

# SOIL SALINITY / CONDUCTIVITY METERS

In irrigation areas, one is often confronted with salinization problems. In order to acquire the necessary understanding regarding these issues, it is very important to check the salinity of the soil regularly. Also in examining ecosystems that are influenced by salt water (lagoons, etc.), it is necessary that we know the salinity of the soil. In some countries, salinization problems can occur in road shoulders, as a consequence of salt sprinkling in winter.

Determination of the soil salinity is possible by taking soil samples and having these examined in a laboratory. However, this method is labour-intensive and requires transport as well as the availability of a laboratory.

Eijkelkamp Agrisearch Equipment has developed a probe which enables its user to determine the salinity of a soil electrically. This probe is called the EC-probe (Electrical Conductivity). In combination with an earth resistivity meter, the resistivity of the soil is measured,

and this reading is subsequently converted into electrical conductivity. This conductivity depends on the structure and texture of the soil, and the moisture content and salinity of the groundwater. This method is less accurate than a soil sample analysis in a laboratory set-up, but for an estimate of the salinity this method is highly satisfactory. When one has sufficient reference samples, the EC-probe can be used to perform many comparative measurements in a certain area in a short period of time.

Also included in our product range is the WET sensor, to measure pore water conductivity and temperature in the top layer of a soil. The measurement values are shown on the display of the hand held meter and can be stored in the memory (including time and sensor location). These data can be read on a PC.

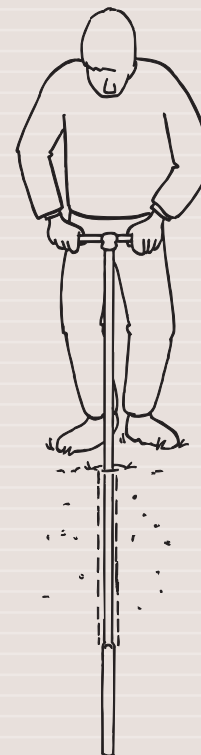
**14.01 EC-probe for salinity measurements, standard set for readings to a depth of 1 m**

The EC-probe consists of a stainless steel bar, provided with a detachable handle.



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**The gouge auger is used to pre-drill a hole.**



**The probe is pushed into the hole.**



EC-probe for soil salinity measurements, standard set

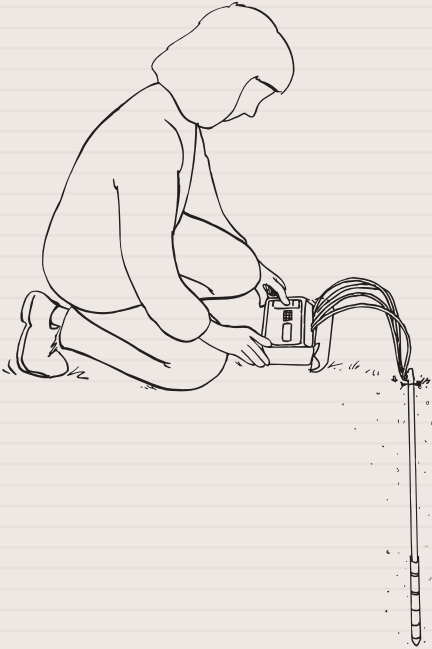


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Having connected the EC-probe to the resistivity meter, the latter is subsequently read off.



The bar is provided with a 10 cm graduation.

Inside the actual probe, at the bottom of the bar, there are four electrodes, separated by a sealing ring and an insulation ring.

To facilitate measurements with the EC-probe, proper contact (= low contact resistance) with the surrounding soil is necessary.

To establish proper contact, first the gouge auger is used to make a pilot hole to the desired depth. The drilled out soil can be used as a reference sample to determine the calibration curve.

In every EC-measurement, the temperature of the soil stratum that is to be read must also be measured.

For this purpose, the tip of the probe is provided with a temperature sensor. Having measured the earth resistivity, the temperature correction factor is determined.

The temperature coefficient can be read before the electrical conductivity is calculated.

The standard set includes: the EC-probe, an earth resistivity meter, the single gouge auger, a spatula, and a strong transport bag.

### Advantages

- Operates quickly and easily.
- Saves labour and laboratory research.
- Is relatively inexpensive compared to laboratory research.
- Earth resistivity meter comes in splashproof, shock-resistant synthetic housing.

