

Instruction Manual

**PHH-200
Soil pH
Test Kit**



These Instruments are in
Compliance with the CE Directives



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OMEGA will add the CE mark to every appropriate device upon certification.

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WARNING: These products are not designed for use in, and should not be used for, patient-connected applications.

Dear Customer,

Thank you for choosing an Omega Engineering product. Please read the instruction manual carefully prior to use. It will provide you with necessary information for the correct use of the kit.


Remove the test kit 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 Omega Customer Service.

Each kit is supplied with:

- Portable pH meter
- pH electrode
- Soil drill
- Soil preparation solution
- Buffer solution pH 4.01 (1 pc.)
- Buffer solution pH 7.01 (1 pc.)
- Hard carrying case
- 100 ml plastic beaker (1 pc.)

Note: Any damaged or defective item must be returned in its original packing materials.

Battery replacement

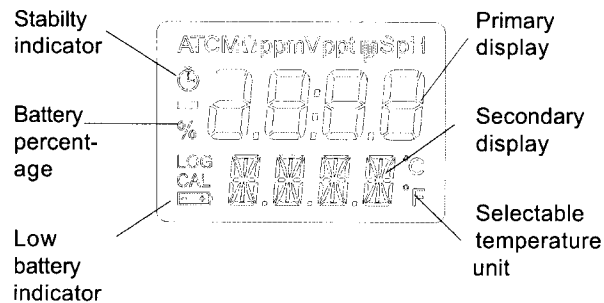
The meter displays the remaining percentage when turned on. When the battery level is below 5%, the  symbol on the bottom left of the LCD lights up to indicate a low battery condition. If the battery level is low enough to cause erroneous readings, the Battery Error Prevention System (BEPS) turns the meter off.

To ensure a watertight seal, the batteries are accessed by separating the front and back halves of the meter. The 4 Philips-head screws are located on the 4 corners of the back of the meter. Once the back has been removed, carefully replace the 3 AA batteries located in the battery compartment, paying attention to their polarity. Re-attach the back, making sure that the gasket is in place.

Portable pH Meter

SPECIFICATIONS

Range	pH	-2.00+16.00
	Temperature	-5.0 to 150.0°C or 23.0 to 221.0°F
Resolution	pH	0.01pH
	Temperature	0.1°C or 0.1°F
Accuracy (@20°C/68°F)	pH	±0.02pH
	Temperature	±0.5°C up to 60°C ±1°C up to 105°C ±1.0°F up to 140°F ±2°F up to 221°F
Typical EMC	pH	±0.02pH
Deviation	Temperature	±0.2°C or ±0.4°F
Temperature Compensation		Automatic
pH Calibration		Automatic 1 or 2 points with 2 sets of memorized standard buffers (pH 4/7/10)
Probe		PHE-200 pH/temperature probe (included)
Battery Type/Life		3 x 1.5V AA with BEPS / 500 hours
Environment		0 to 50°C (32 to 122°F); RH 100%
Dimensions		150x80x36mm (5.9x3.1x1.4")



OPERATIONAL GUIDE

To connect the probe

Connect the PHE-200 probe to the DIN socket on the top of the meter by aligning the pins and pushing in the plug. Tighten the nut to ensure a good connection. Remove the protective cap from the probe before taking any measurements.

To turn meter on and to check battery status

Press the ON/OFF/MODE button for 2 seconds. All the used segments on the LCD will be visible for a few seconds, followed by a percent indication of the remaining battery life. Eg. % 100 BATT.

To turn meter off

Press the ON/OFF/MODE button from normal measuring mode. OFF will appear on the bottom display.

To freeze the display

Press the SET/HOLD button for 2 seconds until HOLD appears on the bottom display. Eg. pH 5.73 hold.

Press any button to return to normal mode.

pH measurements & calibration

- Make sure the meter has been calibrated.
- If the electrode has been left dry, soak in pH 7 to reactivate.
- Place the tip of the probe in the sample to be tested.
- Shake the probe briefly while submerged and wait until the ¹ symbol on the top left of the LCD is turned off.
- The LCD will show the pH value automatically compensated for temperature and the temperature of the sample.
- If measurements are taken in different samples successively, rinse the probe tip thoroughly to eliminate cross-contamination; and after cleaning, rinse the probe tip with some of the sample to be measured.

Calibration buffer set

- Press the ON/OFF/MODE button for 6 seconds, until CAL on the bottom display is replaced by TEMP and the current temperature unit. Eg. TEMP °C.
- Press the ON/OFF/HOLD button again to show the current buffer set: pH 7 BUFF (for 4/7/10).

