CONTENTS

Introduction to pH Instrumentation

Single or Multiparameter Instrumentation

Depending on the requirements of the application, users may need to measure only one parameter such as pH or a group of parameters such as pH, ORP, EC, TDS, temperature and others. From benchtops to complete systems and from portables to testers, HANNA provides solutions in all categories of instrumentation.

The HANNA single parameter instrument offers the advantage of simplicity and focus in the requested parameter needs. The advantage of HANNA multiparameter instruments is that a user can choose a single meter packed with all the requirements they need to meet the demands of their application.

Multiparameter instruments offer different operating solutions that tailor to a user's real-world needs: multiparameter meters that can measure two or three parameters, but only one per time or multiparameter meters that offer two or three parameters measured simultaneously–useful on experimental and research applications where the influence between the parameters is important to be known. Multiple inputs provide the capability for simultaneous measurement.

pH Measurement Input

Different input solutions are available for HANNA instrumentation according with the type of the electrode selected by the user: a BNC connection for combined pH electrodes or a half cell electrode and reference probe using a separated reference input. A DIN connector is used to connect amplified and intelligent pH electrodes. Electrodes utilizing a DIN connection are usually combined and feature a built-in temperature sensor.

Temperature Input

Temperature is measured to compensate for temperature in pH readings. For HANNA meters featuring temperature compensation, a separate temperature probe is usually supplied with the instrument or the pH probe features a temperature sensor built-in. If a temperature input is not present, many instruments still offer the ability to manually adjust the temperature according with an external temperature reference.

pH Temperature Compensation

pH readings must be temperature compensated. The source of temperature measurement could be from a temperature sensor or from a trimmer that is manually adjusted. In any case, the instrument is correcting the pH reading with temperature.

mV Reading

HANNA meters with this feature can offer the ability to read two different parameters expressed in mV; the pH when the input probe is a pH electrode or ORP if an ORP probe is connected. The mV relative mode permits a calibration of the input expressed in mV.

pH Calibration

pH calibration should be performed daily or every time when a new lot of readings is started. Any kind of errors during the calibration will affect all the readings until a new calibration is performed. Errors during the calibration process can be eliminated if standard calibration procedures are follwed.

Some of the requirements of the standard calibration procedure::

1) To clean and activate the pH electrode before the calibration
2) To use only fresh pH buffers
3) To respect the measurement and rinsing steps during calibration to avoid any kind of buffer contamination.
4) To wait for full stability before a new calibration point is confirmed
5) To have a correct temperature compensation of pH reading and pH buffers.

Based on the conclusion that one of the most important step that have to be done to have good readings during the standard pH measurement is calibration. HANNA pH instruments are supplied with a starter package of solutions to assure this.

pH Calibration Check™

Many instruments feature HANNA's exclusive pH Calibration Check™ technology. Calibration Check™ is a diagnostics system that ensures accurate pH readings every time. By alerting users of potential problems during the calibration process, the Calibration Check™ system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated pH buffer solutions during calibration.

Throughout the calibration process, users are guided step-by-step by the on-screen tutorial. After calibration, the probe condition and response time is evaluated and an electrode condition and response time graph is displayed informing the user of the overall pH electrode status.

Calibration Errors

Instruments utilizing HANNA's Calibration Check™ technology can evaluate an electrode during calibration and store a history of parameters that describe the quality of electrode to be compared from one calibration to another. During calibration, a very small degradation of these parameters is normal and can be expected. A big change in the parameters signifies an error in the calibration procedure such as a dirty electrode before the calibration.

pH Buffer Contamination

pH buffers can be contaminated during the calibration procedure by numerous factors such as introducing a contaminated probe, using old buffers, or by reusing buffers. With these factors, the calibration of the instrument and subsequent measurements will be wrong.

Contaminated buffer issues can be detected during calibration by HANNA instrumentation with Calibration Check™. Warning messages can be generated to inform users about the identified issue.

Response Time of Electrodes

Another parameter that is evaluated during the calibration with Calibration Check™ technology is the response time of an electrode. This is evaluated based on the measurement of time necessary to reach stability when the electrode is immersed in a new buffer that has a difference in pH larger than than 3 pH units from the old one.

Offset and Slope of pH Electrode

The offset and slope are the most important parameters that can describe the quality of an electrode. It is important for a measurement process determination to be stable and accurate.

With HANNA's calibration Check™ technology, the offset of the electrode can be evaluated after one point calibration. Common sense is asking to be 7.00 pH buffer, but HANNA instruments using Calibration Check™ are able to determinate the offset based on any calibration point. The accepted range for offset is ±30 mV. A minimum 2 calibration points is necessary to determine the slope. Between any two calibration points the slope can be evaluated and normally has to be in a range of 80% to 110 %, where the 100% is 59.16 mV/pH @ 25°C.

Calibration Points and pH buffers

The calibration of pH electrodes is performed normally in 2 points: 7 pH, and 4 or 10 pH. This is based on the assumption that the pH electrode is linear from 3 pH up to 10 pH. For the most accurate reading, it is a good practice to calibrate to a point closest to the values received during normal measurement. For a variety of applications and measuring points, many HANNA meters offer the ability to calibrate in more than 2 points, such as 3 points up to 5 points being common. Many instruments can recognize up to 7 calibration pH buffers: 1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 to cover the entire pH range. The recognized pH buffers are temperature compensated by the instrument which is necessary due to pH variation of buffers due to temperature. For example, a 7.01 pH buffer is 7.01 pH only @ 25°C. A table of temperature variation is printed on the label of each pH buffer .

Custom pH Buffers

HANNA has implemented the concept of custom pH buffers into many of its intruments. This concept is solves two different issues: to use non-standard pH buffers or to permit in-line calibration using a reference pH meter that measures the pH of similar sample. In both cases, temperature compensation cannot be performed because the temperature variation correlation is unknown.

Stability During the Calibration

A readings stability has to be reached in order to avoid a wrong calibration. Based on this, the confirmation of a new calibration point is done only after stability criteria is reached. Users are informed during all processes about the stability conditions before the user confirms a stable condition, and any instability will restart the stability evaluation. The stability criteria during the calibration is more rigorous than during the measurement. This mode used in HANNA instrumentation avoids errors by confirmation of calibration points during unstable readings. This principle is respected in any type of calibration: manual or automatic confirmation.

Out of Calibration Range

This is an important feature during measurement and is part of GLP (Good Laboratory Practice). Based on the calibration points where the instrument was calibrated, the measurement is considered accurate or not. If the measurement reading is in a range far from the calibration points, the "Out of calibration range" message is displayed. The measured value is shown and the user can use it, but with the warning from instrument related to possible inaccuracy.

Calibration Time-out

The Calibration Time Out, like Out of Calibration Range are warning messages from GLP (good laboratory practice). Proper, scheduled calibrations are crucial for accurate and repeatable measurements. In the event that readings are performed after an unacceptable time has passed since last calibration, a warning reminder will be displayed. The reading can still be perfromed and used, but under the condition imposed by the warnings.

Step by Step Calibration

In order to avoid errors during the calibration procedure, the meters display indicators that can be followed by the user for a successful calibration. If necessary, it is possible for the calibration steps to be performed in a different order by the user.

Additional Features

GLP (Good Laboratory Practice) and ISO standards are used to request the traceability of operations. HANNA's GLP solutions offer support for quality of calibration plus all the necessary information to identify the instrument, operator and the moment when the calibration was done.

Logging is a common feature for many instruments and can be used to memorize readings. Two working modes are available: log-on-demand and automatic or interval logging. With Log-on-demand, measurements that are considered important by the user will be saved by request upon pressing the log button. With automatic or interval logging, the instrument saves all the readings according with a specified interval. Another logging mode is AutoEnd logging or log on stability.

Analog output is a feature used to connect the instrument to a recorder to record the measurement in analog mode. The common ranges of analog output are 4 - 20 mA or 0 - 20 mA and 0 to 5V.

The graphic LCD that many HANNA meters include improve the user experience with features such as tutorials, contextual help, multi-language support and icons and messages to guide the user through operation and calibration.

Product Spotlights

Research Grade Calibration Check™ pH Meters

3.8-3.11

HI 4521 and HI 4522 are research grade, benchtop instruments that feature 8 measurement ranges: pH, ORP (Oxidation Reduction Potential), ISE (HI 4522 only), conductivity, resistivity, TDS, salinity and temperature. These instruments incorporate dual channels with a separate temperature input and support the external reference electrodes required by half cell pH and ISE sensors.

HI 4221 and HI 4222 are research grade pH, ORP and temperature benchtop meters. HI 4222 also incorporates ISE measurements and dual channels.

These instruments are fully user customizable and offer a large logging space to fulfill the demands and versatility needed by research laboratories.

HI 3000 series pH Benchtop Meters

3.12-3.15

The HI 3512 is a 2 channel professional benchtop meter with a graphic LCD, designed to provide accurate laboratory results. Channel 1 features pH/ORP/ISE and temperature measurement capability while channel 2 measures EC/TDS/NaCl/Resistivity and temperature.

HANNA's HI 3220, HI 3221 and HI 3222 benchtop instruments feature up to five point pH calibration with a choice of five custom buffers and seven standard buffers.

HI 2000 series pH Benchtop Meters

3.18-3.27

HI 2550 is a two channel instrument that measures up to 7 parameters. With this single laboratory bench meter you can measure pH, ORP, ISE, conductivity (EC), TDS, NaCl percentage and temperature.

The HI 2221 and HI 2223 are pH benchtop meters featuring our exclusive Calibration Check™ diagnostics for both pH electrodes and buffer solutions. These advanced instruments compare the characteristics of the pH electrode from one calibration to the next. In the case of large variances in the electrode condition, these meters alert the user that the electrode needs to be properly cleaned prior to calibration and measuring.

Other models such as the HI 2222 pH meter for wine analysis and HI 2216 pH/ORP/ISE meter with 0.001 pH resolution are available.

Product Spotlights

pH/ORP/ISE Waterproof Portable Meters

3.32

HI 98183, HI 98184 and HI 98185 are waterproof, portable meters designed for demanding applications. HI 98183 measures pH/ORP and temperatuare while HI 98184 and HI 98185 also include ISE measurement.

Choose from 7 standard pH buffers and 5 custom pH buffers to obtain up to five point calibration and achieve high precision readings with a pH accuracy of ±0.002 and up to ±0.001 pH resolution.

HANNA's Calibration Check® maintains a history of past calibrations and monitors the pH electrode and buffers during subsequent calibrations for any signs of wide calibration variances due to a dirty or broken electrode or contaminated pH buffers. In measurement mode, the electrode's percent condition is continuously displayed.

Waterproof Portable pH Meters

3.34-3.39

HI 98172 is a pH/ORP/ISE meter housed in a waterproof casing. Up to five point pH calibration is available with seven memorized pH buffers and five custom pH buffers to provide users with the flexibility necessary to adjust the calibration range to obtain the most accurate and precise readings.

HI 98140 and HI 98150 are portable Calibration Check™ pH meters that utilize HANNA's SMART electrode technology.

The HI 9126 includes HANNA's exclusive Calibration Check™ technology. Calibration Check™ monitors the pH bulb and reference junction of the electrode every time the instrument is calibrated. In the event of a dirty pH electrode, Calibration Check™ warns the user that maintenance may be needed.

Other models such as our HI 9126V pH meter for wine analysis are available .

Application Designed Portable pH Meters

3.40-3.48

These compact and waterproof instruments have been designed for specific applications. They feature application specific probes, on-screen tutorial messages for calibration and set-up, and BEPS (Battery Error Prevention System) to alert the user in the event that low battery power could adversely affect readings

HI 991001, HI 991002 and HI 991003 - Industrial
HI 99121 - Soil
HI 99141 - Boiler and cooling towers
HI 99131 - Plating baths
HI 99171 - Leather and paper
HI 99161 - Food and dairy
HI 99163 - Meat
HI 99181 - Skin and scalp

Comparison Guide

Benchtop Meters

GUIDE	Extended pH Range	0.001 pH Resolution	ISE Range	ORP Range/Relative mV	EC/TDS/Salinity Range	Resistivity Range	Temperature Range	pH Calibration: (A)utomatic or (M)anual	Calibration Points	Calibration Check™	pH Buffers: Standard/Custom	Temperature Compensation: (A)utomatic or (M)anual	GLP	(A)uto, (L)og on demand and Auto(E)nd Data Logging	(H)OLD, (M)emory Recall	(P)re-amplified/(S)mart, (B)NC Electrode	PC Connection	On-screen Help, Tutorial and Multi-language	(P)rinting, (A)nalog output and (S)tirring	Page
HI 4522	•	•	•	•	•	•	°C/°FK	A	5	•	8/5	A/M	•	A, L, E	H	B	USB/ RS232	•		3.8
HI 4521	•	•		•	•	•	°C/°FK	A	5	•	8/5	A/M	•	A, L, E	H	B	USB/ RS232	•		3.8
HI 4222	•	•	•	•			°C/°FK	A	5	•	8/5	A/M	•	A, L, E	H	B	USB/ RS232	•		3.10
HI 4221	•	•		•			°C/°FK	A	5	•	8/5	A/M	•	A, L, E	H	B	USB/ RS232	•		3.10
HI 3512	•	•	•	•	•	•	°C/°F	A	5	•	7/2	A/M	•	A, L		B	USB	•		3.12
HI 3222	•	•	•	•			°C/°F	A	5	•	7/5	A/M	•	A, L		B	USB	•		3.14
HI 3221	•	•	•	•			°C/°F	A	5	•	7/5	A/M	•	A, L		B	USB	•		3.14
HI 3220	•	•		•			°C/°F	A	5	•	7/5	A/M	•	A, L		B	USB	•		3.14
HI 123	•	•	•	•			°C/°F	A	5	•	7/2	A/M	•	A, L		B	RS232		P	3.16
HI 122	•	•		•			°C/°F	A	5	•	7/2	A/M	•	A, L		B	RS232		P	3.16
HI 2550	•	•	mV	•	•		°C/°F	A	5		7/2	A/M	•	A, L	H	B	USB			3.18
HI 2223	•	•		•			°C/°F	A	5	•	7/2	A/M	•	L		B	USB			3.20
HI 2221	•			•			°C/°F	A	5	•	7/2	A/M	•	L		B	USB			3.20
HI 2222	•			•			°C/°F	A	2	•	7/2	A/M	•	L		B	USB			3.22
HI 2216	•	•	•	•			°C/°F	A	5		7/2	A/M	•	A, L		B	USB			3.24
HI 2215	•	•		•			°C/°F	A	5		7/2	A/M	•	A, L		B	USB			3.25
HI 2214	•			•			°C/°F	A	5		7/2	A/M	•	A, L		B	USB			3.25
HI 2213	•			•			°C/°F	A	3		5/2	A/M	•		M	B				3.26
HI 2212	•						°C/°F	A	3		5/2	A/M	•		M	B				3.26
HI 2211	•			•			°C/°F	A	2		5/0	A/M			M	B				3.27
HI 2210	•						°C/°F	A	2		5/0	A/M			M	B				3.27
pH 209				•				M	2		3/0	M				B			A	3.28
pH 208	•						°C/°F	A	2		6/0	A			H	P			S	3.27
pH 207	•						°C/°F	A	2		6/0	A			H	P				3.27
pH 21				•			°C	A	2		3/0	M				B				3.30
pH 20							°C	A	2		3/0	M				B				3.30
HI 9815							°C	A	3		3/0	M		A		B	RS232			3.31

