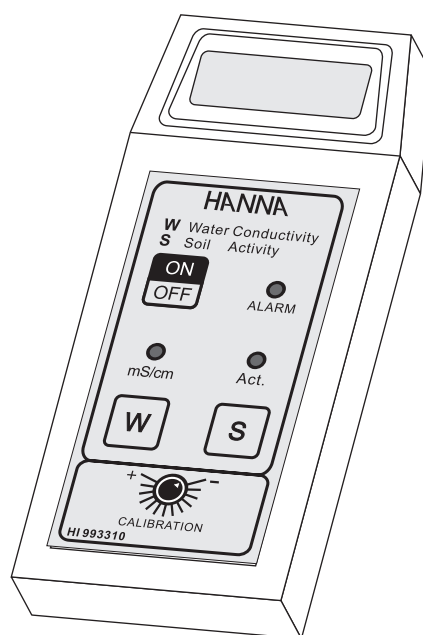

Instruction Manual

HI 993310

Portable Water Conductivity & Soil Activity Meter



Dear Customer,

Thank you for choosing a Hanna product.

Please read this instruction manual carefully before using the meter. This manual will provide you with the necessary information for correct use of the instrument, as well as a more precise idea of its versatility. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com.

This instrument is in compliance with the **CE** directives.

WARRANTY

All Hanna Instruments **meters are warranted for two years** against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. **The electrodes and the probes are warranted for a period of six months.** This warranty is limited to repair or replacement free of charge.

Damages due to accidents, misuse, tampering or lack of prescribed maintenance are not covered.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization number from the Customer Service department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

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PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any noticeable damage, notify your Dealer or the nearest Hanna office immediately.

The meter is supplied with:

- **HI 76304** plastic body, conductivity probe with built-in temperature sensor and 1 m (3.3') cable
- **HI 76305** probe for direct soil measurements with stainless steel conic tip, built-in temperature sensor and 1 m (3.3') cable
- one 9V battery & Instruction manual

Note: Save all packing materials until you are sure that the instrument functions correctly. Any damaged or defective item must be returned in its original packing materials together with the supplied accessories.

GENERAL DESCRIPTION

The soil activity, the conductivity of nutritive solutions, irrigation water and saturated soil-paste are important parameters for growers and horticulturists.

With **HI 993310** it is possible to directly measure, in a quick and simple way, the soil activity in the ground as well as the conductivity of irrigation water, nutritive solutions and saturated soil-paste.

The meter is supplied with two probes: **HI 76305** with stainless steel conic tip for direct soil measurements, and **HI 76304** for fertilizer enriched solutions.

The meter allows readings in two different scales and is provided with two LED's for indicating which parameter is being tested.

HI 993310 is also equipped with an alarm LED that automatically lights up if the soil is too dry, or nutritive substances are lacking.

Calibration for conductivity measurements can be performed with a simple knob located on the front of the meter, and, since the conductivity and the soil activity are correlated parameters, the soil activity measurements are calibrated through the conductivity calibration.

Conductivity measurements are influenced by temperature, while the soil activity depends on the soil texture and its hydric property; both the supplied probes incorporate a temperature sensor which allows the meter to automatically compensate for the temperature variations.

HI 993310 comes in a rugged splashproof case suitable to outdoor measurements.

SOIL ACTIVITY

SOIL ACTIVITY

Plants absorb nutritive elements dissolved in irrigation water. The ion concentration of the soil solution depends on the type of soil. Soil can be rich or poor in nutrients depending on its chemical composition and its property in retaining water and chemical elements. For example, clay soil retains more water than sandy soil since it holds more cations and has a greater microporosity, so that there is a different availability of ions for the roots.

If the soil is dry, fewer ions are at plant's disposal. This is the reason why conductivity readings have to be considered referring to water presence and soil type.

The **HI 76305** soil probe makes it easier to control the soil conditions and to manage the crops.

