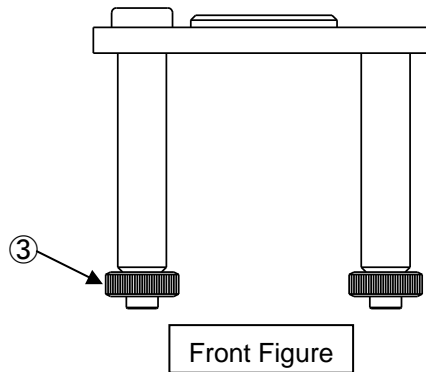
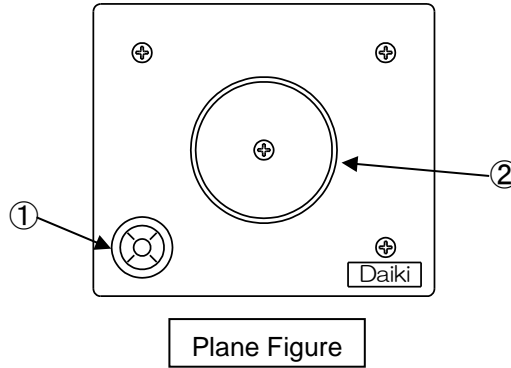


Model	Name of goods	Q'ty	No.	Check
DIK-4056	Digital Permeameter, 1 Fold type (*1)	1 set		
	(Details)			
DIK-1801-11	Stainless sampling tube, 100ml (*2)	1 pc.	①	
DIK-4001-13	Rubber ring (*3)	1 pc.	②	
DIK-4001-15	Net dish with stopper (*3)	1 pc.	③	
DIK-4055-17	Scale tube for falling head (New type) (*3)	1 pc.	④	
DIK-4001-18	Weight (*3)	1 pc.	⑤	
DIK-4001-19	Net plate (*3)	1 pc.	⑥	
DIK-4001-21	Pipette	1 pc.	⑦	
DIK-4001-22	Silicon tube (O.D.φ10 x I.D.φ7 x L150mm) (*3)	1 pc.	⑧	
DIK-4051-18	Water dish (*3)	1 pc.	⑨	
DIK-4055-20	Level stand (for 1 Fold Type) (*4)	1 pc.	⑩	
DIK-4026	Digital Permeability Monitor, 1 Fold Type (*5)	1 set	⑪	
Option				
DIK-4026-12	Dedicated software for monitor (*6)	1 pc.	⑬	
DIK-3521-51	Sample holding cover	1 pc.	⑫	
1201-19	Aluminum case (W365xD225xH250mm) (*7)	1 pc.		

- (*1) : In case of 5 Fold Type, The model name is “DIK-4060 Digital Permeameter 5 Fold Type”.
- (*2) : In case of 5 Fold Type, DIK-1801 Stainless Sampling Tube, 100ml x 1 set is attached.
- (*3) : In case of 5 Fold Type, quantity is 5 in each item.
- (*4) : In case of 5 Fold Type, DIK-4051-20 Level stand (for 5 Fold Type) is attached.
- (*5) : In case of 5 Fold Type, The model name is “DIK-4030 Digital Permeability Monitor 5 Fold Type”.
- (*6) : In case of 5 Fold Type, the dedicated software is equipped as standard.
- (*7) : In case of 5 Fold Type, “4050-05 Case” is provided.