Portable Meters

GUIDE	Extended pH Range	0.001 pH Resolution	ISE Range	ORP Range/Relative mV	Temperature Range	pH Calibration: Automatic (A) or Manual (M)	Calibration Points	Calibration Check™	pH Buffers: Standard/Custom	Temperature Compensation: Automatic (A) or Manual (M)	GLP	(A)uto, (L)og on demand and Auto(E)nd Data Logging	(H)OLD, (M)emory Recall	(P)re-amplified/(S)mart, (B)NC Electrode	PC Connection	On-screen Help, Tutorial and Multi-language	(S)ensor Check™, (R)echargenbale battery	Battery Management / BEPS	Page
HI 98185	•	•	•	•	°C/°F	M	5	•	7/5	A, M	•	A, L, E	H	B	USB	•	R	•	3.32
HI 98184	•	•	•	•	°C/°F	M	5	•	7/5	A, M	•	A, L, E	H	B	USB	•	R	•	3.32
HI 98183	•	•		•	°C/°F	M	5	•	7/5	A, M	•	A, L, E	H	B	USB	•	R	•	3.32
HI 98172	•		•	•	°C/°F	M	5	•	6/5	A, M	•	A, L, E	H	B	USB			•	3.34
HI 98160	•			•	°C/°F	A	5	•	8/2	A, M	•	L	H	B	USB			•	3.35
HI 98150	•			•	°C/°F	A	5	•	7/2	A, M	•	L	H	S	USB			•	3.36
HI 98140	•				°C/°F	A	3	•	7/2	A, M	•	L	H	S	USB			•	3.36
HI 9126	•			•	°C/°F	A	2	•	7/2	A, M			M	B				•	3.37
HI 9126V	•			•	°C/°F	A	2	•	7/2	A, M			M	B				•	3.38
HI 9125	•			•	°C/°F	A	2		5/0	A, M			M	B				•	3.39
HI 9124	•				°C/°F	A	2		5/0	A, M			M	B				•	3.39
HI 991003	•			•	°C/°F	A	2	•	6/0	A			H	P			S	•	3.40
HI 991002	•			•	°C/°F	A	2	•	6/0	A			H	P				•	3.40
HI 991001	•				°C/°F	A	2	•	6/0	A			H	P				•	3.40
HI 99121	•				°C/°F	A	2	•	6/0	A			H	P				•	3.42
HI 99131	•				°C/°F	A	2	•	6/0	A			H	P				•	3.43
HI 99141	•				°C/°F	A	2	•	6/0	A			H	P				•	3.44
HI 99171	•				°C/°F	A	2	•	6/0	A			H	P				•	3.45
HI 99161	•				°C/°F	A	2	•	6/0	A			H	P				•	3.46
HI 99163	•				°C/°F	A	2	•	6/0	A			H	P				•	3.47
HI 99181	•				°C/°F	A	2	•	6/0	A			H	P				•	3.48
HI 8424	•			•	°C/°F	A	2		3/0	A			H	B				•	3.49
HI 83141				•	°C	M	2			A				P				•	3.50
HI 8314				•	°C	M	2			A				B				•	3.51
HI 8014				•		M	2			M				B				•	3.52
HI 8010						M	2			M				B				•	3.52

HI 4521 • HI 4522

Research Grade Meters with Calibration Check™ and USP
pH/ORP/ISE and EC/TDS/Resistivity/Salinity and Temperature

- **Up to eight measurement parameters**
- **Two input channels**
  pH/ORP/ISE and EC/TDS/Resistivity/Salinity
- **pH Calibration Check™**
- **Five point pH and ISE calibration with standard and custom buffers**
- **USP 645 method, ISE incremental methods and salinity scales**
- **Fully customizable**
- **Large log memory with different logging methods**

HI 4521 and HI 4522 are research grade, benchtop instruments that feature 8 measurement parameters: pH, ORP (Oxidation Reduction Potential), ISE (HI 4522 only), conductivity, resistivity, TDS, salinity and temperature. These instruments incorporate dual channels with a separate temperature input and support the external reference electrodes required by half cell pH and ISE sensors.

The user interface is customizable and capable of displaying two channels at the same time, showing the measurements in various modes: basic measurement with or without GLP information, graph or logging data.

These instruments offer multi-language support and contextual help is available through a dedicated Help key. Clear tutorial messages and directions are available on-screen to quickly and easily guide users through all measurement and calibration procedures to ensure measurements and calibrations are performed properly.

HANNA's pH Calibration Check™ diagnostics system ensures accurate readings every time by alerting users of potential problems during the calibration process. The Calibration Check™ system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated pH buffer solutions. After the guided calibration process, electrode condition is evaluated and an indicator is displayed informing the user of the overall pH electrode status.

Automatic, semiautomatic and manual pH calibration is available in up to five points, with eight standard (1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) and up to five custom buffers. The Out of Calibration Range and Cal Due features alert the user in the event the measurement is far from the calibration point or when the meter is due for recalibration. Proper, scheduled calibrations are crucial for accurate and repeatable measurements.

HI 4522 features up to five point Manual Selection and Custom Standard ISE calibration with up to five standard solutions and up to five custom solutions with or without temperature compensation. From the on-screen list, users can select their ISE electrode parameter along with it's standard configuration profile or create their own.

Up to a four point automatic or custom standard conductivity calibration can be performed in up to four points as well as probe cell constant. One fixed point salinity calibration can be performed on the Percent Scale only. Three salinity ranges are available: practical scale, natural sea water scale and percentage scale.

Up to ten profiles can be saved and recalled eliminating the need to reconfigure each time when a different probe is used. User definable configurations can include: temperature compensation in accordance with each parameter, isopotential points for pH and ISE, measurement units of ISE concentrations and ISE electrode type, temperature units, EC temperature reference, EC temperature coefficient, EC probe type, and cell constant.

Three selectable logging modes are available: Automatic, Manual and AutoHold logging. Up to 100 logging lots with up to 10,000 recods each can be stored for automatic or manual modes along with up to 200 USP reports, and up to 100 ISE methods reports. Automatic logging features a selectable area and sampling period while GLP information includes complete data about user calibration of each parameter and identification information for the instrument, user, and company. Data can be transferred to a PC via the opto-isolated RS232 or USB ports and HI 92000 software (optional).

SPECIFICATIONS		HI 4521	HI 4522
pH	Range	-2.000 to 20.000 pH	
	Resolution	0.1 pH; 0.01 pH; 0.001 pH	
	Accuracy	±0.1 pH; ±0.01 pH; ±0.002 pH ±1 LSD	
mV	Range	±2000 mV	
	Resolution	0.1 mV	
	Accuracy	±0.2 mV ±1 LSD	
ISE	Range	–	1 x 10^{-6} to 9.99 x 10^{10} concentration
	Resolution	–	1; 0.1; 0.01; 0.001 concentration
	Accuracy	–	±0.5% (monovalent ions); ±1% (divalent ions)
Conductivity	Range	0.000 to 9.999 µS/cm; 10.00 to 99.99 µS/cm; 100.0 to 999.9 µS/cm; 1.000 to 9.999 mS/cm; 10.00 to 99.99 mS/cm; 100.0 to 999.9 mS/cm; 1000 mS/cm	
	Resolution	0.001 µS/cm; 0.01 µS/cm; 0.1 µS/cm; 0.001 mS/cm; 0.01 mS/cm; 0.1 mS/cm	
	Accuracy	±1% of reading (±0.01 µS/cm)	
	Cell Constant	0.0500 to 200.00	
	Cell Type	2, 4 rings	
	Calibration Type	auto standard recognition, user standard single point / multi point calibration	
	Calibration Reminder	yes	
	Temperature Coefficient	0.00 to 10.00 %/°C	
	Reference Temperature	15.0 °C to 30.0°C	
	Profiles	up to 10	
	USP Compliant	yes	
Resistivity	Range	1.0 to 99.9 Ohms x cm; 100 to 999 Ohms x cm; 1.00 to 9.99 kOhms x cm; 10.0 to 99.9 kOhms x cm; 100 to 999 kOhms x cm; 1.00 to 9.99 MOhms x cm; 10.0 to 100.0 MOhms x cm	
	Resolution	0.1 Ohms x cm; 1 Ohms x cm; 0.01 kOhms x cm; 0.1 kOhms x cm; 1 kOhms x cm; 0.01 MOhms x cm; 0.1 MOhms x cm	
	Accuracy	±2% of reading (±1 Ohm x cm)	
TDS	Range	0.000 to 9.999 ppm; 10.00 to 99.99 ppm; 100.0 to 999.9 ppm; 1.000 to 9.999 ppt; 10.00 to 99.99 ppt; 100.0 to 400.0 ppt actual TDS (with 1.00 factor)	
	Resolution	0.001 ppm; 0.01 ppm; 0.1 ppm; 0.001 ppt; 0.01 ppt; 0.1 ppt	
	Accuracy	±1% of reading (±0.01 ppm)	
Salinity	Range	practical scale: 0.00 to 42.00 psu; natural sea water scale: 0.00 to 80.00 ppt; percent scale: 0.0 to 400.0%	
	Resolution	0.01 for practical scale/natural sea water scale; 0.1% for percent scale	
	Accuracy	±1% of reading	
Temperature	Range	-20.0 to 120°C; -4.0 to 248.0°F; 253.15 to 393.15K	
	Resolution	0.1°C; 0.1°F; 0.1K	
	Accuracy	±0.2°C; ±0.4°F; ±0.2K (without probe)	
Calibration	pH	automatic, up to five point calibration, eight standard buffers available (1.68, 3.00, 4.01, 6.86, 7.01,9.18, 10.01, 12.45), and five custom buffers	
	ISE	–	automatic, up to five point calibration, 5 fixed standard solutions available for each measurement unit, and 5 user defined standards
	Conductivity	auto standard recognition, user standard single point/multi-point	
	Salinity	percent scale–1 point (with HI 7037 standard)	
pH Calibration Check™		yes	
Relative mV Offset Range		±2000 mV	
Input Channel(s)		1 pH/ORP + 1 EC	1 pH/ORP/ISE + 1 EC
GLP		cell constant, reference temperature/coefficient, calibration points, cal time stamp, probe offset for conductivity	
Temperature Compensation	pH	automatic or manual from -20.0 to 120.0°C/-4.0 to 248.0°/253 to 393K	
	EC	disabled, linear and non-linear (natural water)	
pH Electrode		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)	
EC Probe		HI 76312 platinum, 4-ring conductivity/TDS probe with internal temperature sensor and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662-T stainless steel temperature probe with 1 m (3.3') cable (included)	
Logging	Record	100 lots with 10,000 record/lot	
	Interval	settable between 1 and max log time	
	Type	automatic, log on demand, auto HOLD	
Replatinization		yes	
Display		color graphic LCD with on-screen help, graphing, language selection and custom configuration	
PC Connection		USB and RS232	
Power Supply		12 VDC adapter (included)	
Environment		0-50°C (32 to 122°F) (273 to 323K) RH max 95% non-condensing	
Dimensions / Weight		160 x 231 x 94 mm (6.3 x 9.1 x 3.7") / 1.2 Kg (2.64 lbs.)	

ORDERING INFORMATION

HI 4521-01 (115V), **HI 4521-02** (230V), **HI 4522-01** (115V) and **HI 4522-02** (230V) are supplied with HI 76312 conductivity/TDS probe, HI 1131B pH electrode, HI 7662-T temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachet (2), HI 7071S electrolyte solution (30 mL), HI 76404N electrode holder, 12 VDC adapter and instructions.

SOLUTIONS

HI 6004	pH 4.010 buffer solution, 500 mL
HI 6007	pH 7.010 buffer solution, 500 mL
HI 6010	pH 10.010 buffer solution, 500 mL
HI 7030L	12880 µS/cm cal. solution, 500 mL
HI 7031L	1413 µS/cm calibration solution, 500 mL
HI 7033L	84 µS/cm calibration solution, 500 mL
HI 7034L	80000 µS/cm cal. solution, 500 mL
HI 7035L	111800 µS/cm cal. solution, 500 mL
HI 7039L	5000 µS/cm cal. solution, 500 mL
HI 7037L	Salinity standard solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection

For a complete list of Solutions and Electrodes, see the end of pH *Section 3,* ISE *Section 4* and Conductivity *Section 6*.

HI 4221 • HI 4222

Research Grade Meters with Calibration Check™

pH/ORP/ISE and Temperature

- **Two input channels (HI 4222)**
  pH/ORP/ISE and temperature
- **pH Calibration Check™**
- **Five point pH and ISE calibration with standard and custom buffers**
- **ISE incremental methods**
- **User customizable interface for one (HI 4221) or two (HI 4222) channels**
- **Fully customizable**
- **Large log memory with different logging methods**

HI 4221 and HI 4222 are research grade pH, ORP and temperature benchtop meters. HI 4222 also incorporates ISE measurements and dual channels with a separate temperature input and support the external reference electrodes required by half cell pH and ISE sensors.

The user interface of both instruments are customizable and the HI 4222 is capable of displaying two channels at the same time. These meters are capable of showing the measurements in various modes: basic measurement with or without GLP information, graph or logging data.

These instruments offer multi-language support and contextual help is available through a dedicated Help key. Clear tutorial messages and directions are available on-screen to quickly and easily guide users through all measurement and calibration procedures to ensure measurements and calibrations are performed properly.

HANNA's exclusive Calibration Check™ diagnostics system ensures accurate pH readings every time by alerting users of potential problems during the calibration process. The Calibration Check™ system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated pH buffer solutions during calibration. After the guided calibration process, the electrode condition is evaluated and an indicator is displayed informing the user of the overall pH electrode status.

