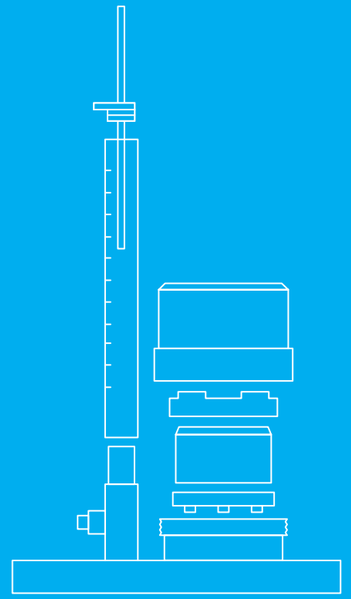
CE

Quick Guide
KSAT



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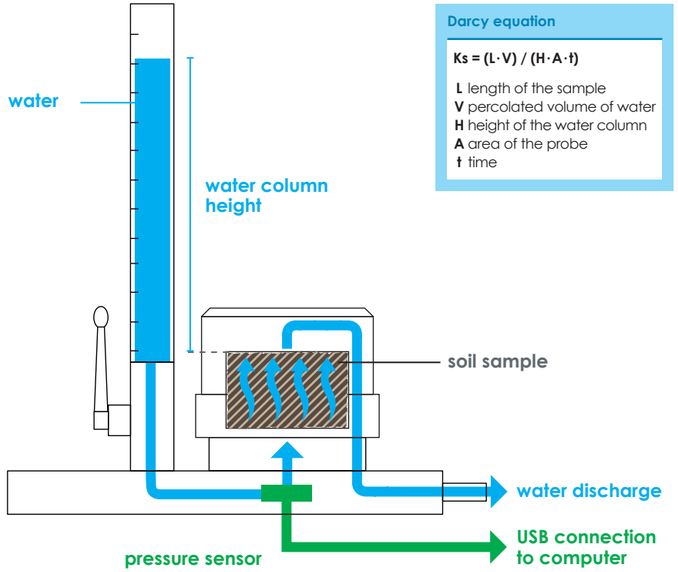
At a glance – how it works

The device measures the hydraulic conductivity, Ks, of saturated soil samples. Measurements are based on the Darcy equation.



Darcy equation

Ks = (L·V) / (H·A·t)

L length of the sample
V percolated volume of water
H height of the water column
A area of the probe
t time