- Press the SET/HOLD button for changing the buffer set.
- Press the ON/OFF/MODE button to return to normal pH measuring mode.

pH calibration

- Press and hold the ON/OFF/MODE button for 3 seconds, until OFF on the bottom display is replaced by CAL.
- Release the button. The LCD will display pH 7 USE.
- For a *single point pH calibration*, place the probe in any buffer from the selected buffer set (eg. pH 7 or pH 4 or pH 10). The meter will recognize the buffer value and will display OK for 1 second.

If the pH 7 buffer was used, press the ON/OFF/MODE button to return to the pH measuring mode.

- For a *two point pH calibration*, place the probe in pH 7. The LCD will display the recognized buffer value and OK for 1 second and then display pH 4 USE.

Place the probe in the second buffer value (pH 4 or 10). When the second buffer is recognized, the LCD will display OK for 1 second and the meter will return to normal measuring mode.

To change the temperature unit (from °C to °F)

Press the ON/OFF/MODE button for 6 seconds, until CAL on the bottom display is replaced by TEMP and the current temperature unit. Eg. TEMP °C.

Use the SET/HOLD button to change the temperature unit, and then press ON/OFF/MODE until the meter returns to normal measuring mode.

To reset to the default calibration

To clear a previous calibration, press the ON/OFF/MODE button after entering the calibration mode. The bottom LCD will display ESC for 1 second and the meter will return to normal measuring mode. The "CAL" symbol on the LCD will disappear. The meter will be reset to the default calibration.

SOIL pH

pH is the measure of the hydrogen ion concentration $[H^+]$. Soil can be acid, neutral or alkaline, according to its pH value.

Fig. 1 shows the relationship between the scale of pH and types of soil. Most plants prefer a pH range from 5.5 to 7.5; but some species prefer more acid or alkaline soils. Nevertheless, every plant requires a particular range of pH, for optimum growth.

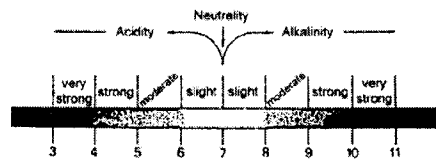


Fig. 1. Types of soil according to the pH value

pH strongly influences the availability of nutrients and the presence of micro-organisms and plants in the soil.

For example, fungi prefer acidic conditions whereas most bacteria, especially those supplying nutrients to the plants, have a preference for moderately acidic or slightly alkaline soils. In fact, in strongly acidic conditions, nitrogen fixing and the mineralization of vegetable residual is reduced.

Plants absorb the nutrients dissolved in the soil water and the nutrient solubility depends largely on the pH value. Hence, the availability of elements is different at different pH levels (Fig. 2).

Each plant needs elements in different quantities and this is the reason why each plant requires a particular range of pH to optimize its growth.

For example, iron, copper and manganese are not soluble in an alkaline environment. This means that plants needing these elements should theoretically be in an acidic type of soil. Nitrogen, phosphorus, potassium and sulfur, on the other hand, are readily available in a pH range close to neutrality.

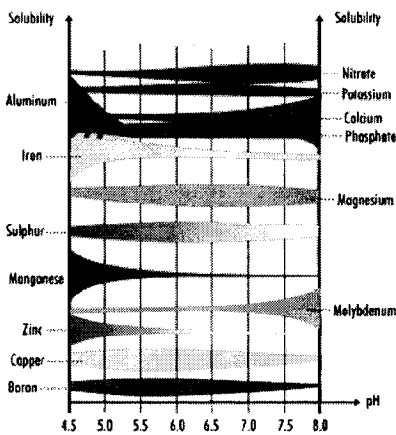


Fig. 2. Solubility of the elements according to varying pH values

Furthermore, abnormal pH values, increase the concentration of toxic elements for plants. For example, in acid conditions, there can be an excess of aluminum ions in such quantities that the plant can not tolerate.

Negative effects on chemical and physical structure are also present when pH values are too far from neutral conditions (break up of aggregates, a less permeable and more compact soil).

Management of the soil in relation to the pH value

Once the pH value is known, it is advisable to choose crops that are suitable for this range (e.g. in an acid soil, cultivate rice, potato, strawberry).

Add fertilizers that do not increase acidity (for example urea, calcium nitrate, ammonium nitrate and superphosphate) or lower alkalinity (e.g. ammonium sulfate).