Automatic, semiautomatic and manual pH calibration is available in up to five points, with 8 standard (1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) and up to 5 custom buffers. The Out of Calibration Range and Cal Due features alert the user in the event the measurement is far from the calibration point or when the meter is due for recalibration. Proper, scheduled calibrations are crucial for accurate and repeatable measurements.

HI 4222 also features Manual Selection and Custom Standard ISE calibration up to five points, with standard solutions and up to 5 custom solutions, with or without temperature compensation.

From the on-screen list, users can select their ISE electrode parameter along with it's standard configuration profile or create their own.

Up to 10 profiles can be saved and recalled for both instruments, eliminating the need to reconfigure each time when a different electrode is used. User definable configurations can include: temperature compensation modes in accordance with each parameter, isopotential points for pH and ISE (HI 4222 only), measurement units of ISE concentrations, ISE electrode type (HI 4222 only), and temperature units.

Three selectable logging modes are available: Automatic, Manual and AutoHold logging. Up to 100 logging lots with 10,000 records each can be stored for automatic or manual mode, and up to 100 ISE methods reports (HI 4222 only). Automatic logging features a selectable area and sampling period while GLP information includes complete data about user calibration of each parameter and identification information for the instrument, user, and company. Data can be transferred to a PC via the opto-isolated RS232 or USB ports and HI 92000 software (optional).

SPECIFICATIONS		HI 4221	HI 4222
pH	Range	-2.000 to 20.000 pH	
	Resolution	0.1 pH; 0.01 pH; 0.001 pH	
	Accuracy	±0.1 pH; ±0.01 pH; ±0.002 pH ±1 LSD	
mV	Range	±2000 mV	
	Resolution	0.1 mV	
	Accuracy	±0.2 mV ±1 LSD	
ISE	Range	–	1×10^{-7} to 9.99×10^{10} concentration
	Resolution	–	1; 0.1; 0.01; 0.001 concentration
	Accuracy	–	±0.5% (monovalent ions); ±1% (divalent ions)
Temperature	Range	-20.0 to 120°C; -4.0 to 248.0°F; 253.15 to 393.15K	
	Resolution	0.1°C; 0.1°F; 0.1K	
	Accuracy	±0.2°C; ±0.4°F; ±0.2K (without probe)	
Calibration	pH	automatic, up to five point calibration, eight standard buffers available (1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 5 custom buffers	
	ISE	–	automatic, up to five point calibration, five fixed standard solutions available for each measurement unit, and five user defined standards
pH Calibration Check™		yes	
Relative mV Offset Range		±2000 mV	
Input Channel(s)		1 pH/ORP	2 pH/ORP/ISE
GLP		cell constant, reference temperature/coefficient, calibration points, cal time stamp, probe offset for conductivity	
Temperature Compensation	pH	automatic or manual from -20.0 to 120.0°C/-4.0 to 248.0°/253 to 393K	
pH Electrode		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662-T stainless steel temperature probe with 1 m (3.3') cable (included)	
Logging	Record	100 lots with 10,000 record/lot	
	Interval	settable between one and max log time	
	Type	automatic, log on demand, auto HOLD	
Replatinization		yes	
Display		color graphic LCD with on-screen help, graphing, language selection and custom configuration	
PC Connection		USB and RS232	
Power Supply		12 VDC adapter (included)	
Environment		0-50°C (32 to 122°F) (273 to 323K) RH max 95% non-condensing	
Dimensions		160 x 231 x 94 mm (6.3 x 9.1 x 3.7")	
Weight		1.2 Kg (2.64 lbs.)	

ORDERING INFORMATION

HI 4221-01 (115V), **HI 4221-02** (230V), **HI 4222-01** (115V) and **HI 4222-02** (230V) are supplied with HI 1131B pH electrode, HI 7662-T temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachet (2), HI 7071S electrolyte solution (30 mL), 12 VDC adapter and instructions.

ELECTRODES

HI 1131B	Glass body pH electrode with BNC connector and 1 m (3.3') cable
HI 7662-T	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 6004	pH 4.010 buffer solution, 500 mL
HI 6007	pH 7.010 buffer solution, 500 mL
HI 6010	pH 10.010 buffer solution, 500 mL
HI 7004L	pH 4.01 buffer solution, 500 mL
HI 7007L	pH 7.01 buffer solution, 500 mL
HI 7010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

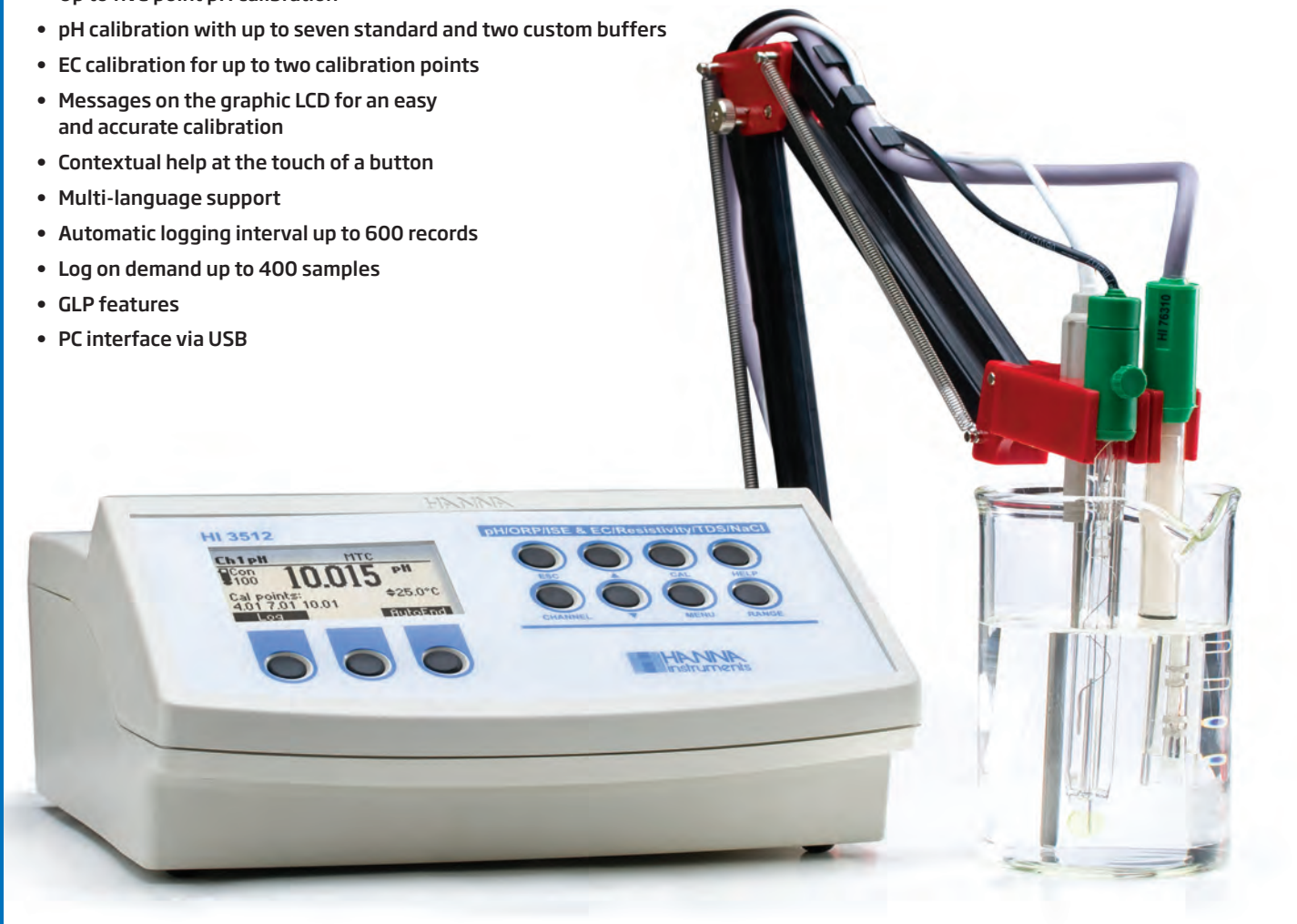
HI 76404N	Electrode holder
HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection

For a complete list of Solutions and Electrodes, see the end of pH *Section 3* and ISE *Section 4*.

HI 3512

Two Channel, pH/ORP/ISE, EC/TDS/NaCl/Resistivity Benchtop Meter

- pH Calibration Check™ and electrode condition
- Up to five point pH calibration
- pH calibration with up to seven standard and two custom buffers
- EC calibration for up to two calibration points
- Messages on the graphic LCD for an easy and accurate calibration
- Contextual help at the touch of a button
- Multi-language support
- Automatic logging interval up to 600 records
- Log on demand up to 400 samples
- GLP features
- PC interface via USB



The HI 3512 is a 2 channel professional benchtop meter with a graphic LCD, designed to provide accurate laboratory results. Channel 1 features pH/ORP/ISE and temperature measurement capability while channel 2 measures EC/TDS/NaCl/Resistivity and temperature.

The pH channel offers up to five point pH calibration with seven standard buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) and up to two custom buffers.

HANNA's exclusive Calibration Check™ diagnostics system ensures accurate pH readings every time by alerting users of potential problems during the calibration process. The Calibration Check™ system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated pH buffer solutions during calibration. After the guided calibration process, the probe condition is evaluated and an indicator is displayed informing the user of the overall pH electrode status.

This instrument can measure using ORP electrodes (pH channel input), thanks to their capability to measure mV with a resolution up to 0.1 mV and ISE electrodes on ppm scale (pH channel input). The electrode type and unit selection capability and the ISE calibration in up to five calibration standard solutions make this instrument very useful for a large range of concentration solution measurements.

The EC channel offers up to two calibration points with 7 memorized standards (0.00 µS/cm, 84.0 µS/cm, 1.413 mS/cm, 5.00 mS/cm, 12.88 mS/cm, 80.0 mS/cm and 111.8 mS/cm). The EC channel supports autoranging, manual ranging and lock of the user selected range, temperature compensation selection, temperature reference selection (15 °C, 20 °C or 25 °C) and temperature coefficient set.

TDS factor can be set between 0.40 and 1.00.

pH and EC channels also provide user selectable "out of calibration range" warnings and a "calibration timeout" to remind the user when a new calibration is necessary.

Messages on the graphic LCD offer directions for easy and accurate calibration for both channels as well as diagnostics to alert the user when calibration or measurement issues are detected.

Other features of the HI 3512 include log-on-demand of up to 400 samples, automatic logging interval with log on stability feature of up to 600 records, auto HOLD that freezes the first stable reading on the LCD display, GLP to view the last calibration data for pH, rel mV, ISE, EC or NaCl and PC interface via USB.

SPECIFICATIONS		HI 3512
pH	Range	-2.0 to 20.0; -2.00 to 20.00; -2.000 to 20.000 pH
	Resolution	0.1 pH; 0.01 pH; 0.001 pH
	Accuracy	±0.01 pH; ±0.002 pH
mV	Range	±2000.0 mV
	Resolution	0.1 mV
	Accuracy	±0.2 mV
ISE	Range	1.00 E-7 to 9.99 E10 conc.
	Resolution	3 digits 0.01, 0.1, 1, 10 conc.
	Accuracy	±0.5% of reading (monovalent ions); ±1% of reading (divalent ions)
Temperature Channel 1	Range	-20.0 to 120.0 °C (4.0 to 248.0 °F)
	Resolution	0.1 °C (0.1 °F)
	Accuracy	±0.2 °C (±0.4 °F) (excluding probe error)
Relative mV Offset Range		±2000 mV
pH Calibration		up to five point calibration, seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers
Calibration Check™		yes
Slope Calibration		from 80 to 110%
pH Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature probe		HI 7662-T temperature probe with 1 m (3.3') cable (included)
ISE Calibration		up to five-point calibration points 6 standard solutions available (0.1, 1, 10, 100, 1000, 10000 ppm)
EC	Range	0.001 µS/cm to 400 mS/cm (shows values up to 1000 mS/cm actual conductivity); 0.001 to 9.999 µS/cm; 10.00 to 99.99 µS/cm; 100.0 to 999.9 µS/cm; 1.000 to 9.999 mS/cm; 10.00 to 99.99 mS/cm; 100.0 to 999.9 mS/cm; 1000 mS/cm (autoranging)
	Resolution	0.001 µS/cm; 0.01 µS/cm; 0.1 µS/cm; 0.001 mS/cm; 0.01 mS/cm; 0.1 mS/cm; 1 mS/cm
	Accuracy	±1% of reading (±0.01 µS/cm or 1 digit whichever is greater) excluding probe error
Resistivity	Range	1.0 to 99.9 ohms; 100 to 999 ohms; 1.00 to 9.99 Kohms; 10.0 to 99.9 Kohms; 100 to 999 Kohms; 1.00 to 9.99 Mohms; 10.0 to 100.0 Mohms (autoranging)
	Resolution	0.1 ohm; 1 ohm; 0.01 Kohms; 0.1 Kohms; 1 Kohms; 0.01 Mohms; 0.1 Mohms
	Accuracy	±1% of reading (±10 ohms or 1 digit whichever greater) excluding probe error
TDS	Range	0.000 to 9.999 ppm; 10.00 to 99.99 ppm; 100.0 to 999.9 ppm; 1.000 to 9.999 g/L; 10.00 to 99.99 g/L; 100.0 to 400.0 g/L (autoranging)
	Resolution	0.001 ppm; 0.01 ppm; 0.1 ppm; 0.001 g/L; 0.01 g/L; 0.1 g/L
	Accuracy	±1% of reading (±0.05 ppm or 1 digit whichever greater) excluding probe error
	Factor	0.40 to 1.00
Salinity	Range	% NaCl: 0.0 to 400.0 %
	Resolution	0.1 %
	Accuracy	±1% of reading excluding probe error
Temperature Channel 2	Range	-20.0 to 120°C
	Resolution	0.1°C
	Accuracy	±0.2 °C (excluding probe error)
EC Calibration		automatic up to two points with seven memorized standards (0.00 µS/cm, 84.0 µS/cm, 1.413 mS/cm, 5.00 mS/cm, 12.88 mS/cm, 80.0 mS/cm, 111.8 mS/cm)
Constant Cell Setup		0.010 to 10.000
NaCl Calibration		max. one point only (with HI 7037 standard)
EC Probe		HI 76310 platinum four ring conductivity/TDS probe with 1 m (3.3') cable (included)
Temperature Source		automatic from sensor inside the probe; manual entry
EC Temperature Compensation		NoTC, MTC, ATC
Reference Temperature		15, 20, 25 °C
Temperature Coeficient		0.00 to 10.00 %/°C
Log On Demand		400 samples
Lot Logging / Interval		5, 10, 30 seconds; 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes, AutoEnd (max 600 samples)
PC interface		opto-isolated USB
Input Impedance		10^{12} ohms
Power Supply		12 VDC adapter (included)
Environment		0 to 50 °C (32 - 122 °F) RH max 55% non-condensing
Dimensions / Weight		235 x 207 x 110 mm (9.2 x 8.14 x 4.33") / 1.8 Kg (4 lbs.)

