



**STANDARD OPERATING PROCEDURE FOR:
DETERMINATION OF pH**

TVA-KIF-SOP-51

Prepared by
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for
Tennessee Valley Authority
Environment and Technology
Environmental Science and Resources

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1.0 PURPOSE

This standard operating procedure (SOP) provides the technical requirements and operational guidelines for determining the pH of water discharged during dredged fly ash dewatering operations at Tennessee Valley Authority's (TVA's) Kingston Fossil Plant (KIF) Ash Recovery Project. The pH is measured using a hand-held, portable pH meter.

2.0 GENERAL CONSIDERATIONS

Potential hazards associated with the planned tasks shall be thoroughly evaluated prior to conducting field activities. The *Site-Wide Safety and Health Plan (SWSHP)* provides a description of potential hazards and associated safety and control measures. A job safety analysis (JSA) has been performed for field laboratory testing operations and is included as Table 1 of this procedure.

Personnel performing this pH measurements are required to be familiar with the procedures detailed in this SOP and adhere to the documentation and procedural requirements outlined within this SOP. The TVA Field Laboratory Supervisor (or designee) ensures each employee is adequately trained and provides review of the data and oversight of the pH calibration and recorded field values.

Site personnel must wear nitrile gloves and SWSHP-approved safety glasses while performing the procedures described in this SOP.

The pH probes are appropriately cleaned prior to use in order to avoid cross-contaminating standards and samples.

3.0 PROCEDURES

This section documents the operating procedures and methods associated with determining the pH of a solution. Any deviation in these procedures must be approved by the Field Laboratory Supervisor and Quality Assurance (QA) Officer and fully documented.

Meters are calibrated, operated, and maintained in accordance with the manufacturer's user manual. The two meters currently used by the KIF Field Laboratory are the Hanna 9025 and the Hanna HI 98127. The manufacturer's instructions for calibration are included as attachments to this SOP (Attachments 1 and 2).

3.1 Meter Calibration

Calibration of pH meters is conducted using the steps below in accordance with the manufacturer's instructions prior to use. A two-point calibration, at a minimum, is performed to ensure the accuracy of the meter.

- a. Verify that the two pH standards used to calibrate the pH meter bracket the measurements expected from field activities estimated from historical data or measured using wide-range pH strips (such as Baxter pH strips) with a range of 0 to 14.
- b. Record the buffer solution values and temperatures used to calibrate the meter in the *Daily pH Calibration* logbook (Table 2). Buffer solution values vary with temperature. The temperature-adjusted values are acquired from the manufacturer of the buffer solutions and posted in the laboratory.
- c. Thoroughly immerse the pH probe in the buffer solution and calibrate to read the correct pH of the solution.
- d. Rinse the pH probe after calibration in the solution using deionized (DI) water and blot the probe free of liquid. Wash the probe thoroughly with DI water in order to ensure that the probe is free of one buffer prior to using another buffer.
- e. Record the readings from the pH meter calibration in the *Daily pH Calibration* logbook.

Note: During the calibration of pH meter HI 98128, the value for the first of two solutions will not be displayed prior to completing the calibration. Therefore, after completing the two-point calibration, rinse the pH probe with DI water, blot the probe free of liquid, and immerse in the first of two calibration solutions. Record the value in the *Daily pH Calibration* logbook (Table 2).

- f. Verify the accuracy of the pH meter after completing the two-point calibration of the meter.
- g. Rinse the probe thoroughly of the last buffer solution used. Blot the probe dry.
- h. Immerse the probe into the first (of two) buffer solution and record the reading. If the meter reads greater than ± 0.2 standard units (S.U.) of the expected value of the buffer, the meter requires recalibration. If still outside the acceptable value, the Laboratory Supervisor or designee is contacted. Any necessary maintenance is recorded in the *Daily pH Calibration* logbook (Table 2).

Note: To verify the accuracy of pH meter HI 98128 follow the manufacturer's instructions for calibration, followed by measurement of the pH 7.0 buffer solution. Record this reading as the Actual Value reading in Table 2.

3.2 Sample pH Measurement

Immediately after collection of a water sample (as directed by the appropriate sampling and analysis plan, and/or site management) the following steps are conducted.

- a. With the unit powered on, immerse the pH probe and associated temperature probe in the water sample making sure to not contact the sides and bottom of the container.
- b. Measure the temperature of the sample water making sure the temperature reading has stabilized, and record the value in the appropriate field logbook. The sample may be stirred or swirled to keep the sample homogeneous while measuring.
Note: Agitating the sample container may be required to keep the sample homogeneous while measuring the results in waters laden with processed ash.
- c. Read and record the pH reading in the logbook.
- d. Rinse the probe thoroughly with DI water and store the probe in accordance with the manufacturer's specifications.

3.3 Operational Check

Operational checks may be required during the course of a day if site conditions change (such as temperature) and are conducted as follows.

- a. Rinse the probe with DI water to prevent cross-contamination. Blot dry to remove excess water from the probe.
- b. Immerse the probe into pH 7.00 (or 7.01 depending on the manufacturer) buffer solution. If the expected value for the pH 7.00 solution differs by greater than ± 0.2 S.U., recalibrate the meter according to Section 3.1.

3.4 Logbook Documentation

Logbooks are maintained by the field and laboratory personnel and used to record daily sampling activities per the *Field Documentation* SOP (TVA-KIF-SOP-06). A laboratory *Daily pH Calibration* logbook (Table 2) is used to document daily calibration for the pH meters.

The Field Laboratory Supervisor and/or designee review the field and laboratory logbook entries on a weekly basis at a minimum for completeness and accuracy and indicate this review by initialing the entries.

3.5 Waste Management

The waste water that has been processed and analyzed for pH is managed in accordance with *Management of Investigation-Derived Waste* SOP (TVA-KIF-SOP-12).

Contaminated disposable media is managed as ash-contaminated waste, stored in plastic trash bags, and disposed with the other KIF site ash-contaminated waste in accordance with TVA-KIF-SOP-12.

4.0 REFERENCES

- Hanna Instruments Instruction Manual, pH Meter 98128.
- Hanna Instruments Instruction Manual, pH Meter 9025.
- Tennessee Valley Authority (TVA). *Field Documentation SOP* (TVA-KIF-SOP-06), 2009.
- TVA. *Management of Investigation-Derived Waste SOP* (TVA-KIF-SOP-12), 2009.
- TVA. *Site-Wide Safety and Health Plan for the TVA Kingston Fossil Plant Ash Release Response* (SWSHP), June 2009.
- TVA. *Quality Assurance Project Plan for the Tennessee Valley Authority Kingston Ash Recovery Project* (TVA-KIF-QAPP), December 18, 2009.

Table 1. Job Safety Analysis

Activity/Task: Laboratory Testing

Work Area: TVA KIF Field Laboratory

Date _____

Steps of Activity/Task	Potential Hazard	Safe Plan	Resources
General lab housekeeping	Crowded space with many supplies and instruments in small area.	Keep area neat and clean with supplies stored on shelves above working area. Keep walkways and floor areas free of equipment and supplies.	Shelves and other side of trailer available for storage.
	Lifting buckets of soils or coolers	Use proper lifting practices and a buddy to lift heavy coolers	
	Supplies stored above workspace.	Use step stool to access supplies stored above work space. Do not stand on chairs or tables to reach items above work space.	Step stool
Performing lab tests (moisture content, TSS, etc.)	Exposure to ash and aqueous samples collected from the ballfield and ash recovery system.	Wear safety glasses at all times in the laboratory. Wear gloves at all times when handling samples or equipment that comes in contact with samples.	Nitrile gloves, safety glasses, and eyewash available in lab.
	Glassware breakage and subsequent cuts and abrasions	Handle glassware carefully. Always discard or remove glassware from service if chipped, cracked or otherwise compromised.	
Using drying oven and moisture analyzers for moisture and TSS analyses.	Very hot inside oven and inside the moisture analyzers (110 degrees C). Pinch points around door of oven and lid for moisture analyzers.	Use gloves suitable for handling hot items when removing or adding samples to the oven and moisture analyzers. Keep hands free of pinch points around oven door and lids of moisture analyzers.	Use Teflon coated gloves or liners available in lab.

Steps of Activity/Task	Potential Hazard	Safe Plan	Resources
pH testing	Buffer solutions used for pH meter calibration.	Always wear proper PPE when using chemicals. Keep solutions stored in labeled bottles with lids secured when not in use.	MSDS
Use of TVA vehicle for sample collection and transport.	Low fluid levels or other malfunctioning equipment.	Complete daily walk around inspection of vehicle.	Document in logbook.

Signatures of Persons Involved in Review of JSA

(Supervisor signature/date)

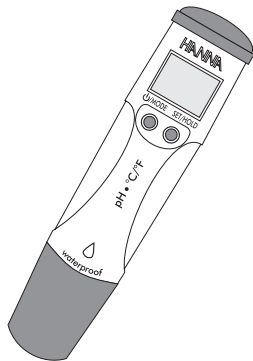
Work shall stop when conditions change, the job changes, or a deficiency is discovered, and the current JSA will be modified or new JSA created.

Attachment 1
Instruction Manual
(Waterproof pH Testers with Replaceable Electrode—HI 98128)

Instruction Manual

HI 98127 • HI 98128

Waterproof pH Testers with Replaceable Electrode



WARRANTY

HI 98127 and HI 98128 are warranted for one year against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. The electrode is 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 shipment costs prepaid. When shipping any instrument, make sure it is properly packaged for complete protection.

All rights are reserved. Reproduction in whole or in part is prohibited without the written consent of the copyright owner.

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

Dear Customer,

Thank you for choosing a Hanna product. This manual will provide you with the necessary information for correct operation. Please read it carefully before using the meter. If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com. These instruments are in compliance with the CE directives.

PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully. If any damage has occurred during shipment, immediately notify your Dealer or the nearest Hanna Customer Service Center.