Note: Key

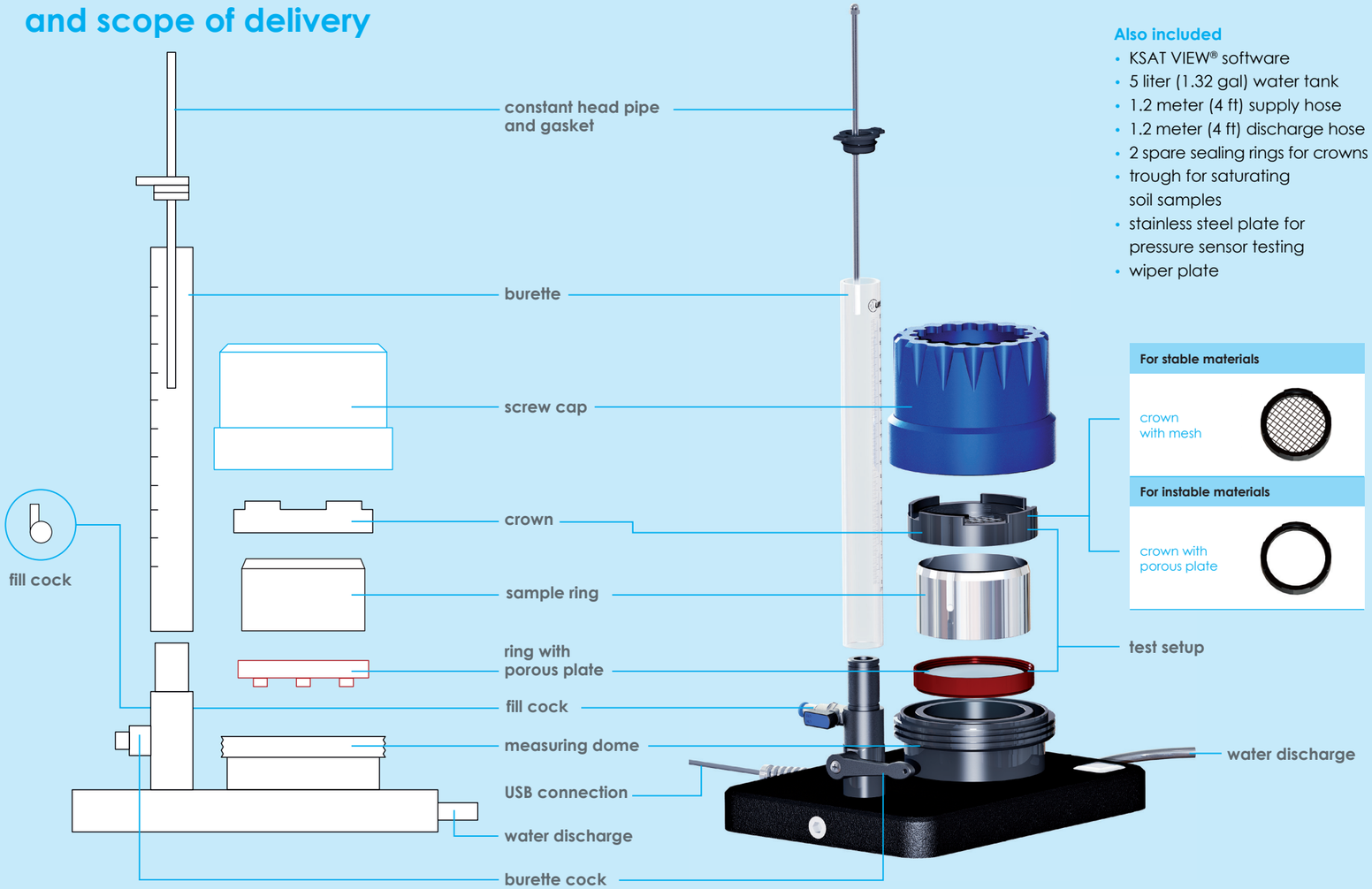
Illustrations
water, soil, electronics, saturated soil, air, all other parts

Instructions

The **blue** column gives step-by-step instructions on how to work with this device, e.g. „Put the sample ring on the ring with porous plate.“

The **grey** column shows the expected results of your work.

Parts of the device and scope of delivery



Also included

- KSAT VIEW® software
- 5 liter (1.32 gal) water tank
- 1.2 meter (4 ft) supply hose
- 1.2 meter (4 ft) discharge hose
- 2 spare sealing rings for crowns
- trough for saturating soil samples
- stainless steel plate for pressure sensor testing
- wiper plate

Facts and data

Technical data

Measurable Ksat values (min.)	0.01 cm/d (0.004 in/d)
Measurable Ksat values (max.)	5000 cm/d (2000 in/d)
Hydraulic conductivity Ks of the porous plate	Ks = 20000 cm/day (10000 in/d)
Typical statistical inaccuracy at constant environmental parameters and constant flow resistance of the soil	approx. 2% (in practice 10%)
Accuracy of the pressure sensor	1 Pa (0.01 cm WC or 0.000145038 psi)
Accuracy of the temperature sensor	0.2° C (0.4 F)
Sample ring (fits also with UMS HYPROP®)	volume: 250 ml (0.066 gal) height 50 mm (2 in), internal diameter: 80 mm (3.15 in)
Software required	Windows 7 and later Microsoft Framework 3.5

Intended use

The KSAT© device is suitable for measuring the hydraulic conductivity of saturated soil samples in a UMS sample ring. The method is based on the German standards DIN 19683-9 and DIN 18130-1 and uses Darcy's equation.

In the computation equations laminar flow is assumed and therefore they are only valid for low flow rates.

Warranty

UMS offers a warranty for material and production defects for this device in accordance with the locally applicable legal provisions, but for a minimum of 12 months. The warranty does not cover damage caused by misuse, inexpert servicing or circumstances beyond our control. The warranty includes replacement or repair and packing but excludes shipping expenses. Please contact UMS or our representative before returning equipment. Place of fulfillment is Gmunder Str. 37, Munich, Germany.