It is recommended that a cost evaluation is made prior to commencement of the soil pH modification. Corrective substances can be added to modify the soil pH, however, the effects are generally slow and not persistent. For example, by

adding lime, the effects in clay soil can last for as long as 10 years, but only 2-3 years in a sandy soil.

For an acid soil, we can use substances such as lime, dolomitic, limestone and marl, according to the nature of the soil (Tab.1).

Soil Ameliorants	Clay soil	Silty soil	Sandy soil
CaO	30-50	20-30	10-20
Ca(OH) ₂	39-66	26-39	13-26
CaMg(CO ₃) ₂	49-82	33-49	16-33
Ca CO ₃	54-90	36-54	18-36

Tab.1. Quantity (q/ha) of pure compound necessary to increase 1 unit of pH

High pH levels can depend on different elements, hence, there are different methods for its correction.

- Soils rich with limestone :

Add organic matter (this is due to the fact that non-organic ameliorants such as sulfur and sulfuric acid might not make economic sense due to the large quantities needed).

- Alkaline-saline soils :

Alkalinity is due to the presence of salts (in particular a high concentration of sodium can be harmful).

Irrigation washes away salts, hence, an appropriate use of irrigation can provide positive results (drop-irrigation being the most recommended).

If alkalinity is caused by sodium, it is recommended to add substances such as gypsum (calcium sulfate), sulfur or other sulfuric compounds (Tab.2). Also in this case, a cost evaluation is necessary.

Soil ameliorants (pure compounds)	Quantity (Kg)
Calcium chloride: CaCl ₂ · 2H ₂ O	85
Sulfuric acid: H ₂ SO ₄	57
Sulfur: S	19
Iron sulfate: Fe ₂ (SO ₄) ₃ · 7H ₂ O	162
Aluminum sulfate: Al ₂ (SO ₄) ₃	129

Tab.2. Quantities provide the same result as 100 Kg of gypsum

Procedure for direct ground measurement

- 1) Dig, discarding 5 cm of topsoil
- 2) Perforate the soil, with soil drill, to a depth of about 20 cm or more
- 3) If the soil is dry, moisten it with a small amount of distilled water
- 4) Wash the electrode with tap water (not distilled)

- 5) Insert the electrode pushing it slightly into the soil to ensure proper contact
- 6) Observe the measurement
- 7) Wash the electrode with tap water (not distilled) and (using a finger) gently remove any soil remaining on the electrode (avoid using a rag or cloth)
- 8) Repeat the procedure in different locations in the field
- 9) Consider the average of the measured data

For best result, it is advisable to measure the pH of a soil solution, using a sample of soil and soil preparation solution; it is better to use this procedure if you have to test a stony field in which you risk damaging the electrode.

Procedure for the measurement of soil solution (1:2,5)

A) Sampling

1) Extracting Soil Sample

Take 1 sample per 1000 m² (0.25 acre) of homogeneous area

Even for small areas, 2 samples are recommended (the more the samples, the better the end-results, because the result is more representative)

2) Avoid extracting samples from soil presenting obvious anomalies and consider them separately

3) Sample quantity:

Take the same quantity of soil for each sample. For example, use bags with similar dimensions (1 bag per sample)

4) Depth of extraction:

General: dig and discard 5 cm (2") of topsoil

Herbaceous crops: from 20 to 40 cm of depth (8" to 16")

Orchards: from 20 to 60 cm of depth (8" to 24")

5) Spread the soil samples on the pages of a newspaper and let the soil dry in a shady place or put it in an oven at 40° C

6) Crumble the dried soil and mix all the samples together to obtain a homogeneous mixture, discarding stones and vegetable residues

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

B) Soil solution preparation and measurement

1) Sift the soil at 2 mm

2) Weigh 10 gr of soil and put it in 25 ml of soil preparation solution HI 7051 (utilize the apposite beaker) or 20 gr of soil per 50 ml of soil preparation solution

3) Mix for 30 seconds

4) Wait 5 minutes

5) Mix again and measure the pH of the solution

ORGANIC SUBSTRATE (PEAT AND MOULD)

pH measurement of organic substrates is important in greenhouses and nursery growing pots. pH should be checked at the outset to make sure that the pH of the substrate bought is that desired (pH can change if too much time elapses from the date of packaging to the moment of utilization).

A) Direct Measurement in pot

If the substrate is not wet, add a little distilled water. Insert the electrode into the soil and measure.

B) Measurement of the Organic Substrate Solution (1: 2 ratio).