Each meter is supplied with:

- HI 73127 pH electrode
- HI 73128 electrode removal tool
- batteries (4 x 1.5V) and instructions

Note: Conserve all packing material until the instrument has been observed to function correctly. Any defective item must be returned in its original packing.

US DESIGN PATENT
D462,024

GENERAL DESCRIPTION

HI 98127 and HI 98128 are waterproof pH and temperature meters. The housing has been completely sealed against humidity and designed to float. All pH readings are automatically temperature compensated (ATC), and temperature values can be displayed in °C or °F units.

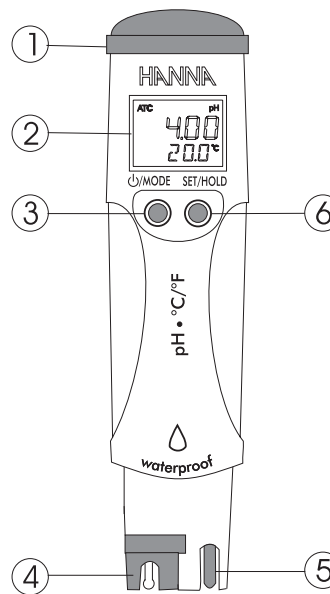
The meters can be calibrated at one or two points with auto-buffer recognition and against five memorized buffer values.

Measurements are highly accurate with a unique stability indicator right on the LCD.

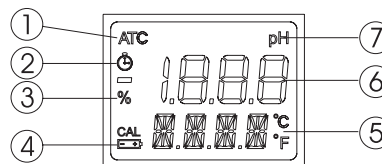
These meters are also provided with battery level indication at start-up, and with a low battery symbol which warns the user when the batteries need to be replaced. In addition the Battery Error Prevention System (BEPS) avoids erroneous reading caused by low voltage level by turning the meter off.

The HI 73127 pH electrode, supplied with the meters, is interchangeable and can be easily replaced. The stainless steel encapsulated temperature sensor facilitates faster and more accurate temperature measurement and compensation.

FUNCTIONAL DESCRIPTION

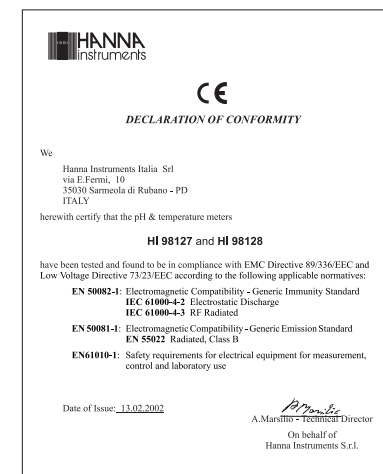


1. Battery compartment
2. Liquid Crystal Display (LCD)
3. ON/OFF/MODE button
4. HI 73127 pH electrode
5. Temperature sensor
6. SET/HOLD button



1. ATC (Automatic Temperature Compensation) indicator
2. Stability indicator
3. Battery life percentage indicator
4. Low battery indicator
5. Secondary display
6. Primary display
7. Measuring unit for primary display

CE DECLARATION OF CONFORMITY



Recommendations for Users

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

The glass bulb at the end of the electrode is sensitive to electrostatic discharges. Avoid touching the glass bulb at all times.

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

To avoid electrical shock, do not use this instrument when voltages at the measurement surface exceed 24 Vac or 60 Vdc. To avoid damages or burns, do not perform any measurement in microwave ovens.

ACCESSORIES

HI 73127	Replaceable pH electrode
HI 73128	Electrode removal tool
HI 70004P	pH 4.01 solution, 20 mL sachet (25 pcs)
HI 70006P	pH 6.86 solution, 20 mL sachet (25 pcs)
HI 70007P	pH 7.01 solution, 20 mL sachet (25 pcs)
HI 70009P	pH 9.18 solution, 20 mL sachet (25 pcs)
HI 70010P	pH 10.01 solution, 20 mL sachet (25 pcs)
HI 77400P	pH 4 & 7 solutions, 20 mL sachet (5 each)
HI 7004M	pH 4.01 solution, 230 mL bottle
HI 7006M	pH 6.86 solution, 230 mL bottle
HI 7007M	pH 7.01 solution, 230 mL bottle
HI 7009M	pH 9.18 solution, 230 mL bottle
HI 7010M	pH 10.01 solution, 230 mL bottle
HI 7061M	Electrode cleaning solution, 230 mL bottle
HI 70300M	Electrode storage solution, 230 mL bottle

SPECIFICATIONS

Range	-2.0 to 16.0 pH (HI 98127)
	-2.00 to 16.00 pH (HI 98128)
	-5.0 to 60.0°C / 23.0 to 140.0°F
Resolution	0.1 pH (HI 98127)
	0.01 pH (HI 98128)
	0.1°C / 0.1°F
Accuracy	±0.1 pH (HI 98127)
	±0.05 pH (HI 98128)
	±0.5°C / ±1°F
Typical EMC Deviation	±0.1 pH (HI 98127) ±0.02 pH (HI 98128) ±0.3°C / ±0.6°F
Temp. Compensation	Automatic
Environment	-5 to 50°C (23 to 122°F); RH 100%
Calibration	1 or 2 points with 2 sets of memorized buffers (pH 4.01/7.01/10.01 or 4.01/6.86/9.18)
Electrode	HI 73127 pH electrode (included)
Battery	4 x 1.5V with BEPS / approx. 300 hours
Auto-off	after 8 minutes of non-use
Dimensions	163 x 40 x 26 mm (6.4 x 1.6 x 1.0")
Weight	100 g (3.5 oz)

OPERATIONAL GUIDE

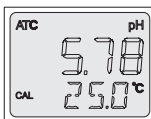
To turn the meter on and check the battery status

Press and hold the ϕ /MODE button until the LCD lights up. All the used segments on the LCD will be visible for 1 second (or as long as the button is pressed), followed by the percent indication of the remaining battery life (E.g. % 100 BATT).

Taking measurements

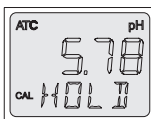
Submerge the electrode in the solution to be tested while stirring it gently. The measurements should be taken when the stability symbol \square on the top left of the LCD disappears.

The pH value automatically compensated for temperature is shown on the primary LCD while the secondary LCD shows the temperature of the sample.



To freeze the display

While in measurement mode, press the SET/HOLD button. HOLD appears on the secondary display and the reading will be frozen on the LCD (E.g. pH 5.78 HOLD).



To turn the meter off

While in normal mode, press the ϕ /MODE button. OFF will appear on the secondary display. Release the button.

Notes:

- Before taking any measurements make sure the meter has been calibrated (CAL tag present on the LCD).
- If measurements are taken in different samples successively, rinse the probe thoroughly to eliminate cross-contamination; and after cleaning, rinse the probe with some of the sample to be measured.

CALIBRATION

For better accuracy, frequent calibration of the instrument is recommended. In addition, the instrument must be recalibrated whenever:

- The pH electrode is replaced.
- After testing aggressive chemicals.
- Where high accuracy is required.
- At least once a month.

Calibration procedure

From normal measuring mode, press and hold the ϕ /MODE button until OFF on the secondary LCD is replaced by CAL. Release the button. The LCD enters the calibration mode displaying "pH 7.01 USE" (or "pH 6.86 USE" if the NIST buffer set was selected).

After 1 second the meter activates the automatic buffer recognition feature. If a valid buffer is detected then its value is shown on the primary display and REC appears on the secondary LCD. If no valid buffer is detected, the meter keeps the USE indication active for 12 seconds, and then it replaces it with WRNG, indicating the sample being measured is not a valid buffer.

For a **single-point calibration** with buffers pH 4.01, 9.18 or 10.01, the meter automatically accepts the calibration when the reading is stable; the meter displays the accepted buffer, with the message "OK 1". After 1 second the meter automatically returns to the normal measuring mode.

If a single-point calibration with buffer pH 7.01 (or pH 6.86) is desired, then after the calibration point has been accepted the ϕ /MODE button must be pressed in order to return to normal mode. After the button is pressed, the meter shows "7.01" (or "6.86") - "OK 1" and, after 1 second, it automatically returns to the normal measuring mode.

Note: It is always recommended to carry out a two-point calibration for better accuracy.

For a **two-point calibration**, place the electrode in pH 7.01 (or pH 6.86) buffer. After the first calibration point has been accepted, the "pH 4.01 USE" message appears. The message is held for 12 seconds, unless a valid buffer is recognized. If no valid buffer is recognized, then the WRNG message is shown. If a valid buffer (pH 4.01, pH 10.01, or pH 9.18) is detected, then the meter completes the calibration procedure. When the buffer is accepted, the LCD shows the accepted value with the "OK 2" message, and then the meter returns to the normal measuring mode.

Note: When the calibration procedure is completed, the CAL tag is turned on.

To quit calibration and to reset to the default values

• After entering the calibration mode and before the first point is accepted, it is possible to quit the procedure and return to the last calibration data by pressing the ϕ /MODE button. The secondary LCD displays "ESC" for 1 second and the meter returns to the normal measuring mode.

• To reset to the default values and clear a previous calibration, press the SET/HOLD button after entering the calibration mode and before the first point is accepted. The secondary LCD displays "CLR" for 1 second, the meter resets to the default calibration and the CAL tag on the LCD disappears.

SETUP

Setup mode allows the selection of temperature unit and pH buffer set.

To enter the Setup mode, press the ϕ /MODE button until CAL on the secondary display is replaced by TEMP and the current temperature unit (E.g. TEMP °C). Then:

- **for °C/°F selection:** Use the SET/HOLD button. After the temperature unit has been selected, press the ϕ /MODE button to enter the buffer set selection mode; press the ϕ /MODE button twice to return to the normal measuring mode.
- **to change the calibration buffer set:** After setting the temperature unit, the meter will show the current buffer set: "pH 7.01 BUFF" (for 4.01/7.01/10.01) or "pH 6.86 BUFF" (for NIST 4.01/6.86/9.18). Change the set with the SET/HOLD button, then press ϕ /MODE to return to normal measuring mode.