NAMES OF PARTS / ASSEMBLY DRAWING

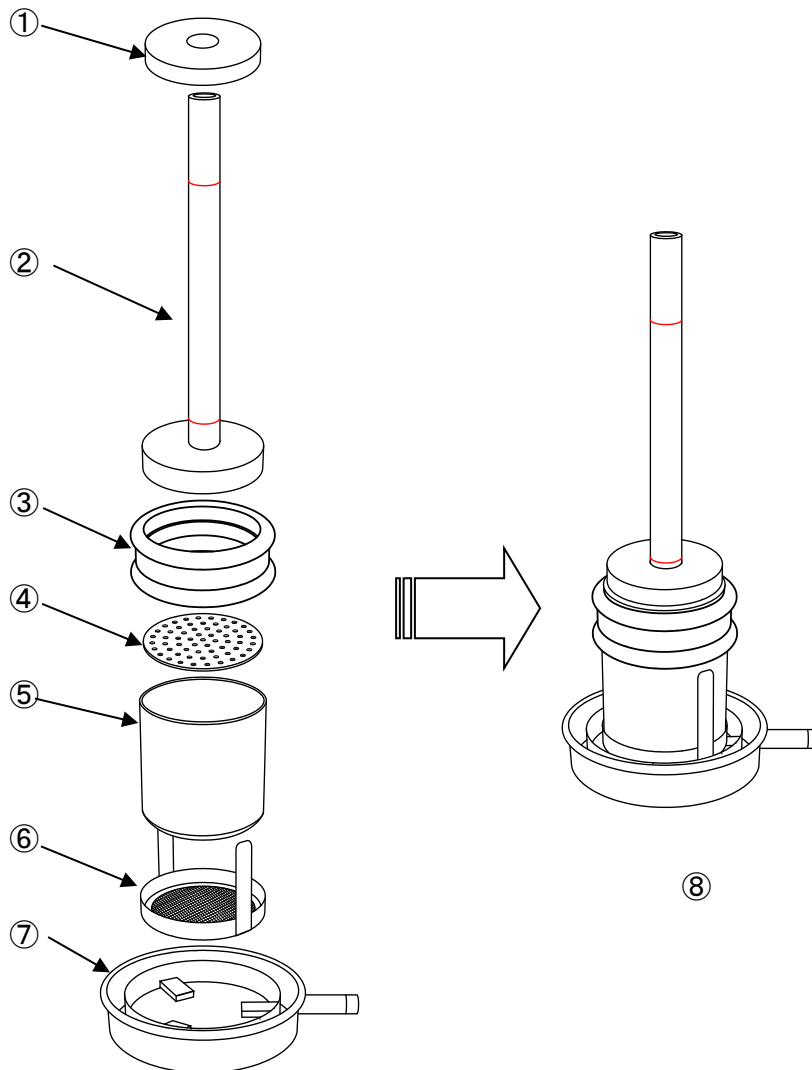
Level stand



①	Level vial Checks the level stand horizontal.	③	Horizontal adjustment screw (4 pcs.) Adjust level of the level stand. Turning screws while checking with the level vial.
②	Sample receiver The place to put Water dish on.		

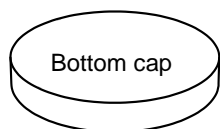
※There are 5 places of Sample receiver for the DIK-4060 Digital Permeameter 5 Fold Type.

Assembly Drawing

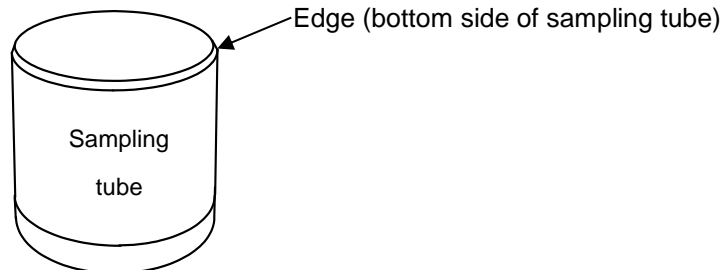


①	Weight Prevents floating from soil expansion.	⑤	Stainless sampling tube 100ml Put sample soil to be measured into it.
②	Scale tube for falling head Measures water permeability volume.	⑥	Net dish with stopper Prevents sample soil from dropping.
③	Rubber ring Connects together the scale tube for falling head, the net dish and the sampling tube.	⑦	Water dish Drains water which was after permeation.
	Net plate Makes water in the scale tube distribute evenly to the soil surface.	⑧	Completed assembly drawing All parts are assembled.