SOIL PROBE

The **HI 76305** soil probe provides a rapid response and an easy way to test the soil activity in a variety of applications, as fertilization and irrigation.

How to use the soil probe:

- Insert the probe in the soil where the roots are more dense or numerous.
- The recommended depth is 10-15 cm (4-6") for lawn and young plants, 20-30 cm (8-12") for vegetables and small plants.
- For plants with deep roots (e.g. trees, maize, sunflower, etc.), take measurements at different depths, e.g. 30 and 50 cm (12 and 20").
- Take measurements in more spots to have a representative average.
- The soil has to be wet. If the soil is dry, add demineralized water.
- The probe tip must be in complete contact with the soil. If the substrate is too soft, press it with your fingers to achieve a proper contact.
- Wait until the value on the display is stabilized.

FERTILIZATION

By measuring the salt contents in soil and substrates, before and after the fertilization, it is possible to have information about the soil fertility and to design an appropriate fertilization plan. Consequently, the plants will receive the right quantity of nutrients resulting in a regular and rapid growth, greater resistance to disease and a more appealing state manifesting their well being.

The younger plants, especially those that have just germinated, are

particularly sensitive to soil activity. They require a lower quantity of fertilizer because they utilize the reserve of nutrients in the seed. This is true even for resistant species such as sugar beet and alfalfa.

Later on, plants can grow faster with proper fertilization, particularly in conjunction with optimum lighting and temperature.

If slow releasing fertilizers are employed, their effectiveness can be regularly controlled by testing the soil activity.

HIGH SOIL ACTIVITY

Soluble salts are indispensable for plant nutrition. However, when dosed in excess, they can cause various anomalies as toxicity, alteration of the nutrient absorption equilibrium, difficulty in absorbing water, changing of the pH value and damaging of the soil structure. For accurate pH measurements, use the Hanna **HI 99121** pH meter, specially dedicated to soil application.

Some types of soils are naturally rich in salts. Apart from these, an excessive use of fertilizers must be avoided and particular attention must be paid to the use of water with high salt concentration.

If high values are detected, use the appropriate techniques to reduce the presence of salts (washing away irrigation, reduction of fertilizer dosages, addition of gypsum if the activity is caused by sodium, etc.).

IRRIGATION

Low measured values can be due to dry soil. In this case, add demineralized water to the soil, and then repeat the tests. Even soils rich in nutrients can give low values if they are not wet enough. Irrigation schedules can then be made based on the measured value. In case of waterlogged soil, very high values indicate stressed plants.

Find in the following pages a table with some indicative values for soil activity required by some common plants.

ORNAMENTAL PLANTS & FLOWERS	IDEAL VALUES
Amaranthus	0.4-0.6
Anthurium	0.2-0.4
Azalea	0.3-0.5
Begonia	0.3-0.6
Chrysanthemum	0.4-0.7
Croton	0.2-0.4
Cyclamen	0.4-0.6
Dahlia	0.4-0.5
Dieffenbachia	0.4-0.6
Dracaena	0.2-0.4
Euphorbia	0.4-0.6
Ficus	0.4-0.7
Gerbera	0.4-0.6
Kalanchoe	0.2-0.5
Lilium	0.3-0.6
Orchid	0.2-0.4
Pelargonium	0.2-0.4
Peperomia	0.3-0.5
Philodendron	0.4-0.6
Rose	0.2-0.5
Saintpaulia	0.3-0.5
Violet	0.2-0.4
LAWN	IDEAL VALUES
Lawn	0.1-0.4
ORCHARD	IDEAL VALUES
Apricot	0.2-0.4
Orange	0.1-0.3
Cherry	0.2-0.4
Lemon	0.1-0.3
Apple	0.2-0.3
Walnut	0.2-0.4
Pear	0.2-0.4
Peach	0.2-0.4
Plum	0.2-0.4
Grapevine	0.2-0.4