ORDERING INFORMATION

HI 3512-01 (115V) and **HI 3512-02** (230V) is supplied with HI 76310 conductivity/TDS probe, HI 1131B pH electrode, HI 7662-T temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachet (2), HI 7071S electrolyte solution (30 mL), HI 76404N electrode holder, 12 VDC adapter and instructions.

SOLUTIONS

HI 6016 pH 1.679 buffer solution, 500 mL
HI 6004 pH 4.010 buffer solution, 500 mL
HI 6007 pH 7.010 buffer solution, 500 mL
HI 6010 pH 10.010 buffer solution, 500 mL
HI 6124 pH 12.450 buffer solution, 500 mL
HI 7030L 12880 µS/cm calibration solution, 500 mL
HI 7031L 1413 µS/cm calibration solution, 500 mL
HI 7033L 84 µS/cm calibration solution, 500 mL
HI 7034L 80000 µS/cm calibration solution, 500 mL
HI 7035L 111800 µS/cm calibration solution, 500 mL
HI 7039L 5000 µS/cm calibration solution, 500 mL
HI 7037L Salinity standard solution, 500 mL
HI 7061L Electrode cleaning solution, 500 mL
HI 70300L Electrode storage solution, 500 mL

ACCESSORIES

HI 76404N Electrode holder
HI 92000 Windows® compatible software
HI 920013 USB cable for PC connection

For a complete list of Solutions and Electrodes, see the end of pH *Section 3*, ISE *Section 4* and Conductivity *Section 6*.

HI 3220 • HI 3221 • HI 3222

pH/ORP/ISE Graphic LCD pH Benchtop Meters

- One or two input channels
- pH Calibration Check™
- Five point pH calibration with seven standard and five custom buffers
- Stability, interval and log on demand logging
- Up to 400 log on demand records and 600 automatic logging records
- Messages on the graphic LCD for an easy and accurate calibration
- Multi-language support
- GLP features
- PC interface via USB

HANNA's HI 3220, HI 3221 and HI 3222 benchtop instruments feature up to five point pH calibration with a choice of five custom buffers and seven standard buffers.

HI 3222, HI 3221 and HI 3220 feature an interactive user support interface that assists you before, during and after measurement. On-screen tutorials guide users through set-up, calibration and measurement while context sensitive help of any screen is available at a push of a button. The help screen includes language specific assistance for menu parameters, calibration, logging, contact and accessory information for your instrument.

These instruments feature HANNA's exclusive Calibration Check™, a diagnostics system that ensures accurate pH readings every time. By alerting users of potential problems during the calibration process, the Calibration Check™ system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated pH buffer solutions during calibration. Throughout the calibration process, users are guided step-by-step by the on-screen tutorial. After calibration, the probe condition is evaluated and an indicator is displayed informing the user of the overall pH electrode status.

Both the HI 3220 and HI 3221 are equipped with one input channel. HI 3222 is equipped with two input channels for simultaneous measurements. Having these two channels eliminates the need for swapping probes and recalibrating.

These instruments can measure using ORP electrodes (pH channel input), thanks to their capability to measure mV with a resolution up to 0.1 mV. The HI 3221 and HI 3222 can use ISE electrodes in the ppm scale (pH channel input) and provides a choice of measurement units (ppb, ppm, molarity, weight/volume %). The electrode type and unit selection capability and the ISE calibration in up to five calibration standard solutions (HI 3222 only) make these instruments very useful for a large range of concentration solutions measurements.

SPECIFICATIONS		HI 3220	HI 3221	HI 3222
Range	pH		-2.0 to 20.0; -2.00 to 20.00; -2.000 to 20.000 pH	
	mV		±2000 mV	
	ISE	–	1.00 E-3 to 1.00 E5 concentration	1.00 E-7 to 9.99 E10 concentration (choice of units)
	Temperature		-20.0 to 120.0 °C (-4.0 to 248.0°F)	
Resolution	pH		0.1; 0.01; 0.001 pH	
	mV		0.1 mV	
	ISE	–	3 digits 0.01; 0.1; 1; 10 concentration	
	Temperature		0.1°C (0.1°F)	
Accuracy	pH		±0.01; ±0.002 pH	
	mV		±0.2 mV	
	ISE	–	±0.5% of reading (monovalent ions), ±1% of reading (divalent ions)	
	Temperature		±0.2°C (±0.4°F) (excluding probe error)	
Calibration	pH		up to five point calibration, seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + five custom buffers	
	ISE	–	up to two point calibration, six standard solutions (0.1, 1, 10, 100, 1000, 10000 ppm)	up to five point calibration, six standard solutions (in units selected)
	Slope		from 80 to 110%	
pH Calibration Check™			yes	
Rel mV Offset Range			±2000 mV	
Temperature Compensation (pH)			manual or automatic from -20.0 to 120.0°C (-4.0 to 248.0°F)	
Input Channels		1	1	2
pH Electrode		HI 1131B pH electrode with glass body, BNC connector and 1 m (3.3') cable (included)		
Temperature Probe		HI 7662-T temperature probe, stainless steel with 1 m (3.3') cable (included)		
Logging		log on demand 200 samples	log on demand 300 samples	log on demand 400 samples
Lot Logging		5, 10, 30 seconds; 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes (max 600 samples)		
PC Connectivity		opto-isolated USB (with optional HI 92000 software)		
Input Impedance		10^{12} Ohms		
Power Supply		12 VDC adapter (included)		
Environment		0-50°C (32 to 122°F) RH max 55% non-condensing		
Dimensions		235 x 207 x 110 mm (9.2 x 8.14 x 4.33")		
Weight		1.8 kg (4 lbs.)		

ORDERING INFORMATION

HI 3220-01 (115V), **HI 3220-02** (230V), **HI 3221-01** (115V), **HI 3221-02** (230V), **HI 3222-01** (115V) and **HI 3222-02** (230V) are supplied with HI 1131B pH electrode, HI 7662-T temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachet (2), HI 7071S electrolyte solution (30 mL), 12 VDC adapter and instructions.

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 Use: strong acid/alkalis; Glass-body, double junction, refillable, combination pH electrode

HI 1053B Use: emulsions; Glass-body, triple ceramic, refillable, combination pH electrode

HI 1083B Use: biotechnology; Glass-body, open junction, refillable, combination pH electrode

HI 1131B Use: general purpose; Glass-body, single junction, refillable, combination pH electrode

HI 3230B Use: general purpose; Plastic-body, gel-filled, combination platinum ORP electrode

HI 7662-T Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L pH 4.01 buffer solution, 500 mL
HI 5007L pH 7.01 buffer solution, 500 mL
HI 5010L pH 10.01 buffer solution, 500 mL
HI 7020L ORP test solution @200-275 mV, 500 mL
HI 7021L ORP test solution @240 mV, 500 mL
HI 7022L ORP test solution @470 mV, 500 mL
HI 7091L Reducing pretreatment ORP solution, 500 mL
HI 7092L Oxidizing pretreatment ORP solution, 500 mL
HI 7071 3.5M KCl + AgCl electrolyte solution, 30 mL (4), for single junction electrodes
HI 7082 3.5M KCl electrolyte solution, 30 mL (4), for double junction electrodes
HI 7061L Electrode cleaning solution, 500 mL
HI 70300L Electrode storage solution, 500 mL

ACCESSORIES

HI 740155 Plastic refilling pipette (20)
HI 76404N Electrode holder
HI 92000 Windows® compatible software
HI 920013 USB cable for PC connection

For a complete list of Solutions and Electrodes, see the end of pH *Section 3* and ISE *Section 4*.

HI 122 • HI 123

pH Benchtop Meters with Built-in Printer

- pH Calibration Check™
- Electrode response time
- Five pH calibration points
- Seven standard and two custom buffers
- Out of calibration range warning
- Large, custom LCD
- Built-in impact printer
- Separate pH and ISE channels (HI 123)
- Automatic data logging of 2000 records and log on demand
- GLP capabilities
- High and low audible alarms

HI 122 and HI 123 are benchtop instruments featuring a built-in printer, Calibration Check™, electrode response time and condition monitoring, and enhanced diagnostic messages during calibration. HI 123 also incorporates dual inputs to measure both pH and ISE simultaneously.

These meters use HANNA's "P" series of electrodes. For more accuracy, these meters also check if the measurement is outside the calibration range and warns the user in case measurements are too far outside the calibration points. Calibration can be performed in up to five points using the standard seven buffers that are automatically recognized, or by using two custom buffer values. The buffer(s) used during calibration are displayed on the LCD even when in measurement mode.

Users can log on demand up to 50 samples (50 samples per channel for dual channel model). These meters have automatic data logging of up to 1000 points (1000 points per channel for dual channel model) with flexible starting and stopping criteria.

This instrument provides GLP capabilities that allows for the storage and retrieval of all data regarding pH, rel mV, EC and NaCl calibration as well as data regarding the maintenance and status of the electrode.

Printing

The built-in impact printer incorporated into the HI 122 and HI 123 uses regular paper that does not fade with time. A complete set of information based on the measured, set or recorded data can be printed on demand (for current reading in measurement mode, GLP and SETUP modes) or automatically (for autolog and log on demand modes). These models also allow users to print detailed information in four languages for specific help screens and instrument set-up.

Exclusive pH Calibration Check™

HANNA's exclusive Calibration Check™, a diagnostics system that ensures accurate pH readings every time. By alerting users of potential problems during the calibration process, the Calibration Check™ system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated pH buffer solutions during calibration. Throughout the calibration process, users are guided step-by-step by the on-screen tutorial. After calibration, the probe condition and response time is evaluated and an electrode condition and response time graph is displayed informing the user of the overall pH electrode status. The Calibration Time Out and Out of Calibration Range warning complete the instruments' calibration features.

Out of Calibration Range warning:

Measuring samples outside the calibration range may result in loss of accuracy.

Contaminated Buffer warning:

A contaminated buffer solution causes erroneous calibration curve resulting in loss of accuracy during measurement.

Clean pH Electrode warning:

A dirty pH electrode causes erroneous calibration curve resulting in loss of accuracy during measurement.

Check pH Electrode warning:

This message is displayed in the event the junction of the pH electrode is clogged.

SPECIFICATIONS		HI 122	HI 123
Range	pH	-2.00 to 16.00 pH / -2.000 to 16.000 pH	
	mV	±999.9 and ±2000 mV	
	Selective Ions	–	0.001 to 19999 ppm
	Temperature	-20.0 to 120.0°C (-4.0 to 248.0°F)	
Resolution	pH	0.01 pH / 0.001 pH	
	mV	0.1 mV / 1 mV	
	Selective Ions	–	0.001 / 0.01 / 0.1 / 1 ppm
	Temperature	0.1°C (0.1°F)	
Accuracy (@20°C)	pH	±0.01 pH / ±0.002 pH	
	mV	±0.2 mV (±699.9 mV) / ±0.5 mV (±999.9 mV) / ±1 mV (±2000 mV)	
	Selective Ions	–	±0.5% f.s.
	Temperature	±0.4°C (±0.7°F) excluding probe error	
BNC Inputs		1 for pH electrode	2 for pH and/or ISE electrode
pH Calibration Check		status of electrode condition and response time, status of the buffer solutions during calibration	
Relative mV Offset Range		±2000 mV	
pH Calibration		automatic, up to five point calibration standard with seven buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + two custom buffers	
ISE Calibration		–	automatic, one or two point with five standard values (0.1, 1, 10,100, 1000 ppm)
Temperature Compensation		automatic or manual, -20.0 to 120°C (-4.0 to 248.0°F)	
pH Electrode		HI 1131P glass body pH electrode with BNC + pin connectors and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662-T temperature probe, stainless steel with 1 m (3.3') cable (included)	
Input Impedance		10^{12} Ohm	
Log On Demand		50 samples	100 samples
Automatic Logging		1000 samples	2000 samples
PC Connection		RS232 serial port, opto-isolated	
Printer		built-in dot matrix printer, with 44 mm plain paper	
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		280 x 203 x 84 mm (11.0 x 8.0 x 3.3")	
Weight		1.9 kg (4.2 lbs.)	

ORDERING INFORMATION

HI 122-01 (115V), **HI 122-02** (230V), **HI 123-01** (115V) and **HI 123-02** (230V) are supplied with HI 1131P pH electrode, HI 7662-T temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 7071S electrolyte solution (30 mL), (5) paper rolls, 12 VDC adapter and instructions.

ELECTRODES

All electrode part numbers ending in "P" are supplied with a BNC and PIN connector and 1 m (3.3') cable:

HI 1043P	Use: strong acid/alkalis; glass-body, double junction, refillable, combination pH electrode
HI 1053P	Use: emulsions; glass-body, triple ceramic, refillable, combination pH electrode
HI 1083P	Use: biotechnology; glass-body, open junction, refillable, combination pH electrode
HI 1131P	Use: general purpose; glass-body, single junction, refillable, combination pH electrode
HI 7662-T	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7071	3.5M KCl+AgCl Electrolyte, 30 mL (4), for single junction electrodes
HI 7072	1M KNO_3 Electrolyte, 30 mL (4)
HI 7082	3.5M KCl Electrolyte, 30 mL (4), for double junction electrodes

ACCESSORIES

HI 710032	(10) Plain paper rolls
HI 710033	Replacement ink cartridge
HI 76405	Electrode holder
HI 92000	Windows® compatible software
HI 920010	RS232 cable for PC connection

For a complete list of Solutions and Electrodes, see the end of pH *Section 3* and ISE *Section 4*.

HI 2550

pH/ORP/ISE/EC/TDS/NaCl Benchtop Meter

- Up to seven measurement parameters
- Two input channels: pH/ORP/ISE and EC/TDS/Resistivity/NaCl
- Up to five point pH calibration with seven standard and two custom buffers
- EC/TDS autoranging, manual ranging and range lock
- HOLD button to freeze readings on the display
- Automatic Temperature Compensation (pH & EC)
- PC interface via USB

HI 2550 is a 2 channel instrument that measures up to 7 parameters. With this single laboratory bench meter you can measure pH, ORP, ISE, conductivity (EC), TDS, NaCl percentage and temperature.