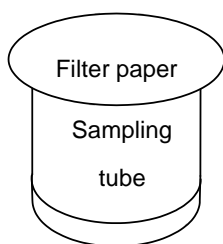
PRE-TREATMENT OF SOIL SAMPLE (SATURATING SAMPLE)



1. Remove a bottom cap of the stainless sampling tube contained with soil sample.

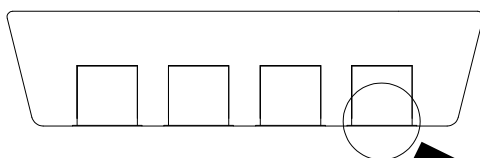


* A side with cutting edge is the bottom side of sampling tube.

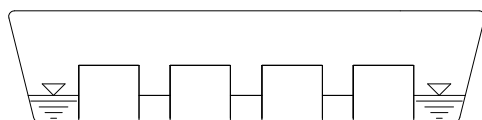
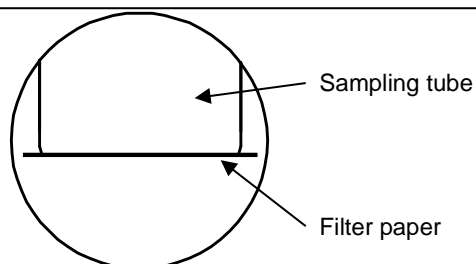


2. Cut a filter paper in a certain size and cover it on the sampling tube.

*Filter paper is not included. Please prepare a filter paper with a diameter of 60 mm or more.



3. Turn the sampling tube upside down without falling soil sample, put it being the filter paper bottom side on the pan or the like and remove the top cap.

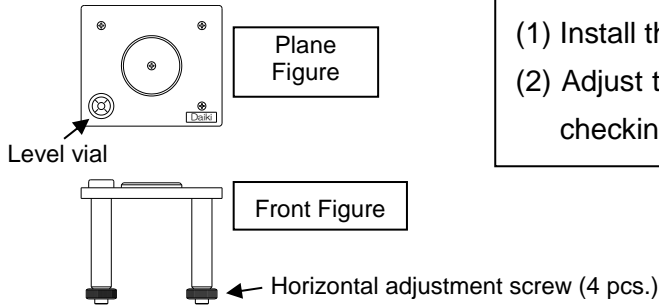


4. Pour water into the pan until the water level comes up to the center of sampling tube, and leave it for 24 hours.

* We recommend using the sample holding cover (DIK-3521-51) in order not to expand the sample soil from saturation. For further information, please refer to “Chapter 2 SAMPLE HOLDING COVER (DIK-3521-51) (OPTION)”.

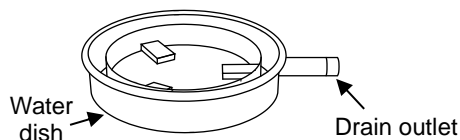
CHAPTER 1 HOW TO START USING

1. Installation of level stand



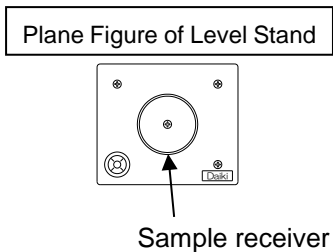
- (1) Install the level stand at stable horizontal place.
- (2) Adjust the level by turning 4 pcs of screws while checking with the level vial.

2. Preparation of measuring / Assembling of soil sample

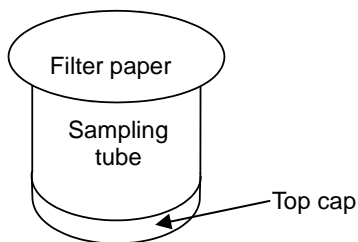


- (1) Insert to connect a supplied silicone tube to the drain outlet of water dish.

* Please place any vessel to hold the drain at the end of silicone tube.

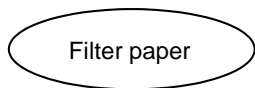


- (2) Place a water dish on the sample receiver to match the shape of the bottom of the water dish.