VEGETABLES & HERBACEOUS CULTIVATIONS	IDEAL VALUES
Asparagus	0.2-0.4
Sugar beet	0.3-0.5
Carrot	0.2-0.4
Cauliflower	0.3-0.5
Cucumber	0.3-0.5
Onion	0.2-0.5
Watermelon	0.2-0.4
Cotton	0.2-0.4
Lettuce	0.3-0.5
Maize	0.3-0.5
Egg plant	0.2-0.4
Melon	0.2-0.4
Bean	0.2-0.4
Strawberry	0.2-0.4
Wheat	0.2-0.4
Oat	0.2-0.4
Potato	0.2-0.5
Pepper	0.2-0.4
Pea	0.2-0.3
Tomato	0.2-0.6
Soybean	0.2-0.3
Spinach	0.2-0.4
Tobacco	0.2-0.4

WATER CONDUCTIVITY

NUTRITIVE SOLUTIONS

The nutritive solutions constitute one of the most important factors in determining the plant's growth and yield. Hence, putting the right solution at the plant's disposal is indispensable to get the best result.

Conductivity (EC) of nutritive solutions must be checked regularly to ensure that it agrees with plant's requirements. The plants also have seasonal preferences, typically requiring lower concentrations in the summer.

PLANT	PREFERRED EC VALUES
Asparagus	1.50-2.00 mS/cm
Watermelon	1.50-2.50 mS/cm
Carrot	1.50-2.00 mS/cm
Cabbage	2.00-3.00 mS/cm
Cucumber	2.00-3.00 mS/cm
Chrysanthemum	1.50-2.50 mS/cm
Onion	1.50-2.00 mS/cm
Bean	2.00-2.50 mS/cm
Strawberry	2.00-2.50 mS/cm
Lettuce	1.00-1.50 mS/cm
Egg plant	2.50-3.00 mS/cm
Melon	1.50-2.50 mS/cm
Potato	2.00-3.00 mS/cm
Pepper	2.00-3.00 mS/cm
Pea	1.00-1.50 mS/cm
Tomato	2.50-5.00 mS/cm
Celery	2.00-2.50 mS/cm
Marrow	2.00-2.50 mS/cm

IRRIGATION WATER

The irrigation water must be checked regularly, especially in the hydroponics industry. Conductivity is the most important parameter to check since plants can be seriously damaged by too high EC value.

Water used for irrigation has been classified in four classes, depending on its conductivity:

Class I	EC < 0.75 mS/cm
Class II	EC = 0.75 to 2.50 mS/cm
Class III	EC = 2.50 to 4.00 mS/cm
Class IV	EC > 4.00 mS/cm

Class I: This type of water can be used without any quantity limitation.

Class II: Only a limited quantity should be used depending on the irrigation techniques and the crop.

Class III: May be used occasionally, but only for tolerant plants and/or well-drained soils.

Class IV: To be used only if there is no other alternative and as little as possible.

SATURATED SOIL-PASTE CONDUCTIVITY

The conductivity value of the saturated soil-paste can be used for classifying the salinity level of the soil and also provides indications about the soil productivity, depending on plants (see also the table on next page for reference).

Response of cultivations depends also from different saturated soil-paste conductivity values.

Find below a schematic classification made by the *U.S. Salinity Lab. Riverside - CA*.

- EC = 0 mS/cm : the salinity effect is negligible.
- EC = 2 mS/cm : the crop of the more sensible cultivations can be reduced.
- EC = 4 mS/cm : the crop of many cultivations is reduced.
- EC = 8 mS/cm : only tolerant plants produce a satisfactory crop.
- EC = 16 mS/cm : only a few very tolerant plants produce a satisfactory crop.

Tolerance of some common plants to the soil conductivity (Ayers & Westcot, 1976).

- EC_0 = maximum of tolerated soil conductivity (salinity).
- EC_{75} = with this soil conductivity value the 75% of the maximum yield is produced.
- EC_{100} = minimum soil conductivity value, then the yield starts decreasing.