Initial operation

Put the KSAT VIEW CD into your computer or download software from **www.ums-muc.de/KSAT.zip**. Double click **ksat.msi** and follow the installation wizard.

The wizard assists you through the installion.

Connect the device to your computer's USB port.

Start the KSAT VIEW software.

The device connects automatically with your computer.

Connect the water supply and discharge hoses.

You are ready to measure!

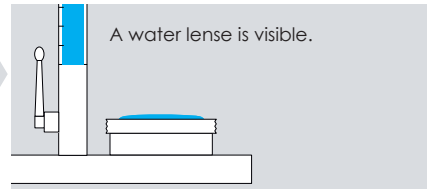
Note

For installing the KSAT VIEW software you may need administrator rights.

Setting zero point

Fill burette by opening the fill cock, then close it.

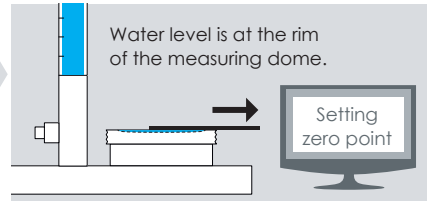
Fill measuring dome by opening the burette cock.



Put wiper plate on the water lense and and take it horizontally off.

Select „Setting zero point“ in the software.

Select „Setting zero point“ button.



Note: pressure reading

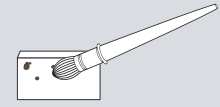
In the mode „measuring“ the screen shows the value -6.9 cm (-3 in) water column after setting zero point. This is because the measuring setup is 6.9 cm (3 in) high.

Measuring

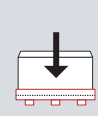
Saturating the soil sample

Take the sample ring with the soil out of the transportation box.

Take lids off and clean the sample ring.

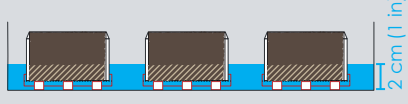


Put the sample ring on the ring with porous plate.



Put both rings into the trough.

Fill in 2 cm (1 in) of degassed water with similar ionic composition as the soil sample.

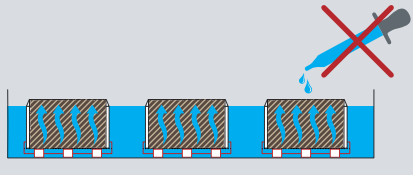


Raise the water level almost to the sample height (recommended times see below)

Do not pour water on the sample – you may trap air.

Use the time table below for a reference to determine how long samples take to saturate.

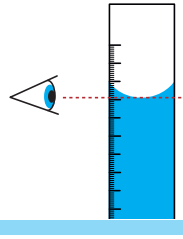
Sample surface shines.



Note: How long saturation typically takes

material	fill up after (approx.)	saturated after (approx.)
coarse sand	9 min	10 min
fine sand	45 min	1 hrs
silt	6 hrs	24 hrs
clay	n.a.	up to 2 weeks

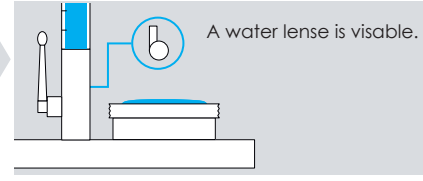
Note: Reading a meniscus in the burette correctly



Preparing the measurement

Open fill cock and fill burette.

Close fill cock, open burette cock and flood the measuring dome.



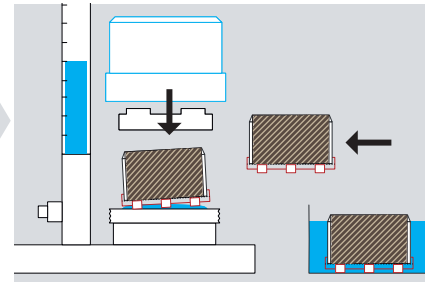
Close burette cock.

Take the soil sample out of the trough and move it horizontally to the device.