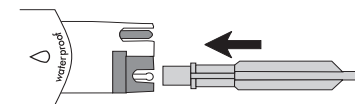
pH ELECTRODE MAINTENANCE

• When not in use, rinse the electrode with water to minimize contamination and store it with a few drops of HI 70300 storage solution in the protective cap. **DO NOT USE DISTILLED OR DEIONIZED WATER FOR STORAGE PURPOSES.**

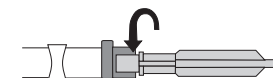
• If the electrode has been left dry, soak in storage solution for at least one hour to reactivate it.

• To prolong the life of the pH electrode, it is recommended to clean it monthly by immersing it in the HI 7061 cleaning solution for half an hour. Afterwards, rinse it thoroughly with tap water and recalibrate the meter.

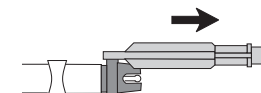
- The pH electrode can be easily replaced by using the supplied tool (HI 73128). Insert the tool into the electrode cavity as shown below.



- Rotate the electrode counterclockwise.



- Pull the electrode out by using the other side of the tool.

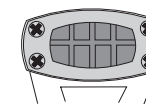


- Insert a new pH electrode following the above instructions in reverse order.

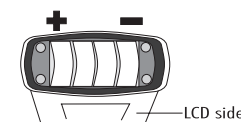
BATTERY REPLACEMENT

The meter displays the remaining battery percentage every time it is switched on. When the battery level is below 5%, the \square symbol on the bottom left of the LCD lights up to indicate a low battery condition. The batteries should be replaced soon. If the battery level is low enough to cause erroneous readings, the meter shows "0%" and the Battery Error Prevention System (BEPS) will automatically turn the meter off.

To change the batteries, remove the 4 screws located on the top of the meter.



Once the top has been removed, carefully replace the 4 batteries located in the compartment while paying attention to their polarity.



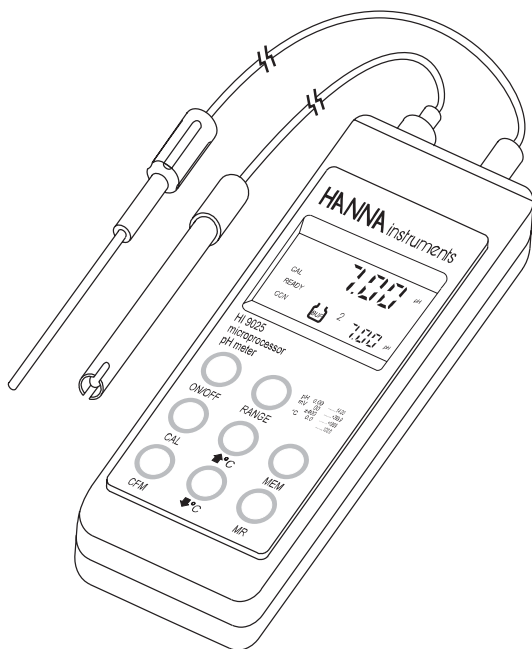
Replace the top, making sure that the gasket is properly seated in place, and tighten the screws to ensure a watertight seal.

Attachment 2
Instruction Manual
(Portable Waterproof pH Meters—HI 9025)

Instruction Manual

HI 9023C - HI 9023CN HI 9024C - HI 9025C HI 9110 - HI 9210 HI 9210N

Portable Waterproof pH Meters



Dear Customer,

Thank you for choosing a Hanna Product. Please read this instruction manual carefully before using the instrument. It will provide you with the necessary information for a correct use of the instrument, as well as a precise idea of its versatility. If you require further technical information, do not hesitate to e-mail us at tech@hannainst.com.

These instruments are in compliance with the **CE** directives.

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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 immediately.

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

These waterproof Hanna instruments are heavy-duty pH meters designed to provide laboratory results and accuracy under harsh industrial conditions.

HI 9023C, pH/mV/°C meter utilizes an advanced customized microprocessor. The meter has three memorized buffer values (4.01, 7.01 and 10.01) and automatic buffer recognition to avoid errors during calibration. There are no trimmers, making calibration an easy process, even for non-technical personnel. Temperature effects are automatically compensated for, or can be manually adjusted. With **HI 9023C** you can also measure ORP (Oxidation Reduction Potential) or Ion Specific. Millivolt measurements automatically switch from 0.1 to 1 mV resolution when the reading reaches 400mV.

HI 9023C is supplied with **HI 1230B** combination double-junction gel pH electrode, **HI 7669/2W** temperature probe, pH 4.01 and 7.01 (20 mL each) buffer solutions, sample vessel, 1.5V AA size batteries (4 each) and a rugged carrying case.

HI 9023CN, pH/mV/°C meter utilizes an advanced customized microprocessor. The meter has three memorized buffer values (4.01, 7.01 and 10.01) and automatic buffer recognition to avoid errors during calibration. Temperature effects are automatically compensated for.

HI 9023CN is supplied with **HI 1217D** 4-in-1 amplified, gel pH/°C electrode, pH 4.01 and 7.01 (20 mL each) buffer solutions, sample vessel, 1.5V AA size batteries (4 each) and a rugged carrying case.

HI 9024C and HI 9025C are pH/°C meters with a built-in microprocessor. A large dual-level LCD displays the pH and temperature simultaneously. The display has graphic symbols to make the calibration procedure easy to follow. The meters have 5 memorized buffer

values (4.01, 6.86, 7.01, 9.18 and 10.01), buffer recognition to avoid errors during calibration and automatic temperature compensation. You can use **HI 9025C** with ORP (Oxidation Reduction Potential) or Ion Specific Electrodes. Millivolt measurements automatically switch from 0.1 to 1 mV resolution when the reading reaches 400 mV. To insure trouble-free operation, the meter's circuitry comes with built-in protection against electromagnetic interference.

HI 9024C and HI 9025C are supplied with **HI 1230B** combination double-junction, gel pH electrode, **HI 7669/2W** temperature probe, pH 4.01 and 7.01 (20 mL each) buffer solutions, sample vessel, 1.5V AA size batteries (4 each) and a rugged carrying case.

HI 9110 pH meter has simple manual temperature compensation and calibration which make this meter easy to use in laboratory and field. The calibration trimmers are sealed behind a protective cover so that they cannot be accidentally moved or readjusted by unauthorized persons.

HI 9110 is supplied with **FC 100B** combination double-junction, refillable pH electrode, calibration screwdriver, 1.5V AA size batteries (4 each) and a soft carrying case.

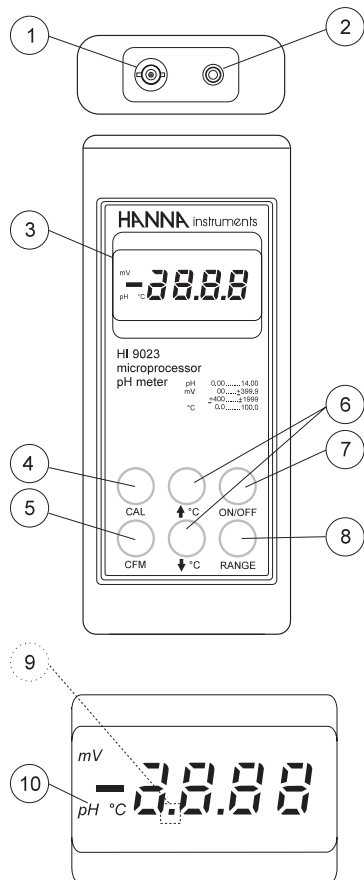
HI 9210 pH meter has simple manual temperature compensation and calibration with only two buttons, making it simple to use for even non-technical personnel. The calibration trimmers are sealed behind a protective cover so that they cannot be accidentally moved or readjusted by unauthorized persons.

HI 9210 is supplied with **HI 1230B** combination double-junction, gel pH electrode, calibration screwdriver and 1.5V AA size batteries (4 each).

HI 9210N pH/°C meter measures both pH and temperature. It has only two buttons, making it simple to use for even non-technical personnel. The calibration trimmers are sealed behind a protective cover so that they cannot be accidentally moved or readjusted by unauthorized persons.

HI 9210N is supplied with **HI 1217D** 4-in-1, gel, amplified pH/°C electrode, calibration screwdriver and 1.5V AA size batteries (4 each).