ORCHARD	EC_0 (mS/cm)	EC_{75} (mS/cm)	EC_{100} (mS/cm)
Grapevine	12	4.1	1.5
Orange & Lemon	8	3.3	1.7
Apple & Pear	8	3.3	1.7
Walnut	8	3.3	1.7
Plum	7	2.9	1.5
Peach	6.5	2.9	1.7
Apricot	6	2.6	1.6
VEGETABLES & HERBACEOUS CULTIVATIONS			
Melon	16	5.7	2.2
Spinach	15	5.3	2.0
Cauliflower	13.5	5.5	2.8
Tomato	12.5	5.0	2.5
Watermelon	10	4.4	2.5
Potato	10	3.8	1.7
Lettuce	9	3.2	1.3
Pepper	8.5	3.3	1.5
Carrot	8	2.8	1.0
Onion	7.5	2.8	1.2
Strawberry	4	1.8	1.0
Oat	28	13	8
Cotton	27	13	7.7
Sugar beet	24	11	7
Soybean	10	6.2	5.0
Maize	10	3.8	1.7
Bean	6.5	2.3	1.0

How to prepare the saturated soil-paste samples for analysis

A) Soil extraction:

- 1) Extract the soil as indicated below:
 - Take one sample for every 1000 m² (0.25 acre) of homogeneous plot of land.
 - For smaller plots, at least 2 samples are recommended (the more samples are taken, the more representative the end-result will be).
- 2) Avoid extracting samples from soil showing obvious anomalies. Treat this type of soil separately.
- 3) Take the same quantity of soil for each sample. For example, use bags with the same dimensions (1 bag per sample).
- 4) Depth of extraction:
 - General: dig and discard 5 cm (2") of the topsoil.
 - Herbaceous crops: from 20 to 40 cm (8" to 16").
 - Orchards: from 20 to 60 cm (8" to 24").

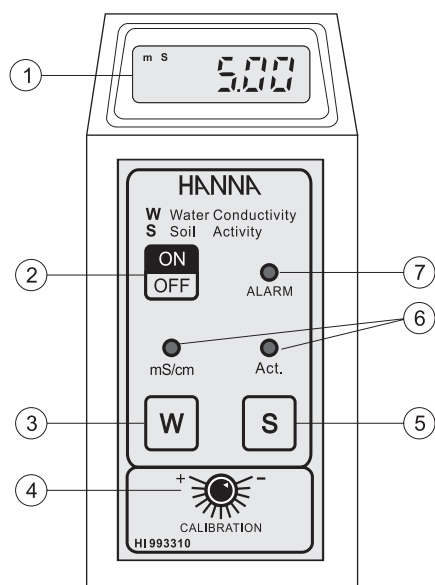
B) Soil sample preparation:

- 1) Spread the soil samples on the page of a newspaper and let them dry in a shady place, or in an oven at 40°C (104°F).
- 2) Crumble the dried soil and mix all the samples together to obtain an homogeneous mixture. Discard stones and vegetable residues.
- 3) From this mixture, take the soil sample for the analysis.

C) Saturated soil-paste preparation:

- 1) Strain the soil with a 2-mm sieve.
- 2) Mix for about 30 seconds one part of soil and two parts of distilled water.
- 3) Wait for 1 hour.
- 4) Filter the solution and measure the conductivity.

FUNCTIONAL DESCRIPTION



- 1) Liquid Crystal Display (LCD)
- 2) ON/OFF key
- 3) Water Conductivity selection key
- 4) Calibration knob
- 5) Soil Activity selection key
- 6) LED indicators
- 7) Alarm LED