Put the sample slightly tilted on the water lense, to make sure air can escape.

Put the crown on the sample ring.

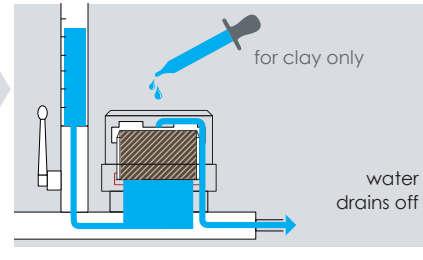
Fix the measuring set up with the screw cap.



Fill burette again.

Open burette cock until water drains off through the discharge.

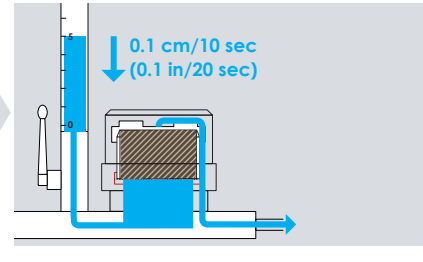
Clay samples may be „watered“ to reduce time.



Fill burette with up to 5 cms (2 in) water column.

Open burette cock and check if sink rate is approx. 0.1 cm/10 sec (0.1 in/20 sec).

If it is significantly less you may add water into the burette to increase the driving pressure and to reduce measuring time.



Note: burette vs screen reading

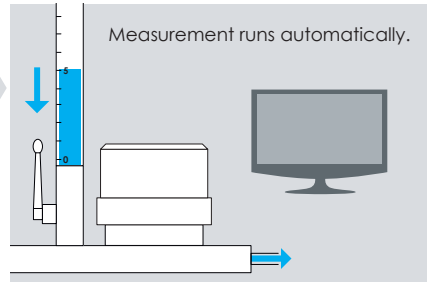
The measuring setup is tight if the meniscus is at zero after the water has drained off.
The pressure reading on the screen may slightly differ by ± 0.1 cm (approx. 0.05 in).

Measuring with falling head technique

Fill burette with up to 5 cm (2 in) water column.

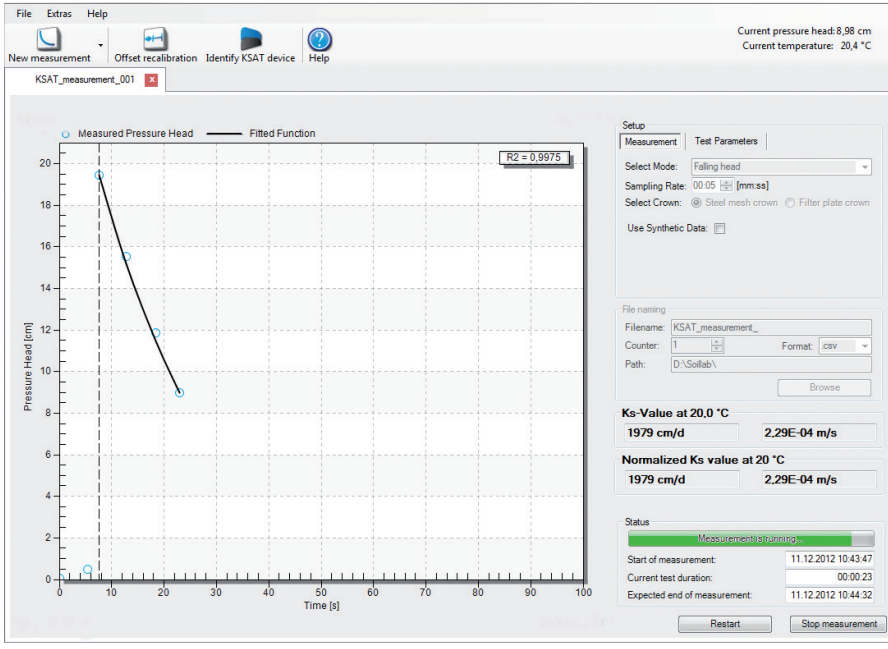
Start measuring mode „Falling Head“ in the software.

Open burette cock quickly.