Utilizing an external temperature probe, pH readings are automatically temperature compensated. To ensure a higher level of precision, pH calibrations are up to five calibration points, chosen from the seven available memorized buffers.

This instrument can measure using ORP electrodes (pH channel input), due to it's capability to measure mV with a resolution up to 0.1 mV and also use ISE electrodes on the mV scale (pH channel input).

EC measurements can be compensated relative to a selected reference temperature. The EC calibration mode allows you to chose from among six recognized conductivity standards and perform a single-point calibration. The most suitable EC and TDS range for your application is automatically selected. The HI 2550 also includes the ability to set and lock the range manually.

This instrument provides GLP capabilities that allows for the storage and retrieval of all data regarding pH, rel mV, EC and NaCl calibration and sample measurement as well as data regarding the maintenance and status of the electrode.

With a built-in logging function, measurements are stored in non volatile memory, and can be transferred to a PC through the USB port. Users can manually log up to 200 records and interval log up to 500 records.

SPECIFICATIONS		HI 2550
Range	pH	-2.0 to 16.0 pH; -2.00 to 16.00 pH; -2.000 to 16.000 pH
	ISE & ORP	±999.9 mV (ISE & ORP); ±2000 mV (ISE & ORP)
	EC	0.00 to 29.99 µS/cm; 30.0 to 299.9 µS/cm; 300 to 2999 µS/cm; 3.00 to 29.99 mS/cm; 30.0 to 200.0 mS/cm; up to 500.0 mS/cm actual* conductivity
	TDS	0.00 to 14.99 ppm; 15.0 to 149.9 ppm; 150 to 1499 ppm; 1.50 to 14.99 g/L; 15.0 to 100.0 g/L; up to 400.0 g/L actual* TDS (with 0.80 factor)
	NaCl	0.0 to 400.0% NaCl
	Temperature	-20.0 to 120.0 °C (pH, EC range)
Resolution	pH	0.1 pH; 0.01 pH; 0.001 pH
	ISE & ORP	0.1 mV (±999.9 mV); 1 mV (± 2000 mV)
	EC	0.01 µS/cm; 0.1 µS/cm; 1 µS/cm; 0.01 mS/cm; 0.1 mS/cm
	TDS	0.01 ppm; 0.1 ppm; 1 ppm; 0.01 g/L; 0.1 g/L
	NaCl	0.1% NaCl
	Temperature	0.1 °C
Accuracy @ 20°C/68°F	pH	± 0.01 pH; ± 0.002 pH
	ISE & ORP	± 0.2 mV (±999.9 mV); ± 1 mV (±2000 mV)
	EC	± 1 % reading (±0.05 µS/cm or 1 digit, whichever greater)
	TDS	±1% of reading (±0.03 ppm or 1 digit, whichever greater)
	NaCl	±1% of reading
	Temperature	± 0.4 °C (excluding probe error)
Relative mV Offset		±2000 mV
pH Calibration		up to five point calibration, seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers
EC Calibration		two point calibration; one point slope calibration; six buffers available: 84.0, 1413 µS/cm; 5.00, 12.88, 80.0, 111.8 mS/cm; one point offset: 0.00 µS/cm
NaCl Calibration		one point with HI 7037L standard (optional)
Temperature Compensation		manual or automatic from: -20.0 to 120.0 °C (pH range) -20.0 to 120.0 °C (EC range) (can be disabled on conductivity range to measure actual conductivity)
Cond. Temp. Coefficient		0.00 to 6.00 %/°C (for EC and TDS only) default value is 1.90 %/°C
TDS Factor		0.40 to 0.80 (default value is 0.50)
pH Probe		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)
Conductivity Probe		HI 76310 platinum four ring conductivity/TDS probe with built-in temperature sensor and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 temperature probe with 1 m (3.3') cable (included)
Input Impedance		10^{12} ohms
PC Connectivity		opto-isolated USB
Log On Demand		200 records
Log Interval Feature		500 records; 5, 10, 30 sec and 1, 2, 5, 10, 15, 30, 60, 120, 180 min stability logging ("StAb")
Power Supply		12 VDC
Environment		0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions		235 x 218 x 108 mm (9.2 x 8.5 x 4.2")
Weight		1.3 Kg (2.9 lb); kit with holder 2.1 Kg (4.6 lb.)

(*) Uncompensated conductivity (or TDS) is the conductivity (or TDS) value without temperature compensation.

ORDERING INFORMATION

HI 2550-01 (115V) and **HI 2550-02** (230V) are supplied with HI 1131B pH electrode, HI 76310 conductivity/TDS probe, HI 7662 temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 7071S electrolyte solution (30 mL), 12 VDC adapter and instruction manual.

ELECTRODES

HI 1131B	Glass body pH electrode with BNC connector and 1 m (3.3') cable
HI 76310	Platinum, 4-ring conductivity/TDS probe with built-in temperature sensor and 1 m (3.3') cable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7030L	12880 µS/cm calibration solution, 500 mL
HI 7031L	1413 µS/cm calibration solution, 500 mL
HI 7033L	84 µS/cm calibration solution, 500 mL
HI 7034L	80000 µS/cm calibration solution, 500 mL
HI 7035L	111800 µS/cm calibration solution, 500 mL
HI 7037L	Salinity standard solution, 500 mL

ACCESSORIES

HI 76404N	Electrode holder
HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection

For a complete list of Solutions and Electrodes, see the end of pH *Section 3*, ISE *Section 4* and Conductivity *Section 6*.

HI 2221 • HI 2223

Calibration Check™ pH Benchtop Meters

- **pH Calibration Check™**
- **On-screen electrode condition and response time**
- **Up to five point calibration with seven standard buffers**
- **Diagnostic alerts through icons**
- **Automatic Temperature Compensation**
- **Log up to 500 samples** (HI 2223)
- **GLP features**
- **PC interface via USB**

A properly manufactured and maintained pH electrode will retain its measuring integrity for a long time. As a result of many factors such as age, poor maintenance or improper handling, any electrode in time will lose its integrity.

The most common cause for pH measurement inaccuracies is an unclean or improperly cleaned electrode. This is very important to note, because during calibration, the instrument assumes that the electrode is clean and that the standardization curve created during the calibration process will remain a valid reference until the next calibration.

A dirty electrode or wrong calibration approach can contribute to buffer solution contamination. A contaminated buffer solution can present a major problem during calibration due to the fact that it is considered the only reference.

The HI 2221 and HI 2223 are pH benchtop meters featuring our exclusive Calibration Check™ diagnostics for both pH electrodes and buffer solutions during calibration. These instruments compare the characteristics of the pH electrode from one calibration to the next.

In the case of large variances in the electrode condition, these meters alert the user that the electrode needs to be properly cleaned prior to calibration and measuring.

The second feature is to detect if the calibration buffer solution is contaminated. After calibration, the probe condition is evaluated and an indicator is displayed informing the user of the overall pH electrode status.

These instruments can measure using ORP electrodes (pH channel input), due to it's capability to measure mV with a resolution up to 0.1 mV.

These instruments also feature five point calibration with seven standard buffers, Automatic Temperature Compensation and GLP capabilities that allow for the storage and retrieval of all data regarding pH. With a built-in logging function, measurements are stored in non volatile memory and can be transferred to a PC through the USB port. Users can manually log up to 200 records and interval log up to 500 records.

Calibration Messages

The calibration history is used to alert users during calibration in the case of an unclean electrode or contaminated buffer to reduce calibration errors and assist in ensuring the highest accuracy.

Electrode aging is a slow process, if a substantial change is seen from a previous calibration, it is likely due to a temporary problem with the electrode or buffers. Calibrating under these conditions will give measurement errors.

Error messages such as to clean or check the electrodes and/or buffers appear if the calibration parameters are out of accepted windows. Calibrations cannot be completed until the errors are corrected.

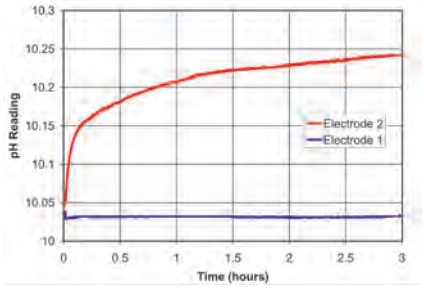
Diagnostic Messages

When using an appropriate HANNA P Type BNC electrode with pin, HI 2221 and HI 2223 will assess electrode condition and response time during each calibration and display the status for the rest of the day.

The digital gauge for electrode condition is a representation of the offset and slope performance of the electrode. The response time gauge is a function of the stabilization time evaluated between the first and second calibration buffers.

The condition and response are also visible when viewing GLP data.

Figure A



Electrode 1 has been properly cleaned before calibration. Electrode 2 has not been properly cleaned.

Figure A (above) shows that the pH measured by a dirty electrode changes over a short period of time. This results from the residue on the pH electrode bulb dissolving into the solution and the electrode gradually returning close to its true characteristics. The resulting pH measurements, based upon the calibration of a dirty electrode, will then be incorrect.

SPECIFICATIONS		HI 2221	HI 2223
Range	pH	- 2.00 to 16.00 pH	-2.00 to 16.00 pH; -2.000 to 16.000 pH
	mV	± 699.9 mV; ± 2000 mV	±999.9 mV; ±2000 mV
	Temperature	-20.0 to 120.0 °C	
Resolution	pH	0.01 pH	0.01 pH; 0.001 pH
	mV	0.1 mV (±699.9 mV); 1 mV (±2000 mV)	0.1mV(±999.9 mV); 1 mV(±2000 mV)
	Temperature	0.1 °C	
Accuracy	pH	± 0.01 pH	±0.01 pH; ±0.002 pH
	mV	± 0.2 mV (± 699.9 mV); ± 1 mV (± 2000 mV)	±0.2 mV (± 999.9 mV); ±1 mV (± 2000 mV)
	Temperature	± 0.2 °C excluding probe error	
pH Calibration		automatic, up to five point calibration with seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45)	
pH Calibration Check™		yes	
Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0°F)	
pH Electrode		HI 1131P glass body pH electrode with BNC + pin connectors and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662 stainless steel temperature probe and 1 m (3.3') cable (included)	
PC Connection		opto-isolated USB	
Data Logging		100 points	500 points
Input Impedance		10^{12} ohm	
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95% non-condensing	
Dimensions		235 x 222 x 109 mm (9.2 x 8.7 x 4.3")	
Weight		1.3 Kg (2.9 lb)	

ORDERING INFORMATION

HI 2221-01 (115V), **HI 2221-02** (230V) and **HI 2223-01** (115V) and **HI 2223-02** (230V) are supplied with HI 1131B pH electrode, HI 7662 temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 cleaning solution sachet, HI 7071S electrolyte solution (30 mL), 12 VDC adapter and instructions.

ELECTRODES

Combination pH electrodes. All part codes ending with P are provided with BNC & Pin connectors, and 1 m (3.3') cable:

HI 1043P	Use: strong acids and bases. glass-body, double junction, refillable
HI 1053P	Use: emulsions. glass-body, triple ceramic junction, refillable
HI 1083P	Use: biotechnology. glass-body, open junction, refillable
HI 1131P	Use: general purpose. glass-body, ceramic junction, refillable
HI 1332P	Use: general purpose. PEI body, double junction, refillable
HI 7662	Temperature probe

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection
HI 76404N	Electrode holder

For a complete list of Solutions and Electrodes, see the end of this section.

HI 2222

Wine Analysis pH Benchtop Meter

- Designed specifically for wine analysis
- Dedicated 3.00 pH buffer for calibration in the wine pH range
- Clog-resistant electrode
- pH Calibration Check™ electrode diagnostics
- Electrode condition on display
- Calibration alarm timeout
- GLP features
- PC interface via USB

HI 2222 is the only pH meter on the market today that allows for automatic pH calibration at pH 3 and pH 7. With the dedicated 3.00 pH buffer for wine calibration in the wine pH range, any error due to calibration will be minimized. The HI 2222's Calibration Check™ diagnostics along with the included HI 1048P clogging resistant pH electode further enhances measurement accuracy.

This wine analysis instrument also features logging of up to 100 samples, GLP (Good Laboratory Practice) capability, and a USB interface for the transfer of data to a PC.

In the process of wine making, most pH measurements are made in the must. A pH electrode gets dirty quickly when measuring the pH of must because sediments build up on both the pH measuring bulb and pH electrode junction. This becomes a big problem during the actual pH measurement if the electrode has not been properly cleaned. A dirty pH electrode can give results that are up to 0.5 pH inaccurate – even after a pH calibration has just been performed.

Conventional pH meters do not warn the user when the pH electrode is dirty. A common example of this occurs just after calibrating the instrument – the pH electrode is immersed into the pH 7 buffer and the reading is lower than expected (pH 6.8 or 6.9 instead of 7.0). HI 2222 uses HANNA 's unique technology to detect when the electrode is dirty and gives a warning during calibration.

It is important to properly clean the pH electrode prior to use. A proper cleaning of the electrode must be done with appropriate cleaning solutions in order to remove all the deposits on the sensitive bulb and junction. HI 70635 (wine deposits removal) and HI 70636 (wine stain removal) are tailored made cleaning solutions that remove deposits from your pH electrode to guarantee accurate calibrations for stable, repeatable measurements and long electrode life. HANNA is the only manufacturer to offer tailor made cleaning solutions for winemaking.

pH Calibration Check™ Indications

Optimal condition

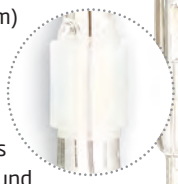
Clogged junction

Clogged junction, dirty electrode

Aged/dirty electrode

Electrode failure

HI 1048P with CPS™ (Clogging Prevention System)



The HI 1048P pH wine electrode with CPS™ (Clogging Prevention System) is HANNA's latest innovation in pH electrode technology.

Conventional pH electrodes use ceramic junctions that clog quickly when used with wine. When the junction is clogged, the electrode does not function. CPS™ technology utilizes the porousness of ground glass coupled with a PTFE sleeve to prevent clogging of the junction. The ground glass allows proper flow of the liquid, while the PTFE sleeve repels dirt. As a result of HANNA's new CPS™ technology, pH electrodes stay fresh for up to 20 times longer than conventional electrodes.

HI 70635 (wine deposits removal) and HI 70636 (wine stain removal) are tailored made cleaning solutions that remove deposits from your pH electrode to guarantee accurate calibrations for stable, repeatable measurements and long electrode life.