Let the substrate dry;

Discard the coarse vegetable residues and pebbles;

In a beaker, prepare a solution composed of 1 part mould and 2 parts soil preparation solution PHTS-200 (for example: fill the beaker with the substrate up to 50 ml, press it gently, empty the content in an other container and add 100 ml of soil preparation solution PHTS-200);

Mix for 30 seconds and then wait for 5 minutes;

Mix again and measure the pH of the solution.

IRRIGATION WATER

The quality of irrigation water is a very important factor to consider. If the pH value is very far from neutral (pH=7), probably, other anomalies are present.

Ranges for evaluation of water quality:

- good from 6 to 8,5

it can be utilized without problems

- sufficient from 5 to 6 and from 8,5 to 9

sensible crops could have problems

- scarce from 4 to 5 and from 9 to 10

utilize it carefully, avoid wetting the vegetation

- very scarce with pH < 4 and pH > 10

There are other anomalies that have to be identified via chemical analysis.

NUTRIENT SOLUTION

A rational fertilization is needed for optimum growth of plants in greenhouses; the pH of a nutrient solution (water + fertilizer) has to meet the plants need. If you have a fertirrigation system with automatic pH control, ensure that it is functioning properly.

Check the pH of the solution distributed to the plants as well as any recycled solutions.

ORCHARD PLANTS

	Preferred pH Range		Preferred pH Range
Apple	5-6.5	Orange	5-7
Apricot	6-7	Peach	6-7.5
Cherry	6-7.5	Pear	6-7.5
Grapefruit	6-7.5	Plum	6-7.5
Grapevine	6-7	Pomegranate	5.5-6.5
Lemon	6-7	Walnut	6-8
Nectarine	6-7.5		

VEGETABLES AND HERBACEOUS CULTIVATIONS

	Preferred pH Range		Preferred pH Range
Artichoke	6.5-7.5	Pepper	6-7
Asparagus	6-8	Early Potato	4.5-6
Barley	6-7	Late Potato	4.5-6
Bean	6-7.5	Sweet Potato	5.5-6
Brussels Sprout	6-7.5	Pumpkin	5.5-7.5
Early carrot	5.5-7	Rice	5-6.5
Late carrot	5.5-7	Soybean	5.5-6.5
Cucumber	5.5-7.5	Spinach	6-7.5
Egg Plant	5.5-7	Strawberry	5-7.5
Lettuce	6-7	String	6-7.5
Maize	6-7.5	Sugar beet	6-7
Melon	5.5-6.5	Sunflower	6-7.5
Oat	6-7	Tomato	5.5-6.5
Onion	6-7	Watermelon	5.5-6.5
Pea	6-7.5	Wheat	6-7

LAWN

	Preferred pH Range
Lawn	6-7.5

GARDEN PLANTS AND FLOWERS

	Preferred pH Range		Preferred pH Range
Acacia	6-8	Ligustrum	5-7.5
Acanthus	6-7	Magnolia	5-6
Amaranth	6-6.5	Narcissus	6-8,5
Bougainvillea	5.5-7.5	Oleander	6-7.5
Dahlia	6-7.5	Oleander	6-7.5
Erica	4.5-6	Paulownia	6-8
Euphorbia	6-7	Portulaca	5.5-7.5
Fuchsia	5.5-7.5	Primula	6-7.5
Gentian	5-7.5	Rhododendron	4.5-6
Gladiolus	6-7	Roses	5.5-7
Hellebore	6-7.5	Sedum	6-7.5
Hyacinth	6.5-7.5	Sunflower	5-7
Iris	5-6.5	Tulip	6-7
Juniper	5-6.5	Viola	5.5-6.5

HOUSEPLANTS

	Preferred pH Range		Preferred pH Range
Abutilon	5.5-6.5	Gardenia	5-6
African violet	6-7	Geranium	6-8
Anthurium	5-6	Hibiscus	6-8
Araucaria	5-6	Jasmine	5.5-7
Azalea	4.5-6	Kalanchoe	6-7.5
Begonia	5.5-7.5	Mimosa	5-7
Camellia	4.5-5.5	Orchid	4.5-5.5
Croton	5-6	Palms	6-7.5
Cyclamen	6-7	Peperomia	5-6
Dieffenbachia	5-6	Philodendron	5-6
Dracaena	5-6	Yucca	6-7.5
Freesia	6-7.5		

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WARRANTY

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of 13 months from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal one (1) year product warranty to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components which wear are not warranted, including but not limited to contact points, fuses, and triacs.

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR WARRANTY RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR NON-WARRANTY REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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