

HANNA LITERATURE

Hanna publishes a wide range of catalogs and handbooks for an equally wide range of applications. The reference literature currently covers areas such as:

- Water Treatment
- Process
- Swimming Pools
- Agriculture
- Food
- Laboratory
- Thermometry

and many others. New reference material is constantly being added to the library.

For these and other catalogs, handbooks and leaflets, contact your dealer or the Hanna Customer Service Center nearest to you. To find the Hanna Office in your vicinity, check our home page at www.hannainst.com.

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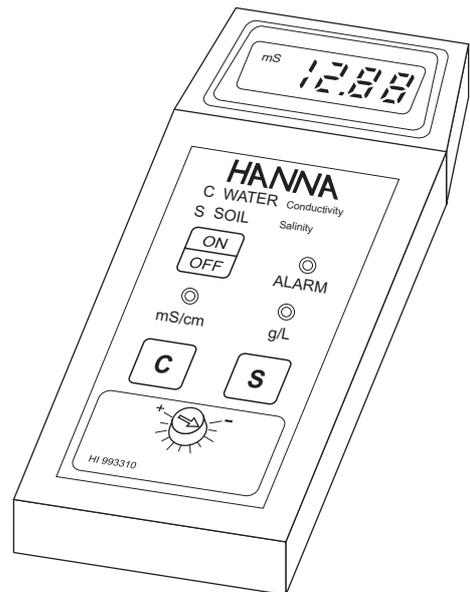


<http://www.hannacan.com>

Instruction Manual

HI 993310

Portable Water Conductivity & Soil Salinity Meter



These Instruments are in
Compliance with the CE Directives

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 a 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 techserv@hannacan.com.

These instruments are in compliance with the **CE** directives EN 50081-1 and EN 50082-1.

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OTHER PRODUCTS FROM HANNA

- CALIBRATION AND MAINTENANCE SOLUTIONS
- CHEMICAL TEST KITS
- CHLORINE METERS
- DISSOLVED OXYGEN METERS
- HYGROMETERS
- ION SPECIFIC METERS (Colorimeters)
- MAGNETIC STIRRERS
- Na/NaCl METERS
- pH/ORP/Na ELECTRODES
- pH/ORP METERS
- PROBES (DO, μ S/cm, RH, T, TDS)
- 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 METERS (Panel and Wall-mounted)
- WATERPROOF METERS
- METERS FOR FOOD INDUSTRY

For additional information, contact your dealer or the nearest Hanna Customer Service Center. You can also e-mail us at: techserv@hannacan.com.



Recommendations for Users

Before using these products, make sure that they are entirely suitable for the environment in which they are used.

Operation of these instruments 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 instruments, 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.

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.

Each meter is supplied with:

- HI 76304 conductivity (plastic) probe
- HI 76305 soil (stainless steel) probe
- 9V battery
- Screwdriver

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

HI 993310 is an instrument that has been specifically designed for rapid measurement of conductivity of liquids and soil. The meter is supplied with two probes, HI 76305 with a stainless steel, conic tip for direct soil measurement, and HI 76304 for fertilizer enriched solutions.

The meter allows you to read two different scales with two LED lights, on the front mask indicating which parameter is being tested. In addition, HI 993310 is equipped with an alarm LED that automatically comes on if the soil is too dry, or nutritive substances are lacking.

Calibration for conductivity measurements can be performed with a simple dial located on the front mask. It is not necessary to calibrate the meter for salinity measurements.

Both probes incorporate a temperature sensor and the meter compensates for the temperature automatically.

HI 993310 comes in a rugged splashproof case for outdoor measurements and the 9V battery lasts 100 hours of continuous use.

CONDUCTIVITY & SALINITY

The salinity of soil, nutritive solutions and irrigation water is an important parameter for growers and horticulturists. Conductivity of solutions and salinity have a close correlation.