SPECIFICATIONS

Range	Act. EC	0.00 to 1.00 0.00 to 19.99 mS/cm
Resolution	Act. EC	0.01 0.01 mS/cm
Accuracy (@20°C/68°F)		±2% F.S. (from 0 to 15.00 mS/cm) excluding probe error
Typical EMC Deviation		±2 % F.S.
Calibration		Conductivity: Manual, single-point through knob Soil Activity: calibrated through the conductivity range calibration
Temperature Compensation		Automatic, from 0 °C to 50 °C with $\beta = 2\%/^{\circ}\text{C}$
Probes (included)		HI 76305 stainless steel conic tip, ATC probe for direct soil meas. with 1 m (3.3') cable HI 76304 plastic body, ATC, conductivity probe with 1 m (3.3') cable
Alarm		Active when soil activity value is lower than 0.20 and higher than 1.00
Environment		0 to 50°C (32 to 122°F); max 95% RH non-condensing
Battery Type Life		1 x 9V (IEC 6LR61) alkaline approx. 100 hours of continuous use
Dimensions		185 x 82 x 52 mm (7.3 x 3.2 x 2.0")
Weight		275 g (9.7 oz.)

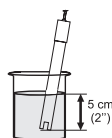
CALIBRATION

The soil activity range is calibrated by performing the calibration of the conductivity range.

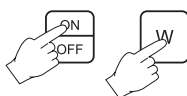
Should the soil activity measurements be not calibrated, contact the nearest Hanna service center for re-calibration.

CALIBRATION PROCEDURE

- Pour sufficient quantity of a conductivity calibration solution (e.g. **HI 7030**) into a beaker. If possible, use plastic beaker to minimize any EMC interference.
- Immerse the conductivity probe in the solution (approximately 5 cm/2").



- Press the ON/OFF button to turn the meter on, and then press the "W" button to enter the Water Conductivity mode.



- Wait a couple of minutes for thermal equilibrium to be reached.
- Turn the calibration knob until the display shows the conductivity value of the calibration solutions at 25°C (e.g. 12.88 mS/cm).



- All subsequent measurements will be compensated to 25°C (77°F).

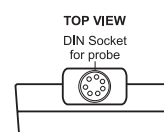
The calibration is now complete and the meter is ready for use.

Notes:

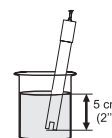
- It is recommended to calibrate the meter at least once a month, and every time the probe or the battery is changed.
- For more accurate measurements, use a calibration solution close to the range to be measured. See the "Accessories" section for a selection of conductivity calibration solutions.

OPERATIONAL GUIDE

- Each meter is supplied complete with a 9V battery. Slide off the battery compartment cover on the back of the meter and install the battery while paying attention to its polarity.
- Connect the proper probe to the meter: use **HI 76305** for measuring soil activity or **HI 76304** for conductivity.
- Securely connect the probe to the meter by aligning the pins with the socket and pushing the plug in. Always detach the probe by holding it by the connector (and not by the cable).



- Make sure the meter has been calibrated before taking any measurements.
- Immerse the conductivity probe into the sample to be measured (approximately 5 cm/2"). If possible, use plastic beakers or containers to minimize EMC interferences.



- For soil activity measurements, directly insert the stainless steel probe in the soil to a depth of 15 cm (6").
- Turn the instrument on by pressing the ON/OFF key.



- Press "W" if using conductivity probe for, or "S" if using soil probe.



Note: Change the probe for taking different type of measurement.

- For Water Conductivity range, wait a couple of minutes for reaching thermal equilibrium before taking any measurements. If the sample's temperature is lower than 20°C or higher than 30°C, allow more time for the thermal equilibrium to be achieved.
- The meter provides for a LED alarm when measuring soil activity. If the LED lights up, the soil is too dry for a proper measurement or it lacks nutritive substances. Wet the soil with a moderate quantity of demineralized water and carry out the measurement again. If the alarm LED lights up, the soil lacks nutritive elements.

Note: Before taking any soil measurement, it is recommended to rub the tip of the HI 76305 soil probe with fine sandpaper.

- After measurements have been completed, switch the meter off, or it will automatically turn itself off after approximately 2 minutes of non-use.
- Clean and dry the probes after use (see the below section).