FUNCTIONAL DESCRIPTION HI 9023C & HI 9023CN

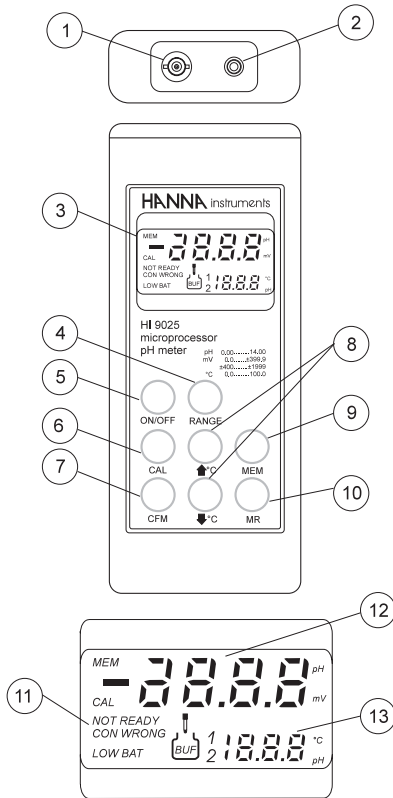


- 1) Electrode connector (BNC for HI 9023C and DIN for HI 9023CN)
- 2) Temperature probe socket (HI 9023C only)
- 3) Liquid Crystal Display
- 4) CAL key to enter or exit calibration mode
- 5) CFM key to confirm calibration
- 6) \uparrow °C and \downarrow °C keys for manual temperature setting (HI 9023C only)
- 7) ON/OFF key to turn the instrument on or off
- 8) RANGE key to select pH, C or mV
- 9) Low battery indicator (additional decimal point)
- 10) Mode indicator

SPECIFICATIONS HI 9023C & HI 9023CN

	HI 9023C	HI 9023CN
Range	0.00 to 14.00 pH ± 399.9 mV (ISE); ± 1999 mV (ORP) 0.0 to 100.0 C 0.0 to 70.0 C	
Resolution	0.01 pH 0.1 mV (ISE); 1 mV (ORP) 0.1 C	
Accuracy (@20°C/68°F)	± 0.01 pH ± 0.2 mV (ISE); ± 1 mV (ORP) ± 0.4 C ± 0.5 C	
Typical EMC Deviation	± 0.02 pH ± 0.2 mV; ± 1 mV ± 0.2 C ± 0.5 C	
Calibration	Automatic with 3 memorized standard buffers (4.01, 7.01, 10.01)	
Temperature Compensation	Automatic or manual 0 to 100 C (32-212 F)	Automatic 0 to 70 C (32-158 F)
Electrode	HI1230B plastic body, combination pH, BNC 1 m cable (included)	HI1217D plastic body, 4-in-1 gel pH/ C, DIN 1 m cable (included)
Temperature Probe	HI 7669/2W (incl.)	not necessary
Input Impedance	10^{12} Ohm	
Battery Type & Life	4x1.5V, AA size (alkaline batteries) approx. 400 hours of continuous use auto-shut off after 10 minutes of non-use	
Environment	0 to 50 C (32 to 122 F); 100% RH	
Dimensions	196x80x60 mm (7.7x3.1x2.4") (meter) 340x230x80 mm (13.8x9x3.1") (kit)	
Weight	425 g (15 oz.) (meter) 1.3 Kg (3.0 lb.) (kit)	

FUNCTIONAL DESCRIPTION HI 9024C & HI 9025C



- 1) BNC electrode connector
- 2) Temperature probe socket
- 3) Liquid Cristal Display
- 4) RANGE key to select pH or mV (HI 9025C only)
- 5) ON/OFF key to turn the meter on or off
- 6) CAL key to enter or exit calibration mode
- 7) CFM key to confirm calibration
- 8) \uparrow °C and \downarrow °C keys for manual temperature setting, or selecting pH buffer value
- 9) MEM key to store pH value in memory
- 10) MR key to recall the stored value from memory
- 11) User-friendly graphic symbols
- 12) Primary display
- 13) Secondary display

SPECIFICATIONS HI 9024C & HI 9025C

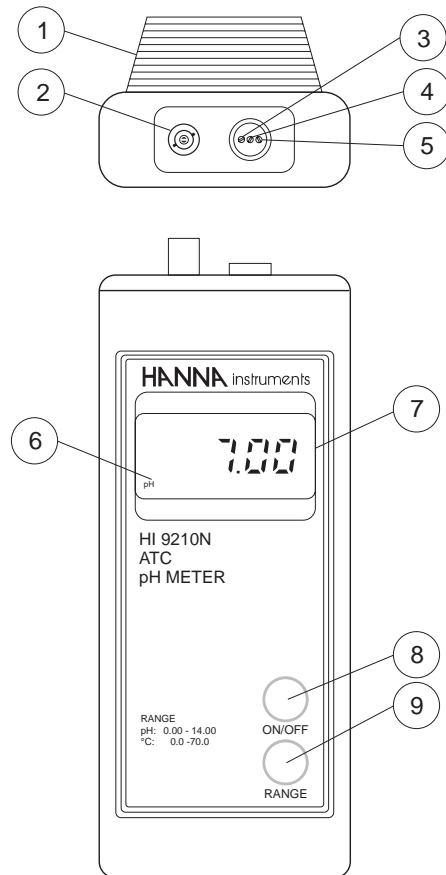
	HI 9024C	HI 9025C
Range	0.00 to 14.00 pH; 0.0 to 100.0 C	
	—	0.0/±399.9 mV (ISE) ±400/±1999 mV (ORP)
Resolution	0.01 pH; 0.1 C	
	—	0.1 mV (ISE) 1 mV (ORP)
Accuracy (@20°C/68°F)	±0.01 pH; ±0.5 C	
	—	±0.2 mV (ISE)
Typical EMC Deviation	±0.01 pH; ±0.1 C	
Calibration	Automatic with 5 memorized standard buffers (4.01, 6.86, 7.01, 9.18, 10.01)	
Offset Calibration	±1 pH	
Slope Calibration	From 70 to 108%	
Temperature Compensation	Automatic or manual from 0 to 100 C (32 to 212 F)	
Electrode	HI 1230B pH electrode (included)	
Temperature Probe	HI 7669/2W (included)	
Input Impedance	10 ¹² Ohm	
Battery Type & Life	4x1.5V, AA size (alkaline batteries) approx. 400 hours of continuous use auto-shut off after 10 minutes of non-use	
Environment	0 to 50 C (32 to 122 F); 100% RH	
Dimensions	meter: 196x80x60 mm (7.7x3.1x2.4") kit: 340x230x80 mm (13.8x9x3.1")	
Weight	meter: 425 g (15 oz.)	
	kit: 1.3 Kg (3.0 lb.)	

FUNCTIONAL DESCRIPTION HI 9110



- 1) Battery cover
- 2) BNC electrode connector
- 3) Offset calibration trimmer
- 4) Slope calibration trimmer
- 5) Temperature setting trimmer
- 6) Mode indicator
- 7) Liquid Crystal Display
- 8) ON/OFF key to turn the meter on or off
- 9) pH/°C SET key to select pH measurement or for manual temperature setting

FUNCTIONAL DESCRIPTION HI 9210 & HI 9210N



- 1) Battery cover
- 2) Electrode connector (BNC for HI 9210 and DIN for HI 9210N)
- 3) Offset calibration trimmer
- 4) Slope calibration trimmer
- 5) Temperature setting trimmer (HI 9210) or Temperature Calibration (HI 9210N)
- 6) Mode indicator
- 7) Liquid Crystal Display
- 8) ON/OFF key to turn the meter on or off
- 9) RANGE key to visualize the temperature (HI 9210N) or for manual temperature setting (HI 9210)

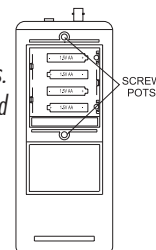
SPECIFICATIONS HI 9110, HI 9210 & HI 9210N

	HI 9110	HI 9210	HI 9210N
Range	pH	0.00 to 14.00 pH	
	°C	—	0.0 to 70.0 C
Resolution	pH	0.01 pH	
	°C	—	0.1 C
Accuracy (@20°C/68°F)	pH	±0.02 pH	
	°C	—	±0.5 C
Typical EMC Deviation	pH	±0.05 pH	±0.02 pH
	°C	—	±0.5 C
Calibration	Manual 2 points through trimmers		
Offset Calibration	±1 pH		
Slope Calibration	From 85 to 105% of nominal value		
Temperature Compensation	Manual 0 to 100 C (32 to 212 F)		Auto 0 to 70 C (32 to 158 F)
Electrode	FC 100B pH (incl.)	HI 1230B pH (incl.)	HI 1217D pH/ C (incl.)
Input Impedance	10 ¹² Ohm		
Battery Type Life	4x1.5 volt, AA size (alkaline batteries); 2000 hours of continuous use		
Environment	0 to 50 C (32 to 122 F); 100% RH		
Dimensions	196 x 80 x 60 mm (7.7 x 3.1 x 2.4")		
Weight	320 g (11.3 oz.)		

OPERATIONAL GUIDE

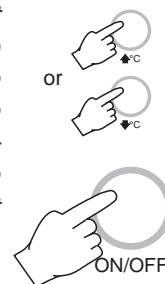
INITIAL PREPARATION

Each meter is supplied complete with batteries. Remove the back cover, unwrap the batteries and install them while paying attention to polarity.



HI 9023C, HI 9024C, HI 9025C:

To prepare the instrument for use connect the pH electrode and the temperature probe to the BNC and temperature sockets on the top of the instrument. The temperature probe can be used independently to take temperature measurements, or it can be used in conjunction with the pH electrode to utilize the meter's ATC capability. If the probe is disconnected, temperature can also be set manually with the UP and DOWN keys. To switch the instrument on, press and hold the ON/OFF key for a fraction of a second. The meter has a built-in protection against electromagnetic interference and the delayed response of the keys assures that the commands are not mistaken for stray signals.



HI 9110 and HI 9210:

Connect the pH electrode to the BNC connector on the top of the instrument and press the ON/OFF key.

HI 9210N and HI 9023CN:

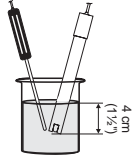


Connect the pH/ C electrode to the DIN connector on the top of the instrument and press the ON/OFF key.



pH MEASUREMENTS

To take a pH measurement remove the electrode protective cap and simply submerge the tip (4cm/1½") of the electrode and the temperature probe (wherever applicable) into the sample to be tested.



Turn the instrument ON and if necessary, press RANGE until the display changes to the pH mode.



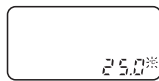
Allow for the electrode to adjust to the solution and stabilize. In order to take more accurate pH measurements, make sure that the instrument is calibrated (see page 16). It is recommended that the electrode is always kept wet and rinsed thoroughly with the sample to be measured before use. The pH reading is directly affected by temperature. In order for the meter to measure the pH accurately, temperature must be taken in consideration. If the sample temperature is quite different from the temperature at which the pH electrode was kept, allow a few minutes for a perfect thermal equilibrium between them.