SPECIFICATIONS		HI 2222
Range	pH	-2.00 to 16.00
	mV	±699.9 mV; ±2000 mV
	Temperature	-20.0 to 120.0 °C
Resolution	pH	0.01
	mV	0.1 mV (± 699.9 mV); 1 mV (± 2000 mV)
	Temperature	0.1°C
Accuracy	pH	±0.01
	mV	±0.2 (±699.9 mV); ±1 (±2000 mV)
	Temperature	± 0.2 °C excluding probe error
pH Calibration Check		yes
pH Calibration		automatic, one or two point calibration with seven memorized buffers available (1.68, 3.00, 6.86, 7.01, 9.18, 10.01, 12.45)
Temperature Compensation		manual or automatic, -20.0 to 120.0°C (-4 to 248°F)
Specialized pH Electrode for Wine		HI 1048P glass body pH electrode with CPS™, BNC connector + pin with 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)
PC Connection		opto-isolated USB
Data Logging		100 points
Input Impedance		10^{12} Ohm
Power Supply		12 VDC adapter (included)
Environment		0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions		235 x 222 x 109 mm (9.2 x 8.7 x 4.3")
Weight		1.3 Kg (2.9 lb)

pH 3.00 Buffer: Calibration for Wine Analysis

Since most wine measurements are taken at a pH of less than 4, these meters have been pre-programmed at a calibration point of 3.00 pH.

Using the pH 3.00 buffer will minimize any measurement error due to calibration.

ORDERING INFORMATION

HI 2222-01 (115V) and **HI 2222-02** (230V) are supplied with HI 1048P pH electrode, HI 7662 temperature probe, HI 76404N electrode holder, HI 5003 pH 3.00 pH buffer solution, HI 70007 pH 7.01 buffer solution sachet, HI 700636 wine stain cleaning solution sachet, HI 700635 wine deposit cleaning solution sachet, HI 7082S electrolyte solution (30 mL), 5 mL graduated syringe, 12 VDC adapter and instructions.

ELECTRODES

HI 1048P	Glass body, food grade pH electrode with open, CPS™ junction, BNC + pin connector and 1 m (3.3') cable, recommended for wine and must applications.
HI 7662	Stainless steel temperature probe and 1 m (3.3') cable

SOLUTIONS

HI 5003	pH 3.00 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7001L	pH 1.68 buffer Solution in FDA approved bottle, 500 mL
HI 70635L	Cleaning solution for wine deposits, 500 mL
HI 700635P	Cleaning Solution for wine deposits, 20mL sachets (25)
HI 70636L	Cleaning solution for wine stains, 500 mL
HI 700636P	Cleaning Solution for wine stains, 20 mL sachets (25)
HI 70300L	Electrode storage solution, 500 mL
HI 7082	3.5M KCl Electrolyte, 30 mL (4), for double junction electrodes
HI 731312	Red wine decolorization kit (25 pcs)

ACCESSORIES

HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection
HI 76404N	Electrode holder

For a complete list of Solutions and Electrodes, see the end of this section.

HI 2216

0.001 Resolution pH/ORP/ISE/°C Benchtop Meter

- **Up to five point pH calibration with seven standard buffers**
- **Up to two point ISE calibration with five standard solutions**
- **0.001 pH resolution**
- **Calibration expiration reminder**
- **GLP features**
- **Automatic Temperature Compensation**
- **Manually log up to 200 records and interval log up to 500 records**
- **PC interface via USB**

The HI 2216 is a pH, ORP, ISE meter with five point pH calibration and 0.001 pH resolution.

This instrument provides GLP capabilities to allow for the storage and retrieval of all data regarding pH, ORP, and ISE calibration.

HI 2216 can perform measurements using ORP electrodes in the mV scale and ISE electrodes in the ppm scale through the pH channel input. A relative mV feature is also provided.

ORDERING INFORMATION

HI 2216-01 (115V) and **HI 2216-02** (230V) is supplied with HI 1131B pH electrode, HI 7662 temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 7071S electrolyte solution (30 mL), HI 700661 cleaning solution sachet, 12 VDC adapter and instructions.

ELECTRODES

Combination pH electrodes provided with BNC connector and 1 m (3.3') cable:

HI 1043B	Use: strong acids and bases. glass-body, double junction, refillable
HI 1053B	Use: emulsions. glass-body, triple ceramic junction, refillable
HI 1083B	Use: biotechnology. glass-body, open junction, refillable
HI 1131B	Use: general purpose. glass-body, ceramic junction, refillable
HI 1332B	Use: general purpose. PEI body, double junction, refillable
HI 7662	Stainless steel temperature probe and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection
HI 76404N	Electrode holder

SPECIFICATIONS		HI 2216
Range	pH	-2.0 to 16.0 pH; -2.00 to 16.00 pH; -2.000 to 16.000 pH
	mV	±999.9 mV (ORP); ±2000 mV (ORP)
	ISE	0.001 to 19990 ppm
	Temperature	-20.0 to 120.0 °C (-4.0 to 248.0°F)
Resolution	pH	0.1 pH; 0.01 pH; 0.001 pH
	mV	0.1 mV (±999.9 mV); 1 mV (±2000 mV)
	ISE	0.001 (to 1.999 ppm); 0.01 (to 19.99 ppm); 0.1 (to 199.9 ppm); 1 (to 1999 ppm); 10 (to 19990 ppm)
	Temperature	0.1 °C
Accuracy	pH	±0.1 pH; ±0.01 pH; ±0.002 pH
	mV	±0.2 mV (±999.9 mV); ±1 mV (±2000 mV)
	ISE	±0.5% FS
	Temperature	±0.2°C (excluding probe error)
Relative mV Offset		±2000 mV
pH Calibration		automatic, up to five point calibration with seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers
ISE Calibration		automatic, one or two points with five available buffers (0.1, 1, 10, 100, 1000 ppm)
Temperature Compensation		manual or automatic (with HI 7662 probe) from -20.0 to 120.0 °C (-4.0 to 248.0°F)
pH Electrode		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)
Input Impedance		10^{12} ohm
PC Connectivity		opto-isolated USB
Data Logging		log on demand, 200 records; autologging, 500 records
Logging Interval		5, 10, 30 seconds and 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes stability logging ("StAb")
Power Supply		12 VDC adapter (included)
Environment		0 to 50°C (32 to 122°F); RH max 95%
Dimensions		235 x 222 x 109 mm (9.2 x 8.7 x 4.3")
Weight		1.3 Kg (2.9 lb.)

For a complete list of Solutions and Electrodes, see the end of pH *Section 3* and ISE *Section 4*.

HANNA instruments

With Great Products, Come Great Results™

0.001 Resolution and Data Logging pH Benchtop Meters

- **Up to five point pH calibration with seven standard buffers**
- **Calibration expiration reminder**
- **Manually log up to 100 records**
- **Interval log up to 500 records** (HI 2215)
- **GLP features**
- **PC interface via USB**

HI 2214 and HI 2215 are pH and ORP benchtop meters offering five point calibration. A relative mV feature is also provided. HI 2215 adds 0.001 pH resolution and interval logging.

These instruments can take measurements using ORP electrodes (pH channel input) due to their capability to measure mV with a resolution up to 0.1 mV.

Both instruments provide GLP capabilities to allow the storage and retrieval of all data regarding pH and relative mV calibration.

SPECIFICATIONS		HI 2214	HI 2215
Range	pH	-2.0 to 16.0 pH; -2.00 to 16.00 pH	-2.0 to 16.0 pH; -2.00 to 16.00 pH; -2.000 to 16.000 pH
	mV	±699.9 mV; ±2000 mV	±999.9 mV; ±2000 mV
	Temperature	-20.0 to 120.0 °C (-4.0 to 248.0°F)	
Resolution	pH	0.1 pH; 0.01 pH	0.1 pH; 0.01 pH; 0.001 pH
	mV	0.1 mV (±699.9 mV); 1 mV (±2000 mV)	0.1 mV (±999.9 mV); 1 mV (±2000 mV)
	Temperature	0.1 °C	
Accuracy	pH	±0.01 pH	
	mV	±0.2 mV (±699.9 mV); ±1 mV (±2000 mV)	±0.2 mV (±999.9 mV); ±1 mV (±2000 mV)
	Temperature	±0.2 °C (excluding probe error)	
Relative mV Offset		±2000 mV	
pH Calibration		automatic, up to five point calibration with seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers	
Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0°F)	
pH Electrode		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)	
Input Impedance		10^{12} ohm	
PC Connectivity		opto-isolated USB	
Data Logging		log on demand, 100 records	
Logging Interval		–	5, 10, 30 seconds and 1, 2, 5, 10, 15, 30, 60, 120, 180 minutes stability logging ("StAb")
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		235 x 222 x 109 mm (9.2 x 8.7 x 4.3")	
Weight		1.3 Kg (2.9 lb)	

ORDERING INFORMATION

HI 2214-01 (115V), **HI 2214-02** (230V) and **HI 2215-01** (115V) and **HI 2215-02** (230V) are supplied with HI 1131B pH electrode, HI 7662 temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 7071S electrolyte solution (30 mL), HI 700661 cleaning solution sachet, 12 VDC adapter and instructions.

ELECTRODES

Combination pH electrodes with BNC connector and 1 m (3.3') cable:

HI 1043B	Use: strong acids and bases. glass body, double junction, refillable
HI 1053B	Use: emulsions. glass-body, triple ceramic junction, refillable
HI 1083B	Use: biotechnology. glass-body, open junction, refillable
HI 1131B	Use: general purpose. glass-body, ceramic junction, refillable
HI 1332B	Use: general purpose. PEI body, double junction, refillable
HI 7662	Stainless steel temperature probe and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920013	USB cable for PC connection
HI 76404N	Electrode holder

For a complete list of Solutions and Electrodes, see the end of this section.

HI 2212 • HI 2213

pH Benchtop Meters with Three Point Calibration

- **Up to three point pH calibration with five standard buffers or two custom**
- **ORP measurement** (HI 2213 only)
- **Relative mV readings** (HI 2213 only)
- **GLP features**
- **Calibration expiration reminder**
- **Automatic Temperature Compensation**

The HI 2212 and HI 2213 are pH and temperature benchtop meters. HI 2213 can measure oxidation reduction potential (ORP) in the mV range. A relative mV feature is also provided.

Calibration can be performed at up to three-points using five standard and two custom buffers.

These instruments feature manual or automatic temperature compensation with the HI 7662 temperature probe.

GLP (Good Laboratory Practice) feature provides data consistency. A calibration reminder can be set to alert the user, that too much time has elapsed since the last pH calibration and a new one should be performed.

ORDERING INFORMATION

HI 2212-01 (115V), **HI 2212-02** (230V) and **HI 2213-01** (115V) and **HI 2213-02** (230V) are supplied with HI 1131B pH electrode, HI 7662 temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 7071S electrolyte solution (30 mL), HI 700661 cleaning solution sachet, 12 VDC adapter and instructions.

ELECTRODES

Combination pH electrodes with BNC connectors, and 1 m (3.3') cable:

HI 1043B	Use: strong acids and bases. glass body, double junction, refillable
HI 1053B	Use: emulsions. glass-body, triple ceramic junction, refillable
HI 1083B	Use: biotechnology. glass-body, open junction, refillable
HI 1131B	Use: general purpose. glass-body, ceramic junction, refillable
HI 1332B	Use: general purpose. PEI body, double junction, refillable
HI 7662	Stainless steel temperature probe and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

SPECIFICATIONS		HI 2212	HI 2213
Range	pH	-2.00 to 16.00 pH	
	mV	–	±699.9 mV; ±2000 mV
	Temperature	-20.0 to 120.0 °C (-4.0 to 248.0°F)	
Resolution	pH	0.01 pH	
	mV	–	0.1 mV; 1 mV
	Temperature	0.1 °C	
Accuracy	pH	±0.01 pH	
	mV	–	±0.2 mV; ±1 mV
	Temperature	±0.2°C (excluding probe error)	
Relative mV Offset Range		–	±2000 mV
pH Calibration		automatic, up to three points with five standard buffers available (4.01, 6.86, 7.01, 9.18, 10.01), and two custom buffers	
Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0°F)	
pH Probe		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)	
Input Impedance		10^{12} ohm	
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		235 x 222 x 109 mm (9.2 x 8.7 x 4.3")	
Weight		1.3 kg (2.9 lbs.)	

For a complete list of Solutions and Electrodes, see the end of this section.

Basic pH Benchtop Meters

- **Simple to operate**
- **Automatic Temperature Compensation**
- **Automatic calibration**
- **Calibration expiration reminder**
- **ORP range**

HI 2211 and HI 2210 are benchtop pH and °C meters. HI 2211 adds measurement for ion concentration (ISE) and Oxidation Reduction Potential (ORP) in the mV range.

These instruments also feature a reading stability indicator used during calibration and a measurement memory/memory recall function .

pH measurements for both instruments are compensated for the temperature effect manually or automatically with the HI 7662 temperature probe. These instruments are equipped with an easy-to-read LCD which shows both the primary reading and °C.

SPECIFICATIONS		HI 2210	HI 2211
Range	pH	-2.00 to 16.00 pH	
	mV	–	±399.9 mV ; ±2000 mV
	Temperature	-20 to 120.0°C	
Resolution	pH	0.01 pH	
	mV	–	0.1 mV; 1 mV
	Temperature	0.1°C	
Accuracy (@20°C)	pH	±0.01 pH	
	mV	–	±0.2 mV (±399.9 mV); ±1 mV (±2000 mV)
	Temperature	±0.4 °C (excluding probe error)	
pH Calibration		automatic, one or two points with five memorized buffer values (pH 4.01, 6.86, 7.01, 9.18, 10.01)	
Temperature Compensation		automatic (with HI 7662 probe) or manual from -20.0 to 120.0°C	
pH Electrode		HI 1131B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)	
Input Impedance		10^{12} Ohm	
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		235 x 222 x 109 mm (9.2 x 8.7 x 4.3")	
Weight		1.3 kg (2.9 lbs.)	

ORDERING INFORMATION

HI 2210-01 (115V), **HI 2210-02** (230V), **HI 2210-03** (AUS plug), **HI 2211-01** (115V) and **HI 2211-02** (230V) are supplied with HI 1131B pH electrode, HI 7662 temperature probe, HI 76404N electrode holder, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 7071S electrolyte solution (30 mL), HI 700661 cleaning solution sachet, 12 VDC adapter and instructions.

