



# HUMBOLDT

## H-4112 Percometer



H-4112 shown with surface probe. Other probes available, see other side.

The Percometer is a reliable, accurate, lightweight and easy-to-use instrument for measuring the dielectric value ( $\epsilon_r$ ), electrical conductivity (J) and temperature of materials indoors and outdoors. Dielectric value is an indication of the volumetric moisture content and the state of molecular bonding in a material. Electrical conductivity is a reflection of ionic concentration, water content and temperature.

### **Moisture Damage** (Structural damage)

When moisture infiltrates a wall, causing damage,  $\epsilon_r$  values will be significantly higher than those from undamaged areas of the wall.

### **Tube Suction Test** (Aggregate moisture susceptibility)

Measuring the suction properties of bound and unbound aggregates and road materials. This passive capillary test demonstrates a materials' capacity to adsorb water if available, free water content directly affects mechanical performance of an aggregate.

### **Asphalt Air Voids** (Pavement quality control)

Air is also one of the volumetric components that influences  $\epsilon_r$ . Measuring  $\epsilon_r$  can provide an indication if a pavement has been sufficiently compacted.

### **Soil Moisture**

Since  $\epsilon_r$  is a function of the amount of free water in a material, Percometer can be an effective tool for determining soil moisture.

### **Frozen/Unfrozen** (Soils and Road Structures)

When the free water in a material freezes the conductivity drops to around zero and  $\epsilon_r$  values decrease to values ranging from 4 to 12.

### **Frost Susceptibility** (Soils and subgrade)

A strong correlation exists between  $\epsilon_r$  and frost susceptibility of unsaturated soils.

### **Salinity/Sulfates**

J is a function of soil salinity, colloid content and temperature. The presence and fraction of sulfates is an important factor in determining if road subgrade can be stabilized with lime

### **Fertility**

Forest regeneration species selection Regeneration potential of a soil can be assessed using  $\epsilon_r$  value.

### **Snow** (Ski wax control)

The amount of unfrozen water determines the friction properties of snow (slipperiness).  $\epsilon_r$  values provide an indication of this amount and can be used to determine how much fluor should be applied to skis.

**Temperature** Useful for evaluating whether changes in electrical conductivity are due to temperature or changes in ionic concentration.

# H-4112 Percometer

The Percometer utilizes two basic probe types, of which there are some variations. The surface probe has been designed for measuring tile walls, aggregate samples and liquids. While the probe utilizes non-destructive technology, its measurements have an effective penetration depth of 2 - 3 cm, depending on the medium. The tube probe has been designed for insertion into soft materials (minimum depth 10cm required for accurate measurements) and is ideal for measuring forest soils and road subgrade.

Percometer permits the use of multiple probes with the same central unit. Each probe is identified by the central unit by its unique probe number, and uses a probe-specific calibration table in the central unit's memory.

## PROBES

### Surface Probe SF (60mm dia.)

$\epsilon_r$  (1 to 40) with an accuracy of +/- (0.1 + 1%)  
Electrical conductivity (0 to 9999mS/cm)  
Temperature (-40 to +80C)  
Recommended applications: Laboratory use, Tube Suction Test, detection of moisture in structures with even surfaces (e.g. behind shower room tiling)

### Surface Probe SV (60mm dia.)

$\epsilon_r$  (1 to 200) with an accuracy of +/- (0.25 + 2%)  
Electrical conductivity (0 to 9999mS/cm)  
Temperature (-40 to +80C)  
Recommended applications: Laboratory use (high  $\epsilon_r$ )

### Short Tube Probe TFS (L = 18 cm)

$\epsilon_r$  (range: 1 to 15) with an accuracy of +/- (0.05 + 1%)  
Electrical conductivity (0 to 9999mS/cm)  
Temperature (-40 to +80C)  
Recommended applications: Laboratory tests, e.g. triaxial testing of aggregates

### Short Tube Probe TVS (L = 18 cm)

$\epsilon_r$  (range: 1 to 90) with an accuracy of +/- (0.25 + 2%)  
Electrical conductivity (range: 0 to 9999mS/cm)  
Temperature (range: -40 to +80C)  
Recommended applications: Percostation; laboratory tests

### Long Tube Probe TVL (L = 100 cm)

$\epsilon_r$  (range: 1 to 90) with an accuracy of +/- (0.25 + 2%)  
Electrical conductivity (range: 0 to 9999mS/cm)  
Temperature (range: -40 to +80C)  
Recommended applications: Field measurements (high  $\epsilon_r$ )

### Long Tube Probe TFL (L = 100 cm)

$\epsilon_r$  (range: 1 to 15) with an accuracy of +/- (0.05 + 1%)  
Electrical conductivity (range: 0 to 9999mS/cm)  
Temperature (range: -40 to +80C)  
Recommended applications: Field measurements

### Surface Probe SF1 (diam = 60 mm)

$\epsilon_r$  (range: 1 to 200) with an accuracy of +/- (0.1 + 1%)  
Temperature (range: -40 to +80C)  
Recommended applications: Laboratory use

## Operating Modes

The Percometer can be operated in two different modes:

**Local Operating Mode:** the standard mode of operation when using the Percometer as a hand-held stand-alone measuring instrument. All relevant information is displayed on the unit's LCD and the device itself is operated using an integrated keyboard.

**Remote Operating Mode:** the Percometer is operated, via modem or serial connection, using special software supplied with the unit. All relevant values are shown on the PC display and the central unit's integrated keyboard is inactive.

## Dielectric value ( $\epsilon_r$ ) measurements

- Measurement range varies according to probe type
- Measurement frequency: 40 - 50 MHz
- Measurement method:  $\epsilon_r$  is measured through the change in the electrical capacity of the electrode (probe) attributable to the influence of the material being measured. The term dielectric constant  $\epsilon_r$  is used here to indicate the real part of the complex relative dielectric permittivity ( $\epsilon_r$ ).
- $\epsilon_r$  measurements are reliable when the conductivity of the material being measured is:
  - < 1000  $\mu\text{S/cm}$  for Tube Probe measurements
  - < 2000  $\mu\text{S/cm}$  for Surface Probe measurements

## Conductivity (J) Measurements

- Measurement range: 0 to 9999  $\mu\text{S/cm}$
- Measurement frequency: 2 kHz square wave signal

## Data storage, PC connection

- Number of measurements stored: 1000
- 24 calibrated probes can be attached to a Percometer:
- Data transfer to PC via RS232; modem optional

## Power supply and battery management

The Percometer is powered by an internal 12 V, 1.5 Ah battery, which ensures a minimum of 8 hours continuous operating time. It can also operate using a +9 to +14 V external power supply.



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