HI 9023C, HI 9024C and HI 9025C:

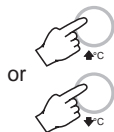
To use the meter's Automatic Temperature Compensation feature, submerge the temperature probe into the sample as close to the electrode as possible and wait for a couple of minutes. If you know the temperature of the sample to be tested you can manually compensate for it.

If manual temperature compensation is desired the temperature probe must be disconnected from the instrument.

The display will show the default temperature of 25°C or the last recorded temperature reading with the "°C" indicator blinking.



The temperature can now be adjusted with the UP and DOWN keys.

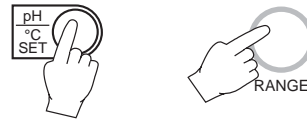


HI 9023C, HI 9023CN and HI 9210N

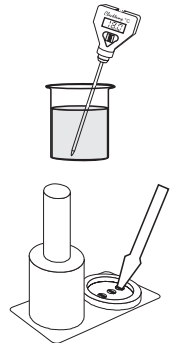
To use the meter's Automatic Temperature Compensation feature, simply submerge the pH/°C electrode into the sample and wait for a couple of minutes. The pH electrode also houses the temperature sensor which will measure and adjust for the temperature effect automatically.

HI 9110, HI 9210:

To use the meter's Manual Temperature Compensation feature: Press the pH/°C key of HI 9110 or the RANGE key of HI 9210 to select the manual temperature mode.

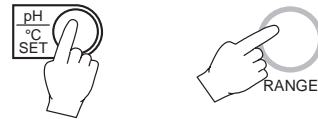


Remove the protective cap on top of the meter to access the trimmers. Measure the temperature of the buffer with a Checktemp or an accurate thermometer.



Using the calibration screwdriver, turn the temperature trimmer (#5 pages 9-10) to display the measured temperature value.

Press the pH/°C key of HI 9110 or the RANGE key of HI 9210 to return to the pH measurement mode.



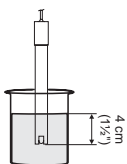
When finished, switch the instrument off and rinse the electrode with clean water. Pour a few drops of HI 70300 storage solution, or in its absence, pH 7 or pH 4 buffers in the protective cap and replace it before storing away the electrode.

ORP MEASUREMENTS (HI 9023C AND HI 9025C)

To enter the "mV" mode (ORP or ISE), turn the instrument ON and press the RANGE key until the display changes to mV.



To measure the mV of a solution simply submerge the ORP or ISE electrode tip (4cm/1½") into the sample to be tested. Allow a few minutes for the readings to stabilize. See also "Taking REDOX Measurements" section at page 29.



TEMPERATURE MEASUREMENTS (HI 9023C, HI 9023CN, HI 9024C, HI 9025C AND HI 9210N):

Taking a temperature measurement is very easy. Turn the instrument ON and press the RANGE key to enter temperature mode.



For HI 9023C, HI 9024C and HI 9025C, dip the liquid/general purpose temperature probe HI 7669/2W into the sample. For HI 9023CN and HI 9210N, simply dip the pH/□C electrode which contains the temperature sensor. Then allow a couple of minutes for the reading to stabilize.

Note: You can also calibrate the offset point of the HI 9210N temperature sensor, if needed. For this purpose, immerse the pH/□C electrode in a solution at a known temperature. Then turn the #5 trimmer (see page 10) until the temperature displayed on the LCD is that of the solution.

pH CALIBRATION

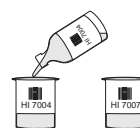
It is recommended to calibrate the instrument frequently, especially if high accuracy is required.

The instrument should be recalibrated for pH:

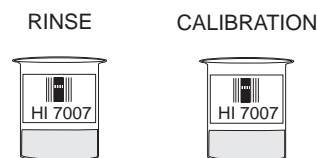
- Whenever the pH electrode or temperature probe is replaced.
- At least once a month.
- After testing aggressive chemicals.
- Whenever the batteries have been replaced.
- If greater accuracy is required.

PREPARATION

Pour small quantities of pH 7.01 and pH 4.01 solution into two clean beakers.



For accurate calibration use two beakers for each buffer solution, the first one for rinsing the electrode and the second one for calibration. This way contamination of buffer is minimized.



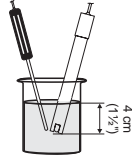
To obtain accurate readings, use pH 7.01 and pH 4.01 buffers if you are going to measure acidic samples, or pH 7.01 and pH 10.01 for alkaline measurements.

PROCEDURE FOR HI 9023C AND HI 9023CN:

- Make sure that the meter is in the pH mode.
- Remove the protective cap from the electrode, rinse it with some pH 7.01 solution, then immerse the pH electrode and temperature probe (HI 9023C) or the pH/□C electrode (HI 9023CN) into pH 7.01 buffer solution and stir gently and wait for the reading to stabilize.



Note: The electrode should be submerged approximately 4 cm (1½") into the solution. With the temperature probe located as close to it as possible (HI 9023C).



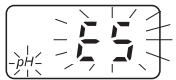
- Press the CAL key. The temperature compensated pH value will blink on the display. For example, if the temperature is 25°C the reading will be pH 7.01. If the temperature is 20°C the reading



will be 7.03. The pH/temperature conversion chart is on page 24.

- Note:** If "E4" flashes, the buffer solution is wrong or the probe is defective (see page 25 for troubleshooting).

- Wait for the "pH" symbol to stop flashing and press the CFM



key. The symbol "E5" will flash to indicate that the electrode is still in the pH 7.01 buffer.

- Rinse the pH electrode (and the temperature probe) with distilled water first and with the pH 4.01 (or 10.01) buffer after.



- Dip the electrode (and the temperature probe) into the pH 4.01 (or 10.01) buffer solution. Stir gently and wait for the reading to stabilize.

- The "E5" symbol should disappear and the temperature compensated value will blink on the display. For example, if you are using pH 4.01 as the buffer, the reading will be 4.01 at 25°C.



- When the "pH" symbol stops flashing, press CFM to confirm the calibration.



The instrument is now calibrated and will remain calibrated even

when it is turned off.

Note: The meter will lose the calibration if the batteries are removed.



HI 9023C only:

To calibrate with manual temperature compensation, follow this procedure:

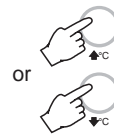
- Disconnect the temperature probe and switch the instrument ON.



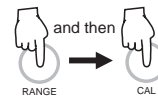
- Press RANGE to select the temperature mode.



- Place the pH electrode into the 7.01 buffer stir gently and wait for the LCD to stabilize.



- Record the buffer temperature by using a Checktemp C or an



accurate thermometer (e.g. 18°C).

- Press the UP and DOWN to adjust the temperature accordingly.
- Press RANGE to display pH and then press the CAL key. The value of the buffer will be displayed.



- Wait for the "pH" symbol to stop flashing.

- Press CFM. The "E5" symbol will flash to indicate that the electrode is still in the 7.01 solution.



- Rinse the electrode with clean or distilled water first and then with pH 4.01 (or 10.01) buffer. Dip the electrode into the pH



4.01 (or 10.01) solution and stir gently.

- Wait for the "pH" symbol to stop flashing. Press CFM to confirm the calibration.

PROCEDURE FOR HI 9024C AND HI 9025C:

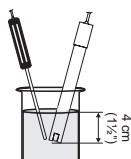
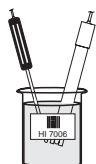
In order to calibrate HI 9024C and HI 9025C, there is a choice of 5 memorized buffers: 4.01, 6.86, 7.01, 9.18 and 10.01 pH.

- Make sure that the meter is in the pH mode.
- Remove the protective cap and rinse the electrode with some of the buffer calibration solution that you are going to use first.

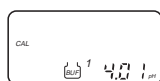
ONE-POINT CALIBRATION:

It is always recommended to perform a two-point calibration for optimum accuracy. In case of necessity, it is possible to carry out only a one-point calibration with the instruments. The offset buffers, that is the Standard 7.01 or the NIST 6.86 are the most appropriate for this purpose even though both meters can be calibrated with any of the 5 memorized calibration solutions.

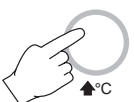
- Immerse the pH electrode into a pH buffer solution (e.g. pH 6.86) and stir gently.



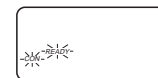
Note: The electrode should be submerged approximately 4 cm (1 1/2") into the solution. With the temperature probe located



as close to it as possible.



- Once the electrode is submerged in the buffer solution, the LCD will notify the user if the reading is not stable by an intermittent "NOT READY". Only when the reading is stable, will it change to a blinking "READY" and "CON".



- Press the CFM key to confirm the calibration. If the reading is not close to the selected buffer, "WRONG" and "WRONG" will blink alternatively. If the reading is close to the selected buffer, the meter stores the reading (and adjusts the offset point). The buffer value is then displayed on the primary LCD and the secondary LCD will display another buffer value (e.g. "4.01").



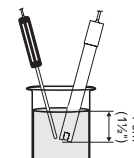
- Press the CAL key and the calibration process is ended with only the offset of the meter calibrated. For best accuracy however, do not press CAL and proceed with a two-point calibration.



TWO-POINT CALIBRATION

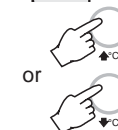
After calibrating at 6.86 or 7.01 pH (see above), for the second buffer use pH 4.01 if you are going to measure acidic samples, and pH 9.18 or pH 10.01 if you are measuring alkaline solutions.

- Proceed as described in "One-point calibration" above but do not end the calibration by pressing CAL.
- After the first calibration point is confirmed, immerse the pH electrode into the second buffer solution (pH 4.01, 9.18 or 10.01) and stir gently.

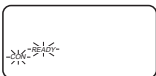


Note: The electrode should be submerged approximately 4 cm (1 1/2") into the solution with the temperature probe located as close to it as possible.

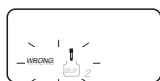
- Select the second buffer value on the secondary display by pressing the \uparrow °C or \downarrow °C key.