One limitation is that this research method is less accurate than a soil sample analysis in a laboratory set-up (however, it is much faster.)



EC-probe



Earth resistivity meter

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## 19.33 W.E.T Sensor, set for direct measurement of water content, soil temperature and conductivity of soil and substrates

The W.E.T. sensor has been developed together with, amongst others, the Institute of Agricultural and Environmental Engineering (IMAG-BV), Wageningen, the Netherlands. The WET sensor measures three vital soil properties directly within the soil: Water content, Electrical conductivity and Temperature. The sensor is unique in its ability to measure pore water conductivity, which is the EC of the water that is available to the plant. Traditionally this measurement has been made by the time-consuming and error-prone method of extracting pore water from the soil by suction, before measuring it with a standard conductivity meter. In contrast, the WET sensor is simply pushed into the soil (or other growing medium) and then read directly using the hand held meter. The measurement is made possible by use of an integrated circuit specially developed at IMAG in order to measure accurately the permittivity and conductivity of the bulk soil. From this

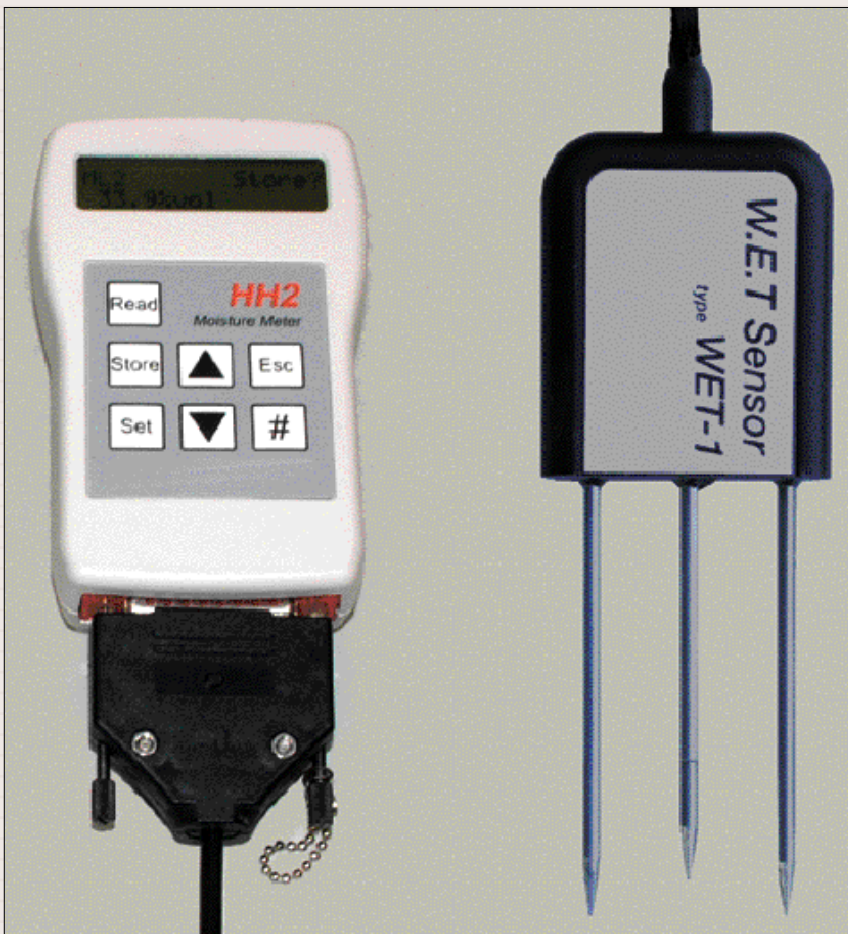
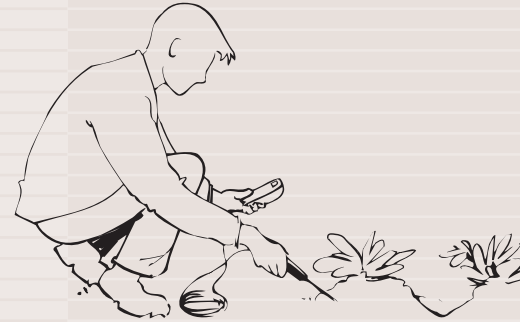
the conductivity of the pore water is calculated using a unique mathematical model. The model eliminates the need for soil specific calibration and makes the readings insensitive to the degree of contact between probe and soil. The three-pin probe is specially designed both for ease of insertion into the soil and to enable local measurements of permittivity and conductivity. It is the combination of these features which enables the pore water conductivity to be calculated reliably from the dielectric readings. The software provided with the WET sensor processes the dielectric data from the probe, calculates and displays the pore water conductivity, and saves the readings to a data file.