ELECTRODES

HI 1043B	Use: strong acids and bases. glass body, double junction, refillable
HI 1053B	Use: emulsions. glass-body, triple ceramic junction, refillable
HI 1083B	Use: biotechnology. glass-body, open junction, refillable
HI 1131B	Use: general purpose. glass-body, ceramic junction, refillable
HI 1332B	Use: general purpose. PEI body, double junction, refillable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 8427	pH/mV electrode simulator
HI 931001	pH/mV electrode simulator with display
HI 76404N	Electrode holder

For a complete list of Solutions and Electrodes, see the end of this section.

pH 209

Analog pH Benchtop Meter

- **Simple to operate**
- **Manual calibration**
- **Manual Temperature Compensation** (MTC)
- **Economical**

The pH 209 benchtop pH meter is designed for durability and simplicity of use. This instrument features a large, easy to read LCD and user friendly dials.

The pH calibration is manual at one or two points using dials on the front panel making them ideal for applications that require custom calibration points.

In many applications, a standard calibration curve such as pH 7 or pH 4 is too far from the value of the sample to achieve the highest accuracy. Manual calibration enables the user to select the instrument's calibration points closer to the desired range of measurement to achieve maximum accuracy.

The pH 209 can also measure ion concentration (ISE) or ORP (oxidation reduction potential) in the extended mV range with optional electrodes.

Durability, simplicity and comprehensive operating procedures make this meter one of the most popular student pH meters available today.

ORDERING INFORMATION

pH 209-01 (115V) and **pH 209-02** (230V) are supplied with HI 1332B pH electrode, 12 VDC adapter and instruction manual.

ELECTRODES

HI 1332B	Use: general purpose. PEI body, double junction, refillable
HI 3131B	Glass body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7004L	pH 4.01 buffer solution, 500 mL
HI 7004M	pH 4.01 buffer solution, 230 mL
HI 7007L	pH 7.01 buffer solution, 500 mL
HI 7007M	pH 7.01 buffer solution, 230 mL
HI 7010L	pH 10.01 buffer solution, 500 mL
HI 7010M	pH 10.01 buffer solution, 230 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

SPECIFICATIONS		pH 209
Range	**pH**	0.00 to 14.00 pH
	mV	±1999 mV
Resolution	**pH**	0.01 pH
	mV	1 mV
Accuracy (@20°C)	**pH**	±0.01 pH
	mV	±1 mV
pH Calibration		manual, two point
Temperature Compensation		manual, 0 to 100°C (32 to 212°F)
pH Electrode		HI 1332B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Input Impedance		10^{12} Ohm
Power Supply		12 VDC adapter (included)
Environment		0 to 50°C (32 to 122°F); RH max 95% non-condensing
Dimensions		240 x 182 x 74 mm (9.4 x 7.2 x 2.9")
Weight		1.0 kg (2.2 lbs.)

For a complete list of Solutions and Electrodes, see the end of this section.

pH Meters for Education

- **Compact and lightweight**
- **Built-in beaker and beaker-top electrode holder**
- **pH and temperature in one probe**
- **Built-in magnetic stirrer** (HI 208)
- **Dual-level LCD**
- **Automatic calibration**
- **Operated by battery or 12 VDC**
- **°C and °F temperature scales**

With features such as a built-in beaker holder, beaker-top electrode holder and rugged, 2-in-1 pH and temperature sensor, the HI 207 and HI 208 are designed to meet busy classroom environments.

These instruments also feature an extended pH range, dual-level LCD with icons for stability and buffer recognition, built-in magnetic stirrer (HI 208 only), automatic pH calibration, and temperature display in either Celsius or Fahrenheit. In addition, all readings are automatically compensated for temperature variations.

In the classroom, these compact units reduce clutter and utilize a minimal amount of space on the desktop. Switch to battery power and the instrument can be taken outside the classroom for field studies. When lab time is over, the instruments are easily cleaned and can be placed out of the way–right away.

SPECIFICATIONS		HI 207	HI 208
Range	**pH**	-2.00 to 16.00 pH	
	Temperature*	-5.0 to 105.0°C / 23.0 to 221.0°F	
Resolution	**pH**	0.01 pH	
	Temperature	0.1°C / 0.1°F	
Accuracy (@20°C)	**pH**	±0.02 pH	
	Temperature	±0.5 (up to 60°C); ±1°C (outside) ±1°F (up to 140°F); ±2°F (outside)	
pH Calibration		automatic, one or two point with two sets of memorized buffer values (pH 4.01/7.01/10.01 or 4.01/6.86/9.18)	
Temperature Compensation		automatic	
Electrode		HI 1291D PEI body pH electrode with internal temperature sensor, DIN connector and 1 m (3.3') cable (included)	
Built-in Magnetic Stirrer		no	yes, built-in at 500 rpm
Battery Type / Life		9V / approximately 500 hours of continuous use (without stirrer)	
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		192 x 104 x 134 mm (7.5 x 4.1 x 5.3")	
Weight		420 g (14.8 oz.)	

(*) The temperature range is limited to 80 °C (176 °F) if using the HI 1291D probe.

ORDERING INFORMATION

HI 207-01 (115V), **HI 207-02** (230V), **HI 208-01** (115V) and **HI 208-02** (230V) are supplied with HI 1291D pH electrode, HI 740035 pH electrode holder and plastic beaker, rubber O-ring, magnetic stir bar (HI 208 only), HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, 12 VDC adapter, battery and instructions.

ELECTRODES

HI 1291D	PEI body, preamplified pH electrode with internal temperature sensor, DIN connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 740036P	Plastic beakers, 50 mL (10)
HI 731316	Magnetic stir bars for HI 208 (5)
HI 740035	Electrode holder and 50 mL plastic beaker for HI 207 and HI 208

For a complete list of Solutions and Electrodes, see the end of this section.

pH 20 • pH 21

Basic pH Benchtop Meters

- **Easy to use meter for performing specific measurements**
- **Automatic pH calibration**
- **ORP readings** (pH 21 only)

pH 20 and pH 21 are basic pH meters designed for simplicity of use in all applications where fast and efficient daily controls are required. These meters are also suitable for the educational field, where students are often first introduced to measuring instruments.

Both models measure pH in the 0 to 14 range, with 0.01 resolution. In addition, the pH 21 can also measure ORP (mV) by using a proper ORP electrode (optional). The pH calibration procedure is automatic and can be performed at one or two points.

Readings can be manually (MTC) or automatically (ATC) compensated for temperature. The automatic temperature compensation is performed if using the optional HI 7662 temperature probe, while for manual compensation the user can set the temperature value through the arrow keys. The meters are also provided with the HOLD function, which allows to freeze reading on the LCD by simply pressing the HOLD button.

ORDERING INFORMATION

pH 20-01 (115V), **pH 20-02** (230V), **pH 21-01** (115V) and **pH 21-02** (230V) are supplied with HI 1110B pH electrode, 12 VDC adapter and instructions.

ELECTRODES AND PROBES

HI 1110B	Glass body pH electrode with BNC connector and 1 m (3.3') cable
HI 3131B	Glass body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

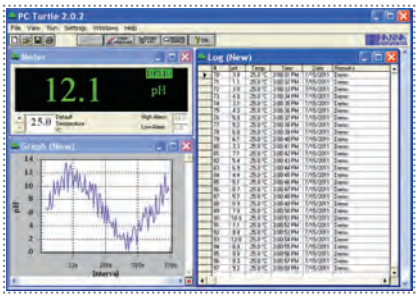
ACCESSORIES

HI 76405	Electrode holder

SPECIFICATIONS		pH 20	pH 21
Range	pH	0.00 to 14.00 pH	
	mV	–	-1999 to 1999 mV
	Temperature	0.0 to 100.0 °C	
Resolution	pH	0.01 pH	
	mV	–	1 mV
	Temperature	0.1°C	
Accuracy (@20°C/68°F)	pH	±0.02 pH	
	mV	–	±2 mV
	Temperature	±1°C	
Temperature Compensation		manual (adjustable with arrow keys) or automatic from 0 to 100°C (with temperature probe)	
pH Electrode		HI 1110B glass body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662 temperature probe with 1 m (3.3') cable (optional)	
pH Calibration		automatic, one or two point	
Power Supply		12 VDC adapter (included)	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		230 x 170 x 75 mm (9.1 x 6.7 x 3.0")	
Weight		500 g (1.1 lbs.)	

For a complete list of Solutions and Electrodes, see the end of this section.

PC (required), beaker and electrode holder not included.



- **Continuous real-time data logging directly on the PC**
- **Compatible with all Windows® versions**
- **Includes pH electrode, RS232 connection cable and software**
- **Inexpensive desktop solution**

The HANNA pH Turtle (HI 9815) is an easy to use transmitter that turns any PC into a pH meter. Simply plug it into your PC's serial port and go! Within moments you can view pH measurements on your PC.

The HI 981500 user-friendly software from HANNA allows continuous real time data logging right from the desktop. This software can be operated in eight different languages: Dutch, English, French, German, Italian, Norwegian, Portuguese and Spanish. The main menu window of this powerful software contains a virtual pH meter display and continuously updates the logging data table and real-time graph with zoom-in features.

The pH Turtle is also supplied with the HI 1333B double-junction, refillable pH electrode to ensure long life, even in varied and unclean samples. In addition, its rugged plastic body provides higher impact resistance.

SPECIFICATIONS	HI 9815
Range	0.0 to 14.0 pH
Resolution	0.1 pH
Accuracy (@20°C/68°F)	±0.2 pH
Calibration	automatic, up to three points directly from PC
Temperature Compensation	manual, 0 to 100°C (32 to 212°F)
pH Electrode	HI 1333B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Input Impedance	10^{12} Ohm
PC Connection	RS232
Environment	0 to 50°C (32 to 122°F); RH max 95%
Dimensions	Ø 88 x 40 mm (Ø 3.5 x 1.6")
Weight	250 g (8.8 oz.)

ORDERING INFORMATION

HI 9815 (pH Turtle) is supplied HI 1333B pH electrode, software and instructions.

ELECTRODES

HI 1333B	PEI body pH electrode with BNC connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 76405	Electrode Holder and steel base
HI 981500	Windows® compatible software

For a complete list of Solutions and Electrodes, see the end of this section.

HI 98183 • HI 98184 • HI 98185

pH/ORP/ISE Waterproof Portable Meters

Feature Highlights

- pH Calibration Check™
- Electrode condition on display
- Five point pH calibration with seven standard buffers and five custom buffers
- Automatic logging and log on demand
- Menu driven for ease of use
- Soft-key extended functionality
- Multiple language selection
- Contextual help at the touch of a button
- GLP features
- USB
- Backlit, graphic LCD and battery life on display
- Waterproof and rugged casing

Rechargeable batteries

These models have up to 200 hours of extended battery life to guarantee long operation in the field. When the batteries are low, you don't have to worry about carrying a spare set with you, the batteries can be recharged with HANNA's inductive recharger. Simply leave the meter on the recharger for a few hours and you're ready to go. The recharger can be plugged into a standard 115V or 230V socket using the appropriate HANNA adapter.

HI 98183, HI 98184 and HI 98185 are waterproof, portable meters designed for demanding applications. HI 98183 measures pH/ORP and temperatuare while HI 98184 and HI 98185 also include ISE measurement.

Choose from 7 standard pH buffers and 5 custom pH buffers to obtain up to five point calibration and achieve high precision readings with a pH accuracy of ±0.002 and up to ±0.001 pH resolution.

HANNA's Calibration Check® maintains a history of past calibrations and monitors the pH electrode and buffers during subsequent calibrations for any signs of wide calibration variances due to a dirty or broken electrode or contaminated pH buffers. In measurement mode, the electrode's percent condition is continuously displayed.

Exchange out the pH probe for an ORP probe to obtain mV readings in the ±2000 mV range. HI 98184 and HI 98185 adds direct ion concentration readings for ISE's and the results are displayed in ppm. The ion charge or nominal slope can be entered manually.

HI 98185 adds auto recognition of 15 different ISE sensors and can be calibrated in up to five points and 6 standard buffers (choice of units). This meter allows an extensive choice of measurement units (ppm, ppt, g/L, ppb, ug/L, mg/mL, M, mol/L, mmol/L, % w/v, user) and has an expanded measuring range of 1.00×10^{-7} to 9.99×10^{-10}.

Press Auto-Hold while measuring and once stabilized, the current reading will remain displayed for your convenience in documenting. Switching to log-on-demand mode allows users to record and save up to 200 samples (HI 98183) or 300 samples (HI 98184 and HI 98185). This data can later be transferred to a PC with the USB connection and HANNA's HI 92000 software. "Out Of Calibration Range Warning" can be engaged to keep the user informed of the current calibration and helps to avoid taking measurements that are out of range.

A backlit, graphic LCD provides easy to read resolution even in low-lit areas. A combination of dedicated and soft keys allows easy, intuitive operation in a choice of languages. Comprehensive GLP data are directly accessible by pressing the GLP key. Access the contextual Help Menu to obtain on-screen information and assistance about each feature at the touch of a button. Designed for field use, these instruments can be operated with one hand and are supplied in a rugged carrying case. With an extended battery life of up to 200 hours, users are assured long operation. The inductive charger can either be plugged into a standard 115V socket with the included adapter or a 12 VDC source, such as a car's 12 V accessory outlet.

These meters come equipped with the HI 72911B pH/ temperature electrode with rugged, titanium casing.

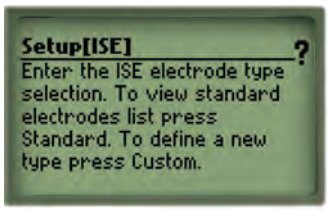
Calibration

pH calibration features detailed Calibration Check™ message.

Users are guided through the calibration procedure with step-by-step on-screen instructions.

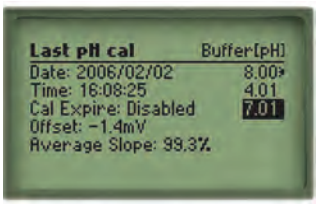
Setup screen

Our extensive setup screen features a host of configurable options such as time, date, temperature units and language for help screens and guides.



Help

Users can consult the on-screen help from any mode simply by pressing the HELP key. The instrument will then explain the options currently available.



GLP

Comprehensive GLP functions are directly accessible by pressing the GLP key. Calibration data, date and ID info are stored for retrieval at a later time.