PROBE MAINTENANCE

HI 76305

Clean the tip with fine sandpaper prior to each measurement. After use, dry the probe with a cloth.

HI 76304

Rinse with tap water after a series of measurements. If a more thorough cleaning is required, clean the probe with a dry cloth.

After probe cleaning, recalibrate the meter.

Recommendations for Users

Before using this product, make sure that it is entirely suitable for the environment in which they are used.

Operation of this instrument in residential area could cause unacceptable interference to radio and TV equipment, requiring the operator to take all necessary steps to correct interferences.

The metal band at the end of the probe is sensitive to electrostatic discharges. Avoid touching this metal band at all times.

During calibration of the instrument, ESD wrist straps should be worn to avoid possible damage to the probe by electrostatic discharge.

Any variation introduced by the user to the supplied equipment may degrade the instruments' EMC performance.

To avoid electrical shock, do not use these instruments when voltages at the measurement surface exceed 24VAC or 60VDC.

Use plastic beakers to minimize any EMC interferences.

To avoid damage or burns, do not perform any measurement in microwave ovens.

BATTERY REPLACEMENT

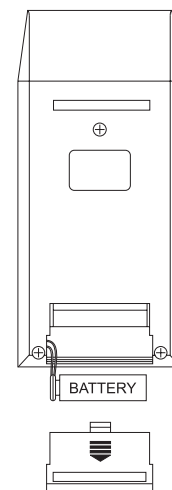
The instrument is powered by a 9 V battery and is provided with the Battery Error Prevention System (BEPS), which turns the unit off when a low battery signal is detected.

When the remaining battery level is less than 10%, the "V" tag lights up on the display to indicate a low battery condition.



It is recommended to replace the battery as soon as the low battery condition is detected.

Remove the cover on the meter's back by applying pressure in the indicated direction. Unplug the rundown battery and replace it with a new one.



Battery replacement must only take place in a non-hazardous area using a 9V alkaline battery.

ACCESSORIES

CONDUCTIVITY CALIBRATION SOLUTIONS

HI 7030L	12.88 mS/cm calibration solution, 500 mL bottle
HI 7030M	12.88 mS/cm calibration solution, 230 mL bottle
HI 7031L	1.41 mS/cm calibration solution, 500 mL bottle
HI 7031M	1.41 mS/cm calibration solution, 230 mL bottle
HI 7039L	5.00 mS/cm calibration solution, 500 mL bottle
HI 7039M	5.00 mS/cm calibration solution, 230 mL bottle

PROBES

HI 76305	Direct soil probe with stainless steel conic tip, built-in temperature sensor and 1m (3.3') cable
HI 76304	Conductivity probe for liquids with built-in temperature sensor and 1m (3.3') cable

OTHER ACCESSORIES

HI 710002	Soft carrying case (for meter only)
HI 710009	Blue rubber boot
HI 710010	Orange rubber boot
HI 721313	Rugged carrying case

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OTHER PRODUCTS FROM HANNA

- CALIBRATION AND MAINTENANCE SOLUTIONS
- CHEMICAL TEST KITS
- CHLORINE METERS
- DISSOLVED OXYGEN METERS
- HYGROMETERS
- ION SPECIFIC METERS
- MAGNETIC STIRRERS
- Na/NaCl METERS
- pH/ORP METERS
- PROBES and ELECTRODES
- PUMPS
- REAGENTS
- SOFTWARE
- THERMOMETERS
- TITRATORS
- TRANSMITTERS
- TURBIDITY METERS
- Wide Range of Accessories

Most Hanna meters are available in the following formats:

- BENCH-TOP METERS
- POCKET-SIZED METERS
- PORTABLE METERS
- PRINTING/LOGGING METERS
- PROCESS CONTROLLERS (Panel and Wall-mounted)
- METERS FOR FOOD INDUSTRY

For additional information, contact your dealer or the nearest Hanna Customer Service Center, or e-mail us at tech@hannainst.com.