The standard set includes: the WET sensor, a hand held meter, the software and a carrying bag.

### Specifications

Probe output: TTL serial data from which is calculated:  
ECp: conductivity of pore water and the volumetric soil moisture. Permittivity, bulk conductivity and

**The WET sensor is used to monitor the effects of irrigation with saline water.**



WET sensor, standard set

**Testing the substrate for nutrient availability with the WET sensor.**





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**The measurements can be read out and processed on a PC.**



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temperature can be read directly. Measuring ranges: Permittivity 1-80, Bulk conductivity 0-200  $\text{mS}\cdot\text{m}^{-1}$ , Temperature -5 to 50°C, volumetric soil moisture 0-1  $\text{m}^3\cdot\text{m}^{-3}$ . Accuracy: Permittivity  $\pm 2.5$ , Bulk conductivity  $\pm 10 \text{ mS}\cdot\text{m}^{-1}$ , Temperature  $\pm 0.7$ , Volumetric soil moisture  $\pm 0.03 \text{ m}^3\cdot\text{m}^{-3}$ , Pore water conductivity depends on water content and conductivity. Response time: ~5 seconds. Calibration: suitable for a variety of standard soil types. Environmental sealed to IP67, connector to IP65. Operating temperature: 0 to 50 °C. Power: Typically 38 mA for 2.5 seconds. Probe dimensions: housing 55x45x10 mm, rods: 68 mm x diameter 3 mm.

### Applications

Salinity monitoring:

The WET sensor probe readings can be compared directly, to give an indication of the likely yield loss associated with the conditions the crop is actually experiencing. The WET sensor is also invaluable for checking in-field variability, and monitoring the effects of irrigation with saline water.

Plant nutrient status and fertigation:

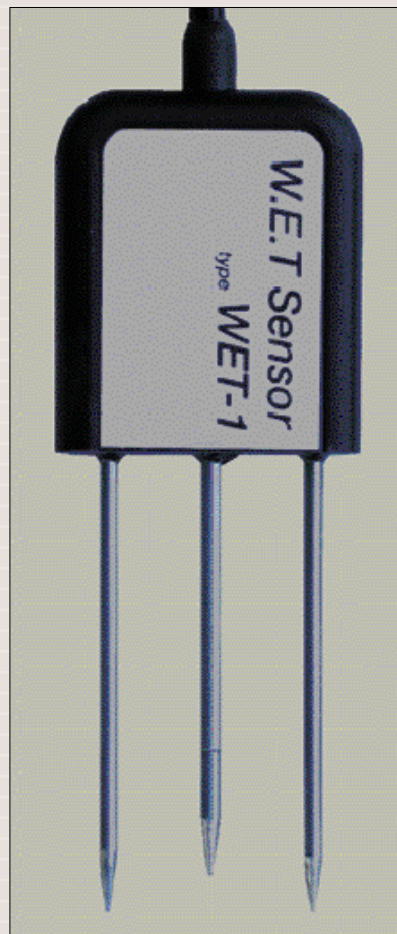
The WET sensor enables rapid testing of nutrient variability, and checking against a baseline, and is expected to be particularly useful for monitoring nutrient availability for organic crops.

Pollution and land reclamation:

Land reclamation and leachate management require monitoring the build-up of dissolved salts and pollutants over large heterogeneous sites. The WET sensor offers a rapid way of sampling the build-up of these chemicals within the pores of the soils, and so assessing the effect on plant growth.

Soil moisture mapping:

The ideal technique for mapping soil moisture content in precision agriculture would be very rapid, non-invasive, and would also deliver information about the moisture profile. Not even the WET sensor can do this! However water content can easily be calculated from bulk conductivity once the pore water conductivity is known.



WET sensor



Hand held meter