Note: How long measuring with falling head and constant head takes

The ballpark duration is seconds to a few minutes for very conductive substrates like sand (~1000 cm/d or 400 in/d), whereas measuring substrates like unstructured clay with very low conductivity (< 0,1 cm/d or 0,05 in/d) may take about 24 hrs or longer.



The typical exponential curve shape.

Measuring with constant head technique

Fill burette with up to 20 cm (8 in) water column.

Insert constant head: capillary bottom immersed into the water down to e.g. 5 cm (2 in).

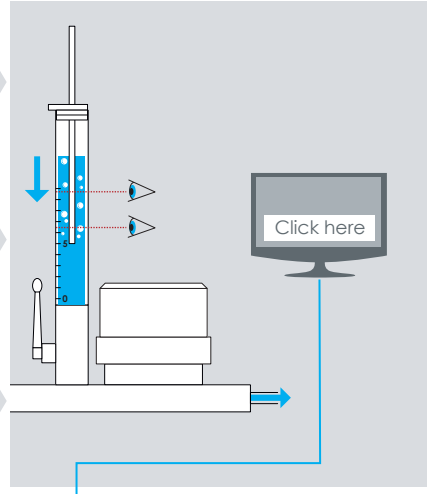
Select measuring mode „Constant Head“ in the software.

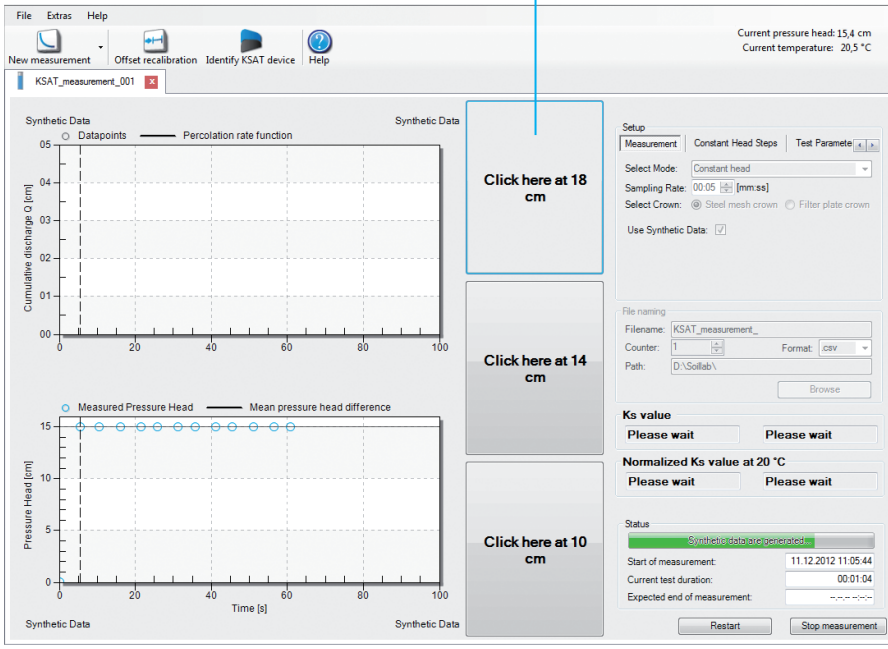
Enter water column levels you are going to read.

Press button „Start measuring“ in the software.

Open burette cock quickly.

Press button „Click here“ in the software when the water column passes the selected levels.



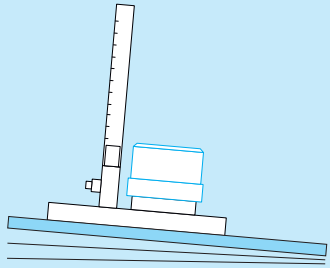


The typical constant curve shape.

How to avoid trouble

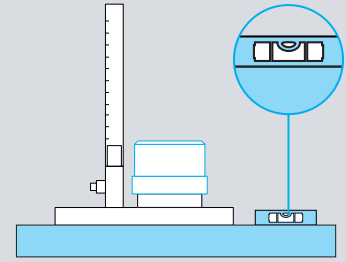
Set up and environment

Wrong



Shaky and tilted work table. Vibrations influence the measuring results.