Note: The electrode should be submerged approximately 4 cm (1½") into the solution with the temperature probe located as close to it as possible.



- Select the second buffer value on the secondary display by



pressing the \uparrow °C or \downarrow □C key.

- When the "READY" and "CON" symbols blink on the display, the reading is stable and the calibration can be confirmed.
- Press the CFM key. If the reading is not close to the selected buffer solution, "WRONG" and "WRONG !" will blink alternatively. If the reading is close to the selected buffer, the slope and the offset are calibrated. The values will be stored in memory and the meter will return to the operating mode.

Note: The meter will automatically skip the buffer that was used for the first calibration to avoid erroneous calibration. At least 1 full pH unit is required between the two buffers used for the offset and slope calibration. As a result, once calibrated at either pH 6.86 or 7.01, the microprocessor will automatically ignore the other one for the second point calibration. It will do likewise for pH 9.18 and 10.01

Note: During calibration, the secondary LCD displays the selected buffer value. With HI 9025C, press the RANGE key to display the buffer temperature during calibration.

PROCEDURE FOR HI 9110, HI 9210 & HI 9210N:

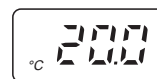
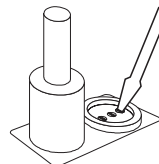
Manual Temperature Compensation

Note: The pH/□C electrode of HI 9210N incorporates a temperature sensor which performs automatic temperature



compensation. Consequently, the following 5 paragraphs are irrelevant to HI 9210N and you can just proceed with pH calibration below.

- Press pH/□C SET key for HI 9110 or the RANGE key for HI 9210 to select the manual temperature setting. The "□C" symbol will be displayed to indicate the temperature setting mode.



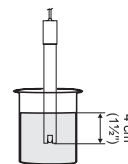
- Remove the protective cap on the top of the meter to have access to the calibration trimmers.



- Record the temperature of the buffer with a Checktemp C or an accurate thermometer (e.g. 20.0°C).
- Using the screwdriver, turn the temperature trimmer (# 5 pages 9-10) to display the recorded temperature value.
- Press the pH/□C SET key for HI 9110 or the RANGE key for HI 9210 to read pH.

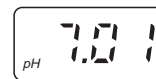
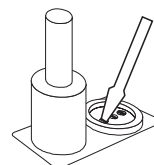
pH Calibration

All three meters provide for manual pH calibration. As a result, you can perform one or two point calibration at a buffer of your choice. The instructions below explain a typical calibration procedure at pH 7 and then 4 or 10.



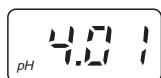
- Remove the protective cap from the electrode, rinse it with some pH 7.01 solution, then dip in pH 7.01 buffer. Stir briefly and wait for one minute for the reading to stabilize.

Note: The electrode should be submerged approximately 4 cm



(1½") into the solution. For HI 9110 and HI 9210, place the thermometer close to the pH electrode.

- Adjust the OFFSET trimmer (#3 pages 9-10) until the LCD shows the pH value at the buffer temperature (see page 24 for pH values at various temperatures). With HI 9210N, press RANGE to read the buffer temperature.



- Rinse first with clean or distilled water and then with a small amount of the next buffer (2nd calibration point). Dip the electrode into pH 4.01 (or 10.01) buffer, stir gently and wait until the display has stabilized.
- Adjust the SLOPE trimmer (#4 pages 9-10) until the LCD displays the pH value at the second buffer temperature (see page 24).
- pH calibration is now complete. Once the calibration process is complete, replace the trimmer cover and tighten it to ensure a proper seal against water and humidity ingress.

pH VALUES AT VARIOUS TEMPERATURES


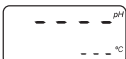

Temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lesser degree than normal solutions.

For manual temperature calibration (standard with HI 9110 and HI 9210 or optional with HI 9023C, HI 9024C and HI 9025C) please refer to the following chart.

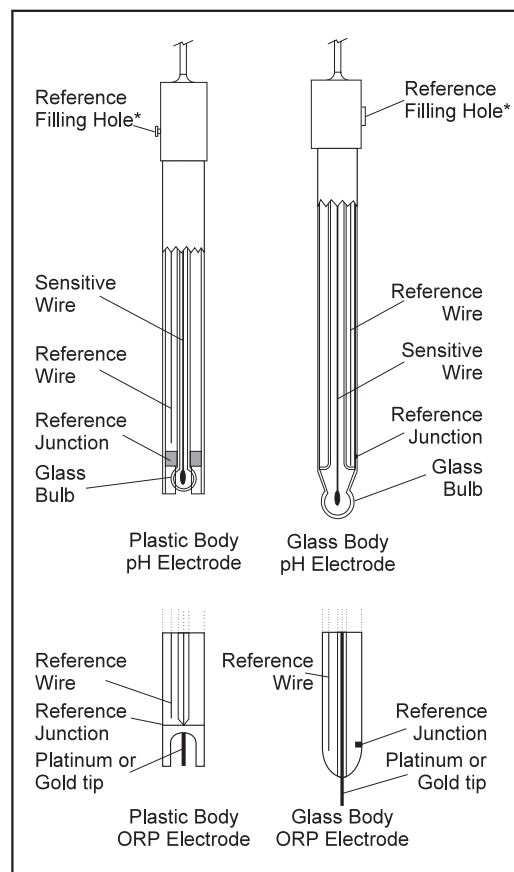
TEMP		pH VALUES				
°C	°F	4.01	6.86	7.01	9.18	10.01
0	32	4.01	6.98	7.13	9.46	10.32
5	41	4.00	6.95	7.10	9.39	10.24
10	50	4.00	6.92	7.07	9.33	10.18
15	59	4.00	6.90	7.04	9.27	10.12
20	68	4.00	6.88	7.03	9.22	10.06
25	77	4.01	6.86	7.01	9.18	10.01
30	86	4.02	6.85	7.00	9.14	9.96
35	95	4.03	6.84	6.99	9.10	9.92
40	104	4.04	6.84	6.98	9.07	9.88
45	113	4.05	6.83	6.98	9.04	9.85
50	122	4.06	6.83	6.98	9.01	9.82
55	131	4.07	6.84	6.98	8.99	9.79
60	140	4.09	6.84	6.98	8.97	9.77
65	149	4.11	6.85	6.99	8.95	9.76
70	158	4.12	6.85	6.99	8.93	9.75

For instance, if the buffer temperature is 25 C, the display should show pH 4.01, 7.01 or 10.01 at pH 4, 7 or 10 buffers, respectively. At 20 C, the display should show pH 4.00, 7.03 or 10.06. The meter reading at 50 C will then be 4.06, 6.98 or 9.82.

TROUBLESHOOTING GUIDE

Symptoms	Problem	Solution
The meter is slow in responding or gives faulty readings	The electrode is not working or the reference junction is clogged	Leave the electrode in a storage solution after cleaning the junction. If problem persists, replace the electrode
The meter does not accept the 2 nd buffer solution for calibration	Out of order pH electrode	Follow the cleaning procedure. If this doesn't work replace the electrode
The reading drifts	Out of order electrode	Replace the pH electrode
Display shows: "E1" or 	Out of range pH scale	a) Recalibrate b) Make sure the pH sample is in the 0 to 14 range c) Check the electrolyte level and the general state of the pH electrode
Display shows: "E2" or 	Out of range temperature scale	Make sure the temperature is in the 0 to 100 C (or 70 C) range and the probe is plugged in
Display shows: "E3" or 	Out of range mV scale	Electrode not connected
Display shows: "E4" or "WRONG (E4)" and/or "WRONG (E4)"	Erroneous buffer solution used for offset calibration	Make sure the buffer setting is correct and the solution is fresh. Replace the buffer if necessary
	Out of order electrode	Replace the pH electrode
Display shows: "E5" or "WRONG (E5)" and/or "WRONG (E5)"	Erroneous buffer solution used for slope calibration	Make sure the buffer setting is correct and the solution is fresh. Replace the buffer if necessary
	Out of order electrode	Replace the pH electrode
The meter does not work with the temperature probe	Out of order temperature probe	Replace the probe
The meter fails to calibrate or gives faulty readings	Out of order pH electrode	Replace the electrode
Display acts erratically	The microprocessor has been electronically disturbed	Remove one of the batteries for one minute to reset the microprocessor

ELECTRODE CONDITIONING & MAINTENANCE



* Not present in gel electrodes.

PREPARATION

Remove the protective cap.
DO NOT BE ALARMED IF ANY SALT DEPOSITS ARE PRESENT. This is normal with electrodes and they will disappear when rinsed with water. During transport tiny bubbles of air may form inside the glass bulb affecting proper functioning of the electrode. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.
 If the bulb and/or junction is dry, soak the electrode in HI 70300 or HI 80300 Storage Solution for at least one hour.

For refillable electrodes:

If the filling solution (electrolyte) is more than 2½ cm (1") below the fill hole, add HI 7082 or HI 8082 3.5M KCl Electrolyte Solution for double junction or HI 7071 or HI 8071 3.5M KCl+AgCl Electrolyte Solution for single junction electrodes.

For a faster response, unscrew the fill hole screw during measurements.

For AmpHel® electrodes:

If the electrode does not respond to pH changes, the battery is run down and the electrode should be replaced.

MEASUREMENT

Rinse the electrode tip with distilled water. Immerse the tip (bottom 4 cm /1½") in the sample and stir gently for a few seconds.

For a faster response and to avoid cross contamination of the samples, rinse the electrode tip with a few drops of the solution to be tested, before taking measurements.

STORAGE

To minimize clogging and assure a quick response time, the glass bulb and the junction should be kept moist and not allowed to dry out.

Replace the solution in the protective cap with a few drops of HI 70300 or HI 80300 Storage Solution or, in its absence, Filling Solution (HI 7071 or HI 8071 for single junction or HI 7082 or HI 8082 for double junction electrodes). Follow the Preparation Procedure above before taking measurements.