With **HI 993310** its possible to measure, in a quick and simple way, the salinity directly in the ground as well as the conductivity of nutritive solutions and irrigation water.

The conductivity measurement in liquids is influenced by temperature whereas salinity of soil depends on the soil texture and its hydric property.

SOIL SALINITY

Plants absorb nutritive elements dissolved in irrigation water. The ion concentration of the soil solution depends on the type of soil. Consequently, 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.

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

The soil probe of **HI 993310** makes it easier to control the soil conditions and to manage the crops.

SOIL PROBE

The soil probe provides a rapid response and is an easy tool to test the salinity of soil in a variety of applications, among them:

FERTILAZATION

By measuring the salt contents in soil and substrates, before and after the fertilization, make it possible to know the soil fertility and to devise 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 salinity. 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.

ACCESSORIES

CONDUCTIVITY BUFFER SOLUTIONS

| | |
|----------|--------------------------|
| HI 7030L | 12880 μ S/cm, 460mL |
| HI 7030M | 12880 μ S/cm, 230mL |
| HI 8030L | 12880 μ S/cm, 460 mL |
| HI 8030M | 12880 μ S/cm, 230 mL |

CONDUCTIVITY PROBES

| | |
|----------|--|
| HI 76305 | Direct soil probe with 1 m cable and ATC |
| HI 76304 | Liquid probe with 1 m cable and ATC |

OTHER ACCESSORIES

| | |
|-----------|-----------------------------------|
| HI 710001 | Soft carrying case for meter only |
| HI 721313 | Rugged carrying case f |
| HI 710009 | Blue rubber boot |
| HI 710010 | Orange rubber boot |
| MAN993310 | Instruction manual |

Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

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 accident, 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.

To validate your warranty, fill out and return the enclosed warranty card within 14 days from the date of purchase.

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If slow releasing fertilizers are employed, one can regularly control their effectiveness by testing the soil salinity.

HIGH SALINITY

Soluble salts are indispensable for plant nutrition. However, when dosed in excess, they can cause various anomalies: toxicity, alteration of the equilibrium in nutrient absorption, difficulty in absorbing water, changing of the pH value and damaging the soil structure.

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 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 salinity is caused by sodium, etc.).

IRRIGATION

If the measured values are low it can be due to the fact that the soil is dry. In this case, repeat the tests after adding demineralized water to the soil. 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, the values can be very high indicating stressed plants.

How to use the soil probe

- The probe should be inserted 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 plant;
- For plants with deep roots (e.g. trees, maize, sunflower etc.), it is advised to measure at different depths (e.g., 30, 50 and 80 cm, that is 12, 20 and 32").
- Take the measure in more spots to have a representative average.
- The soil has to be wet. If the soil is dry, add demineralized water.
- The tip of the probe 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.

Find below some indicative values for common plants. For more precise values consult your local horticulturist:

| 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 |
| Grape vine | 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 |

BATTERY REPLACEMENT

When the battery voltage is low the meter will display "V".

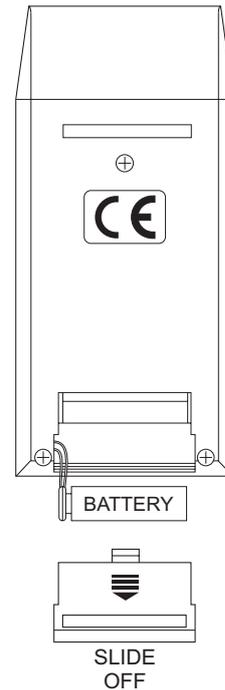


When the low battery indicator appears, the battery has only a few hours left. **HI 993310** will then automatically turn off itself to prevent erroneous measurements, due to low battery.

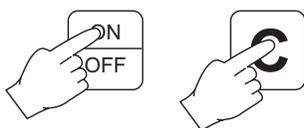
It is recommended to replace the battery immediately upon seeing the "V" symbol.