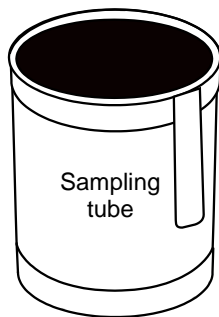
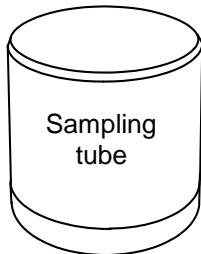


- (3) Put the top cap on the stainless sampling tube filled with fully-saturated soil sample, and then, turn it upside down without dropping sample.

* A side with cutting edge is the bottom side of sampling tube.

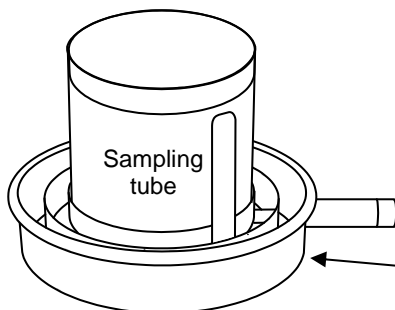


(4) Take off the filter paper.



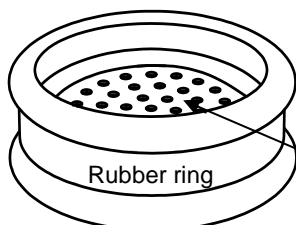
(5) Cover the sampling tube with the net dish with stopper on it.

Net dish with stopper



(6) Turn the sampling tube upside down, and put it with net dish with stopper on the lower side to water dish.

Water dish



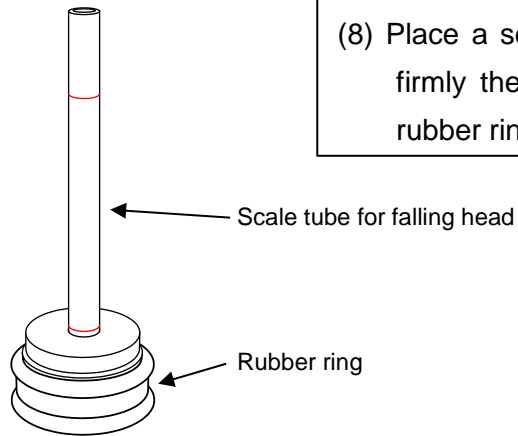
(7) Place a net plate so as to hit the step inside the rubber ring firmly.

Net Plate

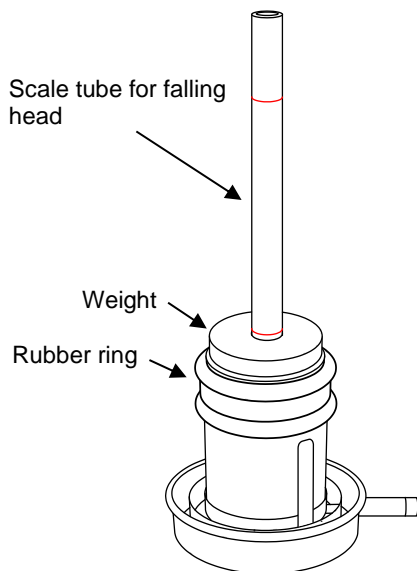
Rubber ring

* Please set a net plate as above. The net surface of the net plate will be come to the sampling tube side.

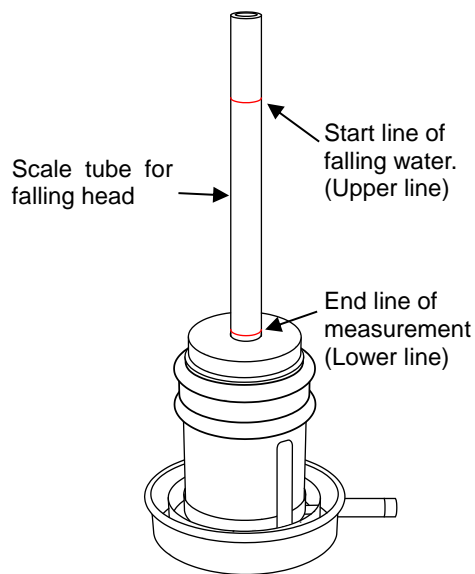
(8) Place a scale tube for falling head so as to hit firmly the step inside of the other side of the rubber ring.