Note: NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER.

PERIODIC MAINTENANCE

Inspect the electrode and the cable. The cable used for connection to the meter must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. Connectors must be perfectly clean and dry. If any scratches or cracks are present, replace the electrode. Rinse off any salt deposits with water.

For refillable electrodes:

Refill the reference chamber with fresh electrolyte (HI 7071 or HI 8071 for single junction or HI 7082 or HI 8082 for double junction electrodes). Allow the electrode to stand upright for 1 hour.

Follow the Storage Procedure above.

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CLEANING PROCEDURE

General Soak in Hanna HI 7061 or HI 8061 General Cleaning Solution for approximately ½ hour.

Removal of films, dirt or deposits on the membrane/junction:

- *Protein* Soak in Hanna HI 7073 or HI 8073 Protein Cleaning Solution for 15 minutes.

- *Inorganic* Soak in Hanna HI 7074 or HI 8074 Inorganic Cleaning Solution for 15 minutes.

- *Oil/grease* Rinse with Hanna HI 7077 or HI 8077 Oil and Fat Cleaning Solution.

IMPORTANT: After performing any of the cleaning procedures rinse the electrode thoroughly with distilled water, refill the reference chamber with fresh electrolyte (not necessary for gel-filled electrodes) and soak the electrode in HI 70300 or HI 80300 Storage Solution for at least 1 hour before taking measurements.

TROUBLESHOOTING

Evaluate your electrode performance based on the following.

- **Noise** (Readings fluctuate up and down) could be due to:
 - **Clogged/Dirty Junction:** Refer to the Cleaning Procedure above.
 - **Loss of shielding due to low electrolyte level** (in refillable electrodes only): refill with fresh HI 7071 or HI 8071 for single junction or HI 7082 or HI 8082 for double junction electrodes.
- **Dry Membrane/Junction:** Soak in HI 70300 or HI 80300 Storage Solution for at least 1 hour.
- **Drifting:** Soak the electrode tip in warm (approx. 50-60°C) Hanna HI 7082 or HI 8082 Solutions for one hour and rinse the tip with distilled water. Refill with fresh HI 7071 or HI 8071 for single junction electrodes and HI 7082 or HI 8082 for double junction electrodes (refillable electrodes only).
- **Low Slope:** Refer to the cleaning procedure above.
- **No Slope:** Check the electrode for cracks in glass stem or bulb and replace the electrode.
- **Slow Response/Excessive Drift:** Soak the tip in HI 7061 or HI 8061 Solutions for 30 minutes, rinse thoroughly in distilled water and then follow the Cleaning Procedure above.

TAKING REDOX MEASUREMENTS (HI 9023C & HI 9025C only)

HI 9023C and HI 9025C have the capability to take ORP measurements. An optional ORP electrode must be used to perform these measurements.

Oxidation-Reduction Potential (REDOX) measurements provide the quantification of the oxidizing or reducing power of the sample tested.

To correctly perform a redox measurement, the surface of the ORP electrode must be clean and smooth.

In order to improve performance and obtain a faster response time, precondition your ORP electrode with reducing or oxidizing solutions.

Generally speaking, if the ORP mV reading corresponding to the pH value of the solution is higher than the values in the table below, an oxidizing pretreatment is necessary; otherwise a reducing pretreatment is necessary:

pH	mV	pH	mV	pH	mV	pH	mV	pH	mV
0	990	1	920	2	860	3	800	4	740
5	680	6	640	7	580	8	520	9	460
10	400	11	340	12	280	13	220	14	160

Reducing pretreatment: immerse the electrode for a few minutes in HI 7091.

Oxidizing pretreatment: immerse the electrode for a few minutes in HI 7092.

When not in use, the tip of the electrode should be kept moist and safe from any mechanical stress which might cause damage to the glass/platinum junction.

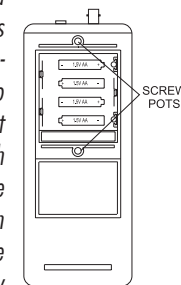
BATTERY REPLACEMENT & AUTO-OFF

If the batteries become weak:

- HI 9023C and HI 9023CN will display a blinking additional decimal point.
- HI 9024C and HI 9025C will display "LOW BAT".
- HI 9110, HI 9210 and HI 9210N will display a "V" on the LCD. Note: **HI 9110, HI 9210 and HI 9210N** are supplied with the advanced "BEPS", Battery Error Preventive System, that detects a low voltage condition in the battery. The "V" symbol is to alert the user that the display will be shut-off after about 5 hours of use. After that, the meter shuts down the display, preventing the taking of erroneous measurements due to low voltage.



Battery replacement must only take place in a non hazardous area using the battery types specified in this instruction manual. To replace rundown batteries, remove the two screws on the rear cover of the instrument and replace all four 1.5V AA batteries with new ones, while paying attention to the correct polarity. Replace the cover and tighten the two screws. The meter is reset any time the batteries are removed. In case of any functional problems, reset the meter by removing and reinstalling the batteries.



ACCESSORIES

pH CALIBRATION SOLUTIONS

HI 70004P	pH 4.01 Buffer Sachets, 20mL, 25 pcs
HI 70007P	pH 7.01 Buffer Sachets, 20mL, 25 pcs
HI 70010P	pH 10.01 Buffer Sachets, 20mL, 25 pcs
HI 7004L	pH 4.01 Buffer Solution, 460 mL
HI 7006L	pH 6.86 Buffer Solution, 460 mL
HI 7007L	pH 7.01 Buffer Solution, 460 mL
HI 7009L	pH 9.18 Buffer Solution, 460 mL
HI 7010L	pH 10.01 Buffer Sol., 460 mL

pH CALIBRATION SOLUTIONS IN FDA APPROVED BOTTLE

HI 8004L	pH 4.01 Buffer Solution, 460 mL
HI 8006L	pH 6.86 Buffer Solution, 460 mL
HI 8007L	pH 7.01 Buffer Solution, 460 mL
HI 8009L	pH 9.18 Buffer Solution, 460 mL
HI 8010L	pH 10.01 Buffer Solution, 460 mL

ELECTRODE STORAGE SOLUTION

HI 70300L	Storage Solution, 460 mL
HI 80300L	Storage Solution in a FDA approved bottle, 460 mL

ELECTRODE CLEANING SOLUTIONS

HI 70000P	Electrode Rinse Sachets, 20 mL, 25 pcs
HI 7061L	General Cleaning Sol., 460 mL
HI 7073L	Protein Cleaning Sol., 460mL
HI 7074L	Inorganic Cleaning Sol., 460mL
HI 7077L	Oil & Fat Cleaning Sol., 460 mL

ELECTRODE CLEANING SOLUTIONS IN FDA

APPROVED BOTTLES

HI 8061L	General Cleaning Solution, 460 mL
HI 8073L	Protein Cleaning Solution, 230 mL
HI 8077L	Oil & Fat Cleaning Solution, 460mL

REFILL ELECTROLYTE SOLUTIONS

HI 7071	3.5M KCl + AgCl Electrolyte, 4x50mL, for single junction electrodes
HI 7072	1M KNO ₃ Electrolyte, 4x50 mL
HI 7082	3.5M KCl Electrolyte, 4x50 mL, for double junction electrodes

REFILL ELECTROLYTE SOLUTIONS IN FDA APPROVED BOTTLES

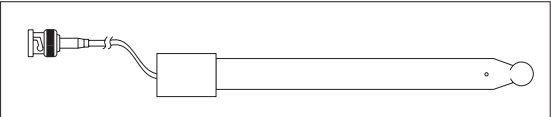
HI 8071	3.5M KCl + AgCl Electrolyte, 4x50mL, for single junction electrodes
HI 8072	1M KNO ₃ Electrolyte, 4x50 mL
HI 8082	3.5M KCl Electrolyte, 4x50 mL, for double junction electrodes

ORP PRETREATMENT SOLUTIONS

HI 7091L	Reducing Pretreatment Solution, 460 mL
HI 7092L	Oxidizing Pretreatment Solution, 460 mL

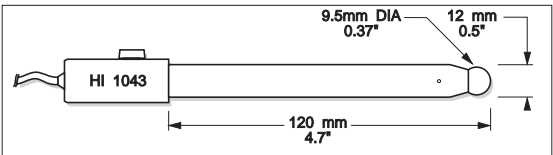
pH & ORP ELECTRODES

All electrodes part numbers ending in B are supplied with a BNC connector and 1 m (3.3') cable, as shown below:



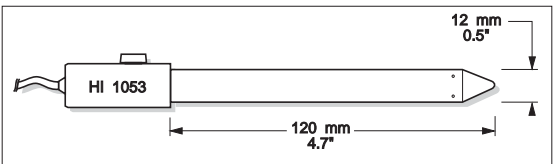
HI 1043B

Glass-body, double junction, refillable, combination pH electrode. Use: strong acid/alkali.



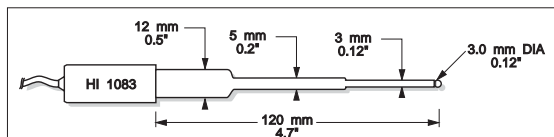
HI 1053B

Glass-body, triple ceramic, conic shape, refillable, combination pH electrode. Use: emulsions.



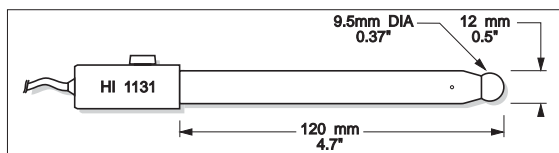
HI 1083B

Glass-body, micro, Viscolene, non-refillable, combination pH electrode. Use: biotechnology, micro titration.