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

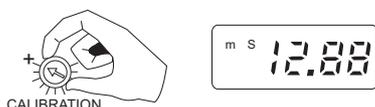
Slide off the battery compartment cover at the rear of the meter and replace the 9V battery with a new one. Make sure the battery contacts are tight and secure before replacing the cover.



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



- Wait for 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 (12.88 mS/cm).

- All subsequent measurements will be compensated to 25°C (77°F).
- The calibration is now complete and the instrument is ready for use.

The instrument should be recalibrated at least once a month, or when the probe or battery is changed.

Note: For more accurate results, it is advisable to use a calibration solution close to the range to be measured. See the accessories on page 9 for a selection of conductivity solutions.

PROBE MAINTENANCE

HI 76305 probe: Clean the tip with a fine sand paper prior to each measurement. After use dry the probe with a cloth.

HI 76304 probe: Rinse with tap water after a series of measurements. If a more thorough cleaning is required, clean the probe with a dry cloth.

After cleaning the probe, recalibrate the instrument.

| | |
|---------|---------|
| 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 |

| ORNAMENTAL PLANTS AND 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 |

LIQUID PROBE

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 with too high a value. Water used for irrigation has been classified in four distinct categories depending on its conductivity:

| | |
|-----------|----------------------|
| Class I | EC < 0.75 mS/cm |
| Class II | EC 0.75 - 2.50 mS/cm |
| Class III | EC 2.50 - 4.00 mS/cm |
| Class IV | EC > 4.00 mS/cm |

Class I: Any quantity of this type of water can be used without 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 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.

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 the plant's constitution. The plants also have seasonal preferences, typically requiring lower concentrations in the summer.

| PLANT | PREFERED EC VALUES |
|--------------|--------------------|
| Asparagus | 1.50-2.00 |
| Watermelon | 1.50-2.50 |
| Carrot | 1.50-2.00 |
| Cabbage | 2.00-3.00 |
| Cucumber | 2.00-3.00 |
| Crysanthemum | 1.50-2.50 |

than 30°C, allow more time for the thermal equilibrium of the system to be achieved.

- The meter provides for an LED alarm when measuring soil salinity. If the LED is lit it means that the soil is too dry for a proper measurement or it lacks nutritive substances. Wet the soil with a moderate quantity of demineralized water. Carry out the measurement again and if the LED comes on, it means that in the soil lacks nutritive elements (see page 5 for more details).

NOTE: Before any soil measurement, it is recommended that the tip HI 76305 (soil probe) is rubbed with a fine sandpaper.

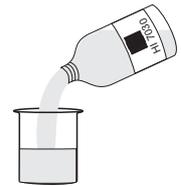
- After the measurement has been completed, the instrument can be switched off, or it will automatically turn itself off after approximately 2 minutes.
- The probes should be cleaned and dried (see "Probe Maintenance" on page 14), after each measurement.

CALIBRATION

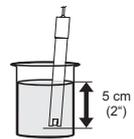
Calibration is not necessary for soil salinity tests.

PROCEDURE FOR WATER CONDUCTIVITY

- Pour sufficient quantity of a conductivity calibration solution (e.g. HI 7030) into a beaker. If possible, use plastic beakers (to minimize any EMC interference).

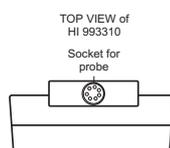


- Immerse the conductivity probe (approx. 5 cm/2").

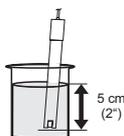


OPERATIONAL GUIDE

- Each meter is supplied complete with a 9V battery and two probes. Slide off the battery compartment cover on the back of the meter (see page 15). Install the battery while paying attention to its polarity.
- Connect the right probe for your measurement. Connect HI 76305 (stainless steel) for soil salinity or HI 76304 (plastic) for water conductivity
- Connect the probe to the meter securely by aligning the pins with the socket and pushing the plug in. Always detach the probe by holding on the connector (and not the cable).