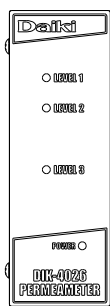
(9) Remove the top cap of sampling tube, then put the rubber ring on to the upper side of sampling tube so as to touch the net plate closely.
(10) Put the weight to the scale tube for falling head in order to prevent from floating soil expanding.



* It causes water leakage and error of measured value, in case of catching some soil into the gap between the rubber ring and the sampling tube. Wipe clear the side surface of the sampling tube, then fit it to the rubber ring.



(11) By using a supplied pipette, pour water into the scale tube for falling head until the water level becomes above the start line of falling water (Upper line).

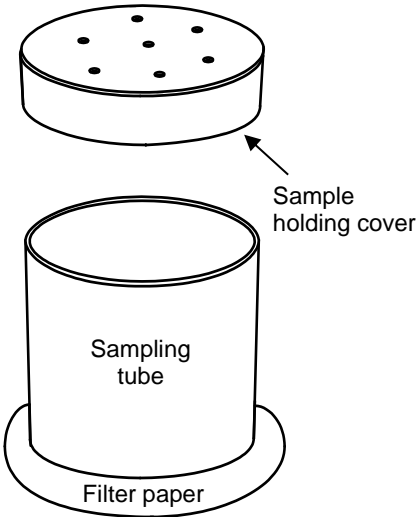


(12) or later, please refer to the separate instruction manual, "DIK-4026 / 4030 Digital Permeability Monitor 1 / 5 Fold Type" for measurement.

DIK-4026 Digital Permeability Monitor

* Small soil particles are accumulated on the lower layer by the water flow and it causes poor permeability gradually. To avoid this case, we don't recommend that the same soil sample is used more than three times repeatedly in measuring.

CHAPTER 2 SAMPLE HOLDING COVER (DIK-3521-51; OPTION)



In case that soil sample is too expanding so as to capillary saturation on pre-treatment sample, an optional, Sample holding cover (DIK-3521-51) can be used to prevent soil sample from over expanding caused by saturation.

WASHING AND KEEPING IT AFTER USE

- Wipe the equipment lightly with a soft cloth which is moistened with water or a little neutral detergent. Never use solvent which is contained benzene, alcohol, acetone, ether, ketone, thinner, gasoline and so on, because they affect deformation and discoloration.
- There is a case that soil accumulates on the water dish or other parts. Please wash the soil off those parts completely and keep them.

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 products made of glass, and 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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Phone number	+81 48 568 2500	+81 77 5671750
FAX number	+81 48 568 2505	+81 77 5671755

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.)

REFERENCE MATERIALS

Coefficient of water permeability K (cm/sec)

Depth \ Soil	Coefficient of water permeability K (cm/sec)				
	5~10cm	10~20cm	20~30cm	30~40cm	40~50cm
Red soil	$1 \sim 2 \times 10^{-2}$	$4 \sim 9 \times 10^{-3}$	$4 \sim 8 \times 10^{-3}$	$6 \sim 9 \times 10^{-3}$	$5 \sim 9 \times 10^{-3}$
Ando soil	$2 \sim 5 \times 10^{-2}$	$5 \sim 7 \times 10^{-3}$	$7 \sim 9 \times 10^{-3}$	1×10^{-2}	$1 \sim 3 \times 10^{-3}$

(Funaki, Hokota-machi, Ibaragi-ken)