Right

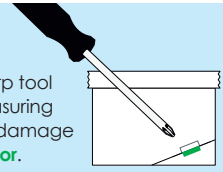


Stable, vibration-free work-table, adjusted with water level

Cleaning the measuring dome

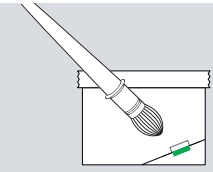
Wrong

Do not use a sharp tool to clean the measuring dome. You may damage the **pressure sensor**.



Right

Use a soft brush to clean the measuring dome.



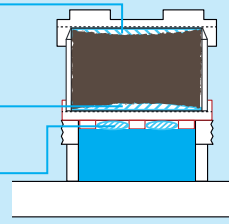
Trapped air

Wrong

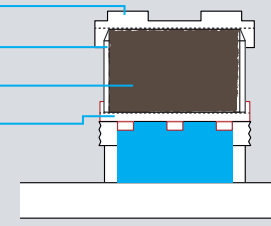
trapped air between crown and soil sample

between soil sample and porous plate

below the porous plate



Right



Leakage free measuring setup

Sample ring and/or sealing rings are dirty.

Clean all parts of the measuring setup epecially the sample ring and the sealing rings.

Flow rates

High flow rates erode the soil sample and lead to wrong measuring results. Air bubbles outgassing from the sample reduce the conductivity. Extremely high flow rates cause turbulent flow and invalidate the methodology.	Keep the flow rates as low as possible. The scientific literature recommends an initial water column of 5 cm (2 in).

Temperature influences

A temperature raise reduces the viscosity of the measuring fluid. E.g. increasing temperature from 20 to 23° C (68 to 73.4 F) causes a 18% change of the measuring result.	Measuring device, environment and water should have the same temperature. Keep the temperature of your lab constant.

Ion specification

Different ion composition and concentration of water and soil affect the value of the measured conductivity.	Make sure the ion composition and concentration of water and soil are similar. If necessary adjust by adding $CaCl_2$.

Outgassing from water

Dissolved gases outgas and form a bubble film between the porous plate and the soil sample. They reduce the value of the measured conductivity.	Use degassed water (Boiling before measuring is ok).

Outgassing from soil sample

Soil samples can pass air bubbles that form a film between the porous plate and the soil sample. They reduce the value of the measured conductivity.	Use degassed water. Saturate the soil sample in vacuum.

Water discharge

Eroded particles from instable materials like sand may plug the discharge channel of the device.	Clean the measuring dome, remove particles and rinse thoroughly.

Cleaning and maintenance

Storage

If you do not use the device for a longer period of time please discharge it completely. Dry all parts, to avoid algae growth or mold formation.

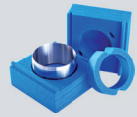
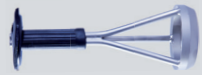
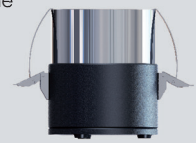
Cleaning

Clean all surfaces with a wet cloth. Make sure water does not dry out in the device. If there are soil particles in the device clean it with a soft gush of water. If needed use a soft brush for cleaning. Then rinse the device thoroughly. Do not forget to clean the threads of the dome and the screw cap with water and a brush.

Note: Cleaning

Do not clean the device with soap, detergents or other fluids containing surfactants as surfactants change the surface tension of the water. This has a significant impact on the measuring results.
The pressure sensor can be damaged by water jets or when being touched with hard and sharp objects like screwdrivers etc.

Accessories

Sample ring and Transport box		Standardized sample ring to gain intact soil samples with consistent volumes. In a transport box for optimum protection.
Hammering adaptor SZA		Soil samples can be taken carefully by using the hammering adaptor SZA250. The soil surface is always visible. Further the soil sample can pass the sample ring and the hammering adaptor.
HYPROP© Measuring system for determining the pF curve the and the unsaturated conductivity		The evaporation method according to Wind/ Schindler is a simple and fast technique to determine retention curves of soil samples in standard 250 ml soil sampling rings. The unsaturated conductivity is determined by measuring the soil water tension with miniature Tensiometers in two levels inside the sample, and then correlated to the soil water tension or the moisture content.