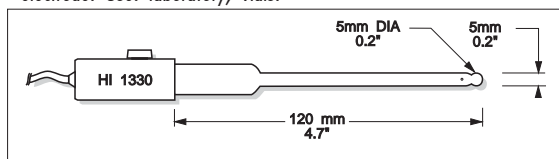
HI 1131B

Glass-body, single junction, refillable, combination pH electrode. Use: general purpose.



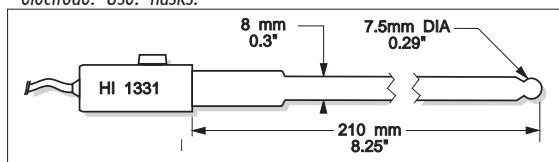
HI 1330B

Glass-body, semimicro, single junction, refillable, combination pH electrode. Use: laboratory, vials.



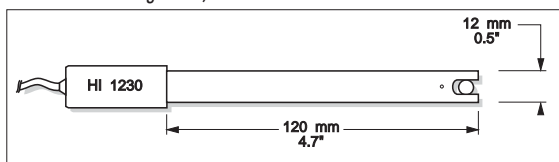
HI 1331B

Glass-body, semimicro, single junction, refillable, combination pH electrode. Use: flasks.



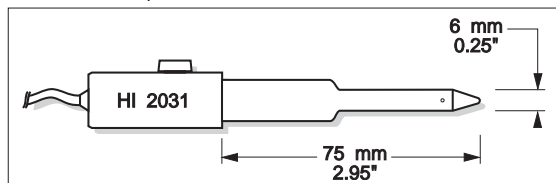
HI 1230B

Plastic-body (Ultem®), double junction, gel-filled, combination pH electrode. Use: general, field.



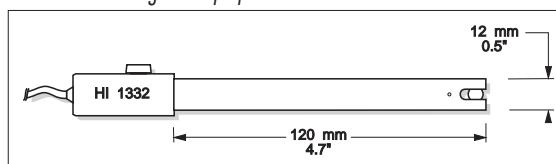
HI 2031B

Glass-body, semimicro, conic, refillable, combination pH electrode. Use: semisolid products.



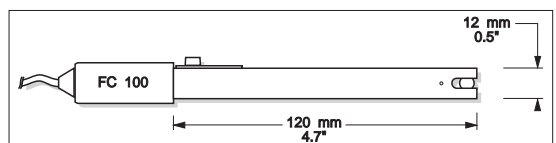
HI 1332B

Plastic-body (Ultem®), double junction, refillable, combination pH electrode. Use: general purpose.



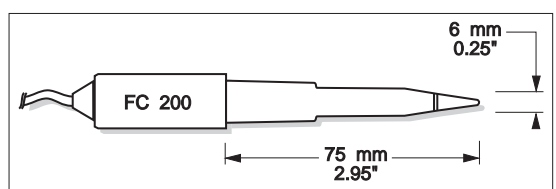
FC 100B

Plastic-body (Kynar®), double junction, refillable, combination pH electrode. Use: general purpose for food industry.



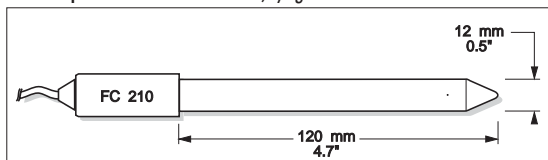
FC 200B

Plastic-body (Kynar®), open junction, conic, Viscolene, non-refillable, combination pH electrode. Use: meat & cheese.



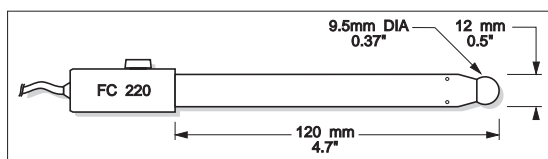
FC 210B

Glass-body, double junction, conic, Viscolene, non-refillable, combination pH electrode. Use: milk, yogurt.



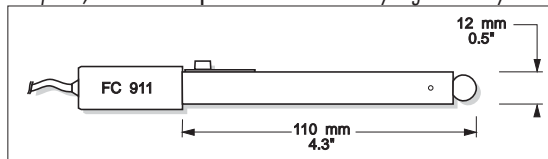
FC 220B

Glass-body, triple-ceramic, single junction, refillable, combination pH electrode. Use: food processing.



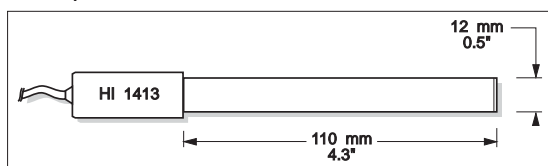
FC 911B

Plastic-body (Kynar®), double junction, refillable with built-in amplifier, combination pH electrode. Use: very high humidity.



HI 1413B

Glass-body, single junction, flat tip, Viscolene, non-refillable, combination pH electrode. Use: surface measurement.

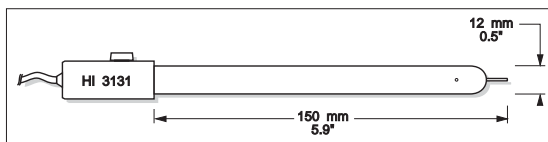


Ultem® is registered Trademark of "General Electric Co."
Kynar® is registered Trademark of "Penwalt Corp."

ORP electrodes:

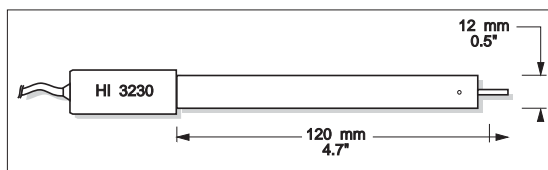
HI 3131B

Glass-body, refillable, combination platinum ORP electrode. Use: titration.



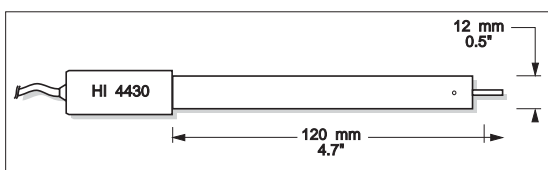
HI 3230B

Plastic-body (Ultem®), gel-filled, combination platinum ORP electrode. Use: general purpose.



HI 4430B

Plastic-body (Ultem®), gel-filled, combination gold ORP electrode. Use: general purpose.



Consult the Hanna General Catalog for an extensive selection of electrodes.

OTHER ACCESSORIES

- ChecktempC Pocket-size thermometer (range -50.0 to 150.0 °C)
- HI 76405 Electrode holder
- HI 7669/2W Temperature probe with 1 m (3.3') screened cable (not HI 9110, HI 9210, HI 9210N and HI 9023CN)
- HI 8427 pH and ORP electrode simulator with 1 m (3.3') coaxial cable ending in female BNC connectors
- HI 931001 pH and ORP electrode simulator with LCD and 1 m (3.3') coaxial cable ending in female BNC connectors
- HI 721317 Rugged carrying case

ELECTRODE APPLICATION REFERENCE GUIDE

Application	Electrodes*
1. Aquarium	HI 1332B
2. Bath-water	HI 1130B
3. Beer	HI 1131B
4. Bread	HI 2031B, FC 200B
5. Cheese	FC 200B
6. Dairy products	FC 100B
7. Dirty water	HI 1230B
8. Emulsions	HI 1053B
9. Environment	HI 1230B
10. Flasks	HI 1331B
11. Food industry general use	FC 911B, FC 100B
12. Fruit	FC 200B, FC 220B
13. Fruit juices, organic	FC 210B
14. Galvanizing waste solution	HI 1130B
15. Heavy-duty applications	HI 1135B
16. High purity water	HI 1053B
17. Horticulture	HI 1053B, FC 200B
18. Laboratory general use	HI 1131B, HI 1230B, HI 1332B, HI 1330B
19. Leather	HI 1413B
20. Lemon juice	FC 100B
21. Meat	FC 200B, HI 2031B
22. Micro plate sampling of less than 100 mL	HI1083B
23. Milk and Yogurt	FC 210B
24. Paints	HI 1053B
25. Paper	HI 1413B
26. Photographic chemicals	HI 1230B
27. Quality control	HI 1332B
28. Sausages	FC 200B, HI 2031B
29. Semisolid products	HI 2031B
30. Skin	HI 1413B
31. Soil samples	HI 1230B
32. Solvents	HI 1043B
33. Strong acid	HI 1043B
34. Submersion application	HI 1130B
35. Surface measurements	HI 1413B
36. Swimming pool	HI1130B, HI 2114P/2
37. Titrations with constant temperature range	HI 1131B
38. Titrations with wide temperature range	HI 1131B
39. Very high humidity	FC 911B
40. Vials and test tube	HI 1330B
41. Wine processing	FC 220B

* All electrode listed are supplied with 1m (3") cable and BNC connector.

WARRANTY

All Hanna Instruments meters are guaranteed 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 guaranteed for a period of six months. This warranty is limited to repair or replacement free of charge.

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

CE DECLARATION OF CONFORMITY


CE <i>DECLARATION OF CONFORMITY</i>
We Hanna Instruments Srl V.le delle industrie 12 35010 Ronchi di Villafranca (PD) ITALY
herewith certify that the waterproof pH meters
HI 9023C HI 9023CN HI 9024C HI 9025C HI 9110 HI 9210 HI 9210N
have been tested and found to be in compliance with the following regulations:
IEC 801-2 Electrostatic Discharge IEC 801-3 RF Radiated EN 55022 Radiated, Class B
Date of Issue: 18-03-1996
 D. Volpato - Engineering Manager On behalf of Hanna Instruments S.r.l.

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 interference.

The glass bulb at the end of the electrode is sensitive to electrostatic discharges. Avoid touching this glass bulb at all times.

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

To maintain the EMC performance of equipment, the recommended cables noted in the user's manual must be used.

In particular cases the instruments could turn off. In such cases, turn them on by pressing the ON/OFF key.

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.

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

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.



<http://www.hannainst.com>