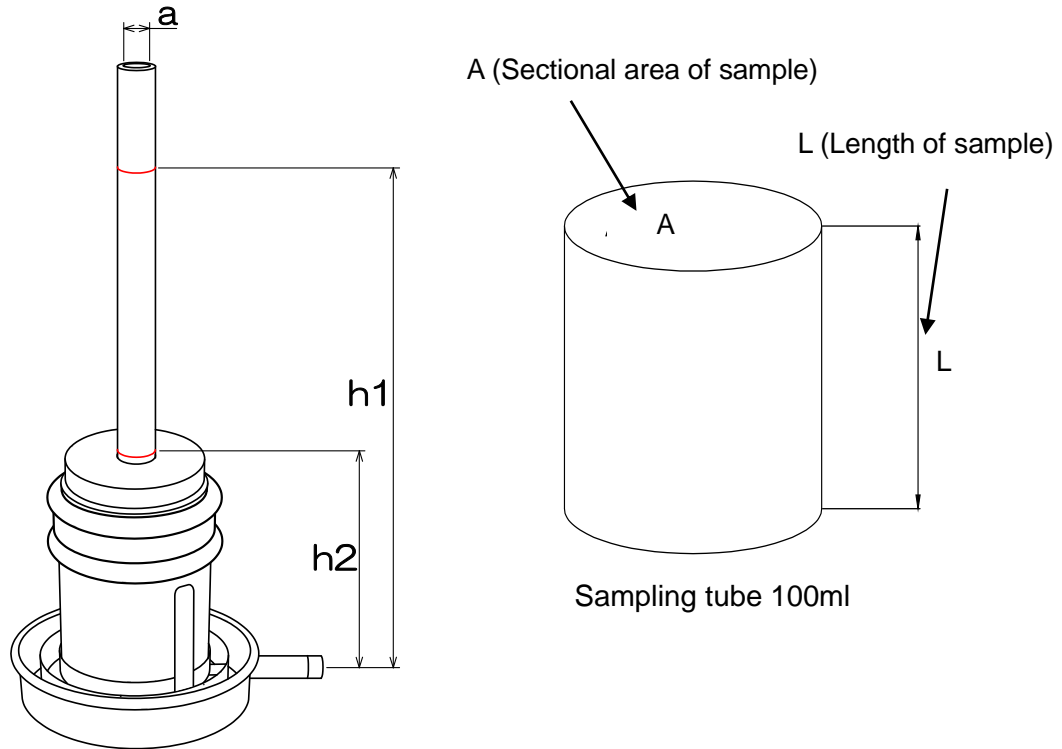
(Actual values measured by DIK-4000 Permeameter, 4 Fold Type)

Particle size & Coefficient of saturated water permeability at 10°C

Name of soil	Unit (K, cm/sec)
Gravel	1
Coarse sand	$1 \sim 10^{-1}$
Medium sand	$10^{-1} \sim 10^{-2}$
Fine sand	$10^{-2} \sim 10^{-3}$
Silty sand	$10^{-3} \sim 10^{-4}$
Silt · weathered clay	$10^{-4} \sim 10^{-7}$
“Inpreiou” rolled fill	$10^{-6} \sim 10^{-8}$
Intact clay	$10^{-7} \sim 10^{-9}$

* The above table is quoted from Skempton and Bishop (1954)

Calculation formula for saturated permeability



Coefficient of saturated water permeability

$$K = \frac{2.3 \cdot a \cdot L}{A \cdot t} \log_{10} \frac{h_1}{h_2} \text{ (cm/sec)}$$

- a ... Sectional area of scale tube (cm²): 0.503 cm²
- A ... Sectional area of sample (cm²): 19.6 cm²
- L ... Length of sample (cm): 5.1 cm
- t ... Time (sec)
- h₁ ... Height from the upper line of scale tube to free water level of the water dish (cm): 18 cm
- h₂ ... Height from the lower line of scale tube to free water level of the water dish (cm): 8 cm

Temperature correction for permeability coefficient (15°C)

$$K_{15} = K_T \times \frac{\eta_T}{\eta_{15}} \text{ (cm/sec)}$$

- K₁₅ ... Coefficient of water permeability at 15°C
- K_T ... Coefficient of water permeability at T°C
- η_T ... Viscosity of water at T°C
- η₁₅ ... Viscosity of water at 15°C

Viscosity of water (η_T) at T°C is calculated by following equation.

$$\eta_T = \frac{100}{2.1482[(Wt - 8.435) + \sqrt{8078.4 + (Wt - 8.435)^2}] - 120}$$

Wt ... Temperature of water