

Novel sensor for measuring matric water potential in the soil

Equitensiometer



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Equitensiometer EQ/Basic and EQ/Adapter

Sensor for measuring matric water potential from 0 to -1500 kPa (0 to -15 bar)



User Manual

Version 2.1

Introduction

Equitensiometer is an instrument that measures matric soil water potential (ψ_m), defined as the amount of work that must be done per unit quantity of water in order to transport reversibly and isothermally an infinitesimal quantity of water, identical in composition to the soil water, from a pool at the elevation and the external gas pressure of the point under consideration, to the soil water (Glossary of Soil Science Terms, Soil Science Society of America (SSSA), July 1987). If the specified quantity is volume, the potential is referred to as pressure (Pascal). Matric soil water potential (resulting from combined effects of capillarity and adsorptive forces within the soil matrix) is the main component of total soil water potential. In the non-saline soils the total soil water potential (ψ_T) is equal to the matric potential.

There are important differences between soil water content (θ_m) and soil water potential (ψ_T). Water content describes the amount of water in a given amount of soil relative to the mass of oven dry soil, but does not give information on the availability of this water to plants. For example, a given plant could be turgid and growing very well in a sandy soil with 10% vol./vol. but in clay soil with the same water content the same plant could be wilting badly and dying (Passioura, 1982). Studies on soil water-plant-relationship need therefore information on soil water availability, i.e. equilibrium and flow. This is best described by the water potential of the soil, a thermodynamic approach whereby potential energy rather than forces are used. This is what Equitensiometer measures, hence an appropriate sensor for researchers interested in plant-soil interactions.

Installation

To operate Equitensiometer you need:

Power: DC 5-15 Volt

Data collection/display device: Analogue differential channel of data logger
for voltage measurement
or Voltmeter

For installation you need:

A soil coring device e.g. Gimlet with 4 cm diameter, spade and water

Make a hole in the soil with diameter > 4 cm and to the desired depth, fill it with the supplied quartz powder mixture (suspension) and insert immediately the Equitensiometer into the hole. After sedimentation, the head of the sensor should be completely buried in the quartz powder.

Equitensiometer (EQ/Basic, EQ/Adapter)

The sensor can be installed vertically, horizontally or in an inclined position. Compared to other soil water sensors, disturbing the natural soil texture does not affect the readings of Equitensiometer.

Conditions of use

Except for soils with high salt contents (e.g. Saline desert soils or synthetic soils with high potassium content), Equitensiometer can be used in almost all other soil types. Physical soil properties (such as humus content, stone content, soil density, soil structure, air pockets, pH values) have no influence on sensor accuracy and operation.

Wiring and logger connections

Equitensiometer is supplied with four core screened cable, which provides these connections:

Brown	Power supply positive +	Connected to	Battery or DC adapter 5-15 V DC
White	Power supply negative -		
Yellow	Output signal positive +		Differential analogue channel of data logger or voltmeter
Green	Output signal negative -		
Braid	Cable screen, not connected within the probe		

The braid screen should be connected to an analogue earth on the logger or other measuring unit.

Calculating the matric potential from the mVolt values of output

The output values of Equitensiometer have the unit mVolt. Relationship between the mVolt values and matric potential is shown in the calibration table supplied with the sensor (last page of this manual). With this table you can easily convert the mVolt values into Kilopascal (kPa). It is also a simple Windows software for converting mVolt values into Kilopascal available.

Each sensor is individually calibrated and the calibration table is only applicable to Equitensiometer with the particular serial number.

Care and Maintenance

Equitensiometer is watertight and sealed and requires no routine maintenance. Soil drying or flooding does not affect sensor functioning. However, during frost period Equitensiometer will provide wrong output, the mVolt values will exceed the maximum of the calibration data. The sensor should not be in contact with any chemical solutions.

Technical specification

Type:	EQ15
Measurement parameter:	Water matric potential in soil
Range:	0 to -1500 kPa (0 to -15 bar)
Accuracy:	For conductivity of soil solution <1 mS/cm Between 0 kPa and -100 kPa: <10 kPa Between -100 kPa and -1500 kPa: 10%
Hysteresis:	Very low, similar as transducer tensiometers
Use area:	Hydrological and plant physiological monitoring in soil, controlling irrigation devices
Environment:	Will withstand burial in wide ranging soil types for long periods
Interface:	Input requirements: 5-15 V DC unregulated Current consumption: max. 23 mA Output signal: 100 -800 mV DC
Case material:	Stainless steel
Dimensions and weight:	Length×width×thickness =17 cm×4 cm×2 cm, cable length = 5m, max. length: 100 m, weight 350 g without cable.