- Make sure that the meter has been calibrated before taking any measurements (see page 7 for calibration).
- Immerse the conductivity probe into the sample (approx. 5 cm/2"). If possible, use plastic beakers or containers.
- For soil salinity measurements, directly insert the stainless steel probe to a depth of 15 cm (6") in the soil.
- Turn the instrument on by pressing the ON/OFF key.
- Press the "C" key for Water Conductivity or "S" for Soil Salinity measurement.



NOTE: Ensure that the probe is also changed when the type of measurement is changed

- In Water Conductivity mode wait for a couple of minutes for the temperature sensor to reach thermal equilibrium with the sample before taking measurements.
When the sample's temperature is lower than 20°C or higher

| | |
|------------|-----------|
| Onion | 1.50-2.00 |
| Bean | 2.00-2.50 |
| Strawberry | 2.00-2.50 |
| Lettuce | 1.00-1.50 |
| Egg plant | 2.50-3.00 |
| Melon | 1.50-2.50 |
| Potato | 2.00-3.00 |
| Pepper | 2.00-3.00 |
| Pea | 1.00-1.50 |
| Tomato | 2.50-5.00 |
| Celery | 2.00-2.50 |
| Marrow | 2.00-2.50 |

PREPARATION OF SAMPLE

To measure the conductivity of diluted soil solutions follow this procedure:

A) Sample preparation:

1) Extract the soil by:

- Taking one 1 sample for every 1000 m² (0.25 acre) of homogeneous plot of land;

- Even 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) Sample quantity:

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");

5) Spread the soil samples on pages of a newspaper and let the soil dry in a shady place, or in an oven at 40° C (104°F);

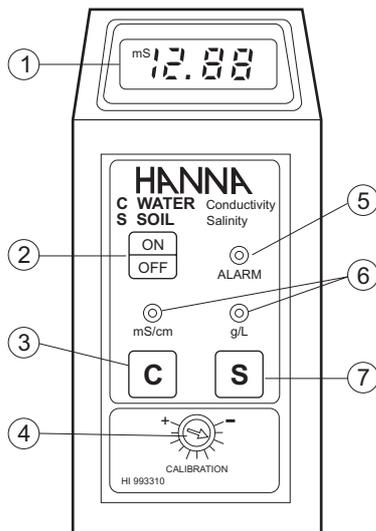
6) Crumble the dried soil and mix all the samples together to obtain a homogeneous mixture. Discard stones and vegetable residues;

7) From this mixture, take the soil sample for the analysis.

B) Soil solution preparation and measurement:

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

FUNCTIONAL DIAGRAM



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

SPECIFICATIONS

| | | |
|-----------------------------|--------------|--|
| Range | g/L mS/cm | 0.00 to 1.00 0.00 to 19.99 |
| Resolution | g/L mS/cm | 0.01 0.01 |
| Accuracy (@ 20°C / 68°F) | | 2% Full Scale from 0 to 15.00 mS/cm excluding probe error |
| Typical EMC Deviation | | ±2 % Full Scale |
| Calibration | | Water conductivity Manual single setpoint through trimmer Soil Salinity: Factory calibrated |
| Temperature Compensation | | Automatic from 0 °C to 50 °C with a β of 2% per degree °C |
| Probe (included) | | HI 76305, amperometric, steel, ATC, 1m cable HI 76304 amperometric, ATC, 1m cable Both probes are included |
| Alarm | | active when salinity value is lower than 0.20 and when salinity values is higher than 1.0 |
| Environment | | 0 to 50°C (32 to 122°F); max 95% RH non-condensing |
| Battery Type Life | | 9 Volt (alkaline) 100 hours of continuous use |
| Dimensions | | 185 x 82 x 45 mm (7.3 x 3.2 x 1.8") |
| Weight | | 355 g (13 oz.) |