SPECIFICATIONS		HI 98183	HI 98184	HI 98185
Range	pH	-2.0 to 20.0; -2.00 to 20.00; -2.000 to 20.000 pH		
	mV	±2000 mV		
	ISE	–	from 1.00 E-3 to 1.00 E5 concentration	from 1.00 E-7 to 9.99 E10 concentration
	Temperature	-20.0 to 120.0 °C (-4.0 to 248.0°F)		
Resolution	pH	0.1; 0.01; 0.001 pH		
	mV	0.1 mV		
	ISE	–	3 digits 0.01; 0.1; 1; 10 concentration	
	Temperature	0.1°C (0.1°F)		
Accuracy	pH	±0.01; ±0.002 pH		
	mV	±0.2 mV		
	ISE	–	±0.5% of reading (monovalent ions), ±1% of reading (divalent ions)	
	Temperature	±0.4°C (±0.8°F) (excluding probe error)		
Calibration	pH	up to five point calibration, seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + five custom buffers		
	ISE	–	up to two point calibration, six standard solutions (0.1, 1, 10, 100, 1000, 10000 ppm)	up to five point calibration, six standard solutions (0.1, 1, 10, 100, 1000, 10000 ppm)
	Slope	From 80 to 110%		
Temperature Compensation (pH)		manual or automatic from -20.0 to 120.0°C (-4.0 to 248.0°F)		
Probe		HI 72911B Titanium body, pH electrode with internal temperature sensor, BNC connector and 1 m (3.3' cable)		
Logging		log on demand 200 samples (100 ea. range)	log on demand 300 samples (100 each range)	
PC Connectivity		opto-isolated USB with optional HI 92000 software		
Input Impedance		10^{12} Ohms		
Battery Type / Life		1.2V AA rechargeable batteries (4) / approximately 200 hours of continuous use without backlight (50 hours with backlight)		
Auto-off		user selectable: 5, 10, 30, 60 min or can be disabled		
Environment		0 to 50°C (32 to 122°F); RH 100%		
Dimensions		226.5 x 95 x 52 mm (8.9 x 3.75 x 2")		
Weight		525 g (18.5 oz.)		

ORDERING INFORMATION

HI 98183-01 (115V), **HI 98183-02** (230V), **HI 98184-01** (115V), **HI 98184-02** (230V) and **HI 98185-01** (115V) and **HI 98185-02** (230V) are supplied with HI 72911B pH electrode, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, rechargeable batteries, HI 710042 inductive battery charger with power adapter, instructions and hard carrying case.

ELECTRODES AND PROBES

Combination pH electrodes with BNC connector and 1 m (3.3') cable:

HI 1043B	Use: strong acids and bases. glass-body, double junction, refillable
HI 1230B	Use: general purpose. PEI body, double junction, gel-filled
HI 72911B	Use: general purpose. titanium body, double junction, gel-filled with internal temperature sensor
HI 3230B	Use: For oxidizing reactions. platinum tipped ORP probe, PEI body, single junction, gel-filled
HI 4430B	Use: Strong oxidizing solutions gold tipped ORP probe, PEI body, single junction, gel-filled
HI 7662	Temperature probe with 1 m (3.3') screened cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7091L	ORP reducing pretreatment solution, 500 mL
HI 7092L	ORP oxidizing pretreatment solution, 500 mL
HI 7020L	ORP test solution @200-275 mV, 500 mL
HI 7021L	ORP test solution @240 mV, 500 mL
HI 7022L	ORP test solution @470 mV, 500 mL

ACCESSORIES

HI 920013	USB cable for PC connection
HI 92000	Windows® compatible software

For a complete list of Solutions and Electrodes, see the end of pH *Section 3* and ISE *Section 4*.

HI 98172

Portable pH/ORP/ISE Meter with Calibration Check™

- **pH Calibration Check™**
- **Five point pH calibration with seven standard and five custom pH buffers**
- **Log on demand (500 samples)**
- **User-selectable "calibration time out"**
- **Tutorial messages on LCD**
- **PC interface via USB**

HI 98172 is a pH/ORP/ISE meter housed in a waterproof casing. Up to five point pH calibration is available with seven memorized pH buffers and five custom pH buffers to provide users with the flexibility necessary to adjust the calibration range to obtain the most accurate and precise readings.

Exchange out the pH sensor for an ORP sensor to obtain mV readings. ISE sensors are calibrated up to five points and measurements are displayed in ppm.

Calibration Check® incorporates an electrode condition graph which alerts the user with regards to the electrode status. If readings are taken too far outside the calibration range, the unit will warn the user with a graphic signal. Users may set a reminder to notify when calibration is due.

HI 98172 features tutorial messages on the LCD and an auto-end mode to ensure readings are taken only when they are stable. Comprehensive GLP data are directly accessible by pressing the GLP key and log-on-demand holds up to 500 records. Data can be transferred to a PC via USB with optional HI 92000 software and HI 920014 USB connection cable.

ORDERING INFORMATION

HI 98172 is supplied with HI 1230B pH electrode, HI 7662 temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, 100 mL plastic beaker, batteries, instructions and hard carrying case.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3131B	Glass body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920014	Mini USB connection cable

SPECIFICATIONS		HI 98172
Range	pH	-4.0 to 20.0 pH; -4.00 to 20.00 pH
	mV	±699.9; ±2000 mV
	ISE	0.001 to 19990 ppm
	Temperature	-20.0 to 120.0°C (-4.0 to 248.0°F)
Resolution	pH	0.1 pH; 0.01 pH
	mV	0.1 mV (±699.9 mV); 1 mV (±2000)
	ISE	0.001 ppm (0.001 to 1.999); 0.01 ppm (2.00 to 19.99); 0.1 ppm (20.0 to 199.9); 1 ppm (200 to 1999); 10 ppm (2000 to 19990)
	Temperature	0.1°C (0.1°F)
Accuracy (@20°C)	pH	±0.1 pH; ±0.01 pH
	mV	±0.2 mV (±699.9 mV); ±1 mV (±2000 mV)
	ISE	±0.5% f.s.
	Temperature	±0.2°C (±0.4°F) excluding probe error
pH Calibration		up to five point calibration with seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 5 custom buffers
ISE Calibration		up to five point calibration with six standard buffers available (0.1, 1, 10, 100, 1000, 10000 ppm)
Slope/Offset Calibration		±1 pH/from 80 to 110%
Relative mV Offset Range		±2000 mV
Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)
Logging		log on demand, 500 samples
PC Connection		opto-isolated USB with optional HI 92000 software
Input Impedance		10^{12} Ohm
Power Supply		1.5V AAA (3) / approximately 200 hours of continuous use without backlight (50 hours with backlight). User selectable auto-off (5, 10, 20, 60 minutes or can be disabled)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions / Weight		185 x 72 x 36 mm (7.3 x 2.8 x 1.4") / 300 g (10.6 oz.)

For a complete list of Solutions and Electrodes, see the end of pH *Section 3* and ISE *Section 4*.

HANNA instruments®

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HI 98160

Portable pH/ORP Meter with Calibration Check™

- **pH Calibration Check™**
- **Five point pH calibration with seven standard and five custom pH buffers**
- **Log on demand (500 samples)**
- **User-selectable "calibration time out"**
- **Tutorial messages on LCD**
- **PC interface via USB**

HI 98160 is a pH/ORP meter housed in a waterproof casing. Up to five point calibration is available with eight memorized pH buffers and two custom pH buffers to provide users with the flexibility necessary to adjust the calibration range to obtain the most accurate and precise readings.

Exchange out the pH sensor for an ORP sensor to obtain mV readings.

HANNA's Calibration Check® incorporates an electrode condition graph which alerts the user with regards to the electrode status. If readings are taken too far outside the calibration range, the unit will warn the user with a graphic signal. Users may set a reminder to notify when calibration is due.

HI 98160 features tutorial messages on the LCD and an auto-end mode to ensure readings are taken only when they are stable. Comprehensive GLP data are directly accessible by pressing the GLP key and log-on-demand holds up to 500 records. Data can be transferred to a PC via USB with optional HI 92000 software and HI 920014 USB connection cable.

SPECIFICATIONS		HI 98160
Range	pH	-4.0 to 20.0 pH; -4.00 to 20.00 pH
	mV	±699.9; ±2000 mV
	Temperature	-20.0 to 120.0°C (-4.0 to 248.0°F)
Resolution	pH	0.1 pH; 0.01 pH
	mV	0.1 mV (±699.9 mV); 1 mV (±2000)
	Temperature	0.1°C (0.1°F)
Accuracy (@20°C/68°F)	pH	±0.1 pH; ±0.01 pH
	mV	±0.2 mV (±699.9 mV); ±1 mV (±2000 mV)
	Temperature	±0.2°C (±0.4°F) excluding probe error
pH Calibration		up to five point calibration with eight standard buffers available (1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers
mV Calibration		automatic, two point at 0, 350 mV or three point at 0, 350, 1900 mV
Offset Calibration		±1 pH
Slope Calibration		from 80 to 110%
Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)
Log On Demand		500 samples
PC Connection		opto-isolated USB with optional HI 92000 software
Input Impedance		10^{12} Ohm
Power Supply		1.5V AAA (3) / approximately 200 hours of continuous use without backlight (50 hours with backlight). User selectable auto-off (5, 10, 20, 60 minutes or can be disabled)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions		185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight		300 g (10.6 oz.)

ORDERING INFORMATION

HI 98160 is supplied with HI 1230B pH electrode, HI 7662 temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, batteries, instructions and rugged carrying case.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3131B	Glass body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920014	Mini USB connection cable

For a complete list of Solutions and Electrodes, see the end of this section.

HI 98140 • HI 98150

Portable pH Meter with SMART Electrodes

- **pH Calibration Check™ Electrode Diagnostics**
- **Waterproof**
- **Up to five point pH calibration**
- **Up to seven automatically recognized pH buffers and up to two custom pH buffers (HI 98150 only)**
- **Log on demand (500 samples)**
- **GLP features**
- **Auto endpoint**
- **User-selectable "calibration time out"**
- **Backlit, multi-level LCD display**
- **Tutorial messages on LCD**
- **Opto-isolated USB**
- **BEPS and % battery life on display**
  Battery Error Prevention System alerts the user in the event that low battery power could adversely affect readings

HI 98140 and HI 98150 are portable Calibration Check™ pH meters that utilize HANNA's SMART electrode technology.

SMART electrodes incorporate a chip, which stores the calibration data performed with a specific instrument. When the "SMART" electrode is attached to the meter again, it is automatically recognized. This allows the operator to optimize time and efficiency with unsurpassed safety. It also avoids erroneous measurements taken in the event the pH electrode is substituted after calibration.

ORDERING INFORMATION

HI 98140 and **HI 98150** are supplied with HI 1618D pH electrode, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 70000 electrode cleaning solution sachet, HI 700661 electrode cleaning solution sachet, batteries, instructions and hard carrying case.

ELECTRODES

HI 3620D	PEI body, Pre-amplified ORP electrode with "SMART" technology, DIN connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL

ACCESSORIES

HI 92000	Windows® compatible software
HI 920014	Mini USB connection cable

SPECIFICATIONS		HI 98140	HI 98150
Range	pH	-4.0 to 20.0 pH; -4.00 to 20.00 pH	
	mV	–	±699.9; ±2000 mV
	Temperature	-20.0 to 120.0°C (-4.0 to 248.0°F)	
Resolution	pH	0.1 pH; 0.01 pH	
	mV	–	0.1 mV (±699.9 mV); 1 mV (outside)
	Temperature	0.1°C (0.1°F)	
Accuracy (@20°C)	pH	±0.1 pH; ±0.01 pH	
	mV	–	±0.2 mV (±699.9 mV); ±1 mV (±2000 mV)
	Temperature	±0.2°C (±0.4°F) excluding probe error	
pH Calibration		up to three point calibration with seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers	up to five point calibration with seven standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and two custom buffers
Offset Calibration		±1 pH	
Slope Calibration		from 80 to 110%	
Temperature Compensation		manual or automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)	
pH Electrode		HI 1618D PEI body, pre-amplified pH electrode with "SMART" technology, internal temperature sensor, DIN connector and 1 m (3.3') cable (included)	
Logging		log on demand, 500 samples	
PC Connection		opto-isolated USB with optional HI 92000 software	
Input Impedance		10^{12} Ohm	
Battery Type / Life		1.5V AAA (3) / approximately 200 hours of continuous use without backlight (50 hours with backlight). User selectable auto-off (5, 10, 20, 60 minutes or can be disabled)	
Environment		0 to 50°C (32 to 122°F); RH max 100%	
Dimensions		185 x 72 x 36 mm (7.3 x 2.8 x 1.4")	
Weight		300 g (10.6 oz.)	

For a complete list of Solutions and Electrodes, see the end of this section.

HANNA instruments

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Calibration Check™ Portable pH Meter

- **pH Calibration Check™**
- **Electrode condition monitoring**
- **Measurement store and recall**
- **Backlit, multi-level LCD display**
- **Real time clock**
- **User-selectable calibration reminder**
- **Tutorial messages displayed on LCD**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings.
- **Battery % displayed on startup.**

The HI 9126 includes HANNA's exclusive Calibration Check™ technology. Calibration Check™ monitors the pH bulb and reference junction of the electrode every time the instrument is calibrated. In the event of a dirty pH electrode, Calibration Check™ warns users that maintenance may be needed.

Calibrated buffers are continuously displayed in measurement mode to remind users of the instrument's calibration point. Users can easily determine if readings are taken too far outside the calibration range.

The HI 9126 can store and recall readings at the touch of a button.

HI 9126 utilizes the HI 1230B double junction pH electrode. The double junction helps to minimize junction contamination for consistently accurate results. The HI 9126 can also measure ORP using optional probes.

SPECIFICATIONS		HI 9126
Range	pH	-2.00 to 16.00 pH
	mV	±699.9 mV; ±1999 mV
	Temperature	-20.0 to 120.0°C / -4.0°F to 248.0°F
Resolution	pH	0.01 pH
	mV	0.1 mV; 1 mV
	Temperature	0.1°C / 0.1 °F
Accuracy (@20°C)	pH	±0.01 pH
	mV	±0.2 mV; ±1 mV
	Temperature	±0.4°C/±0.8°F (excluding probe error)
pH Calibration Check		yes, check of the electrode status during calibration
pH Calibration		automatic, one or two point with seven memorized buffer values (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + 2 custom buffers
Offset Calibration		±1 pH
Slope Calibration		from 80 to 108%
Temperature Compensation		automatic or manual, -20 to 120°C (-4 to 248°F) without temperature probe
pH Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)
Input Impedance		10^{12} Ohm
Battery Type / Life		1.5V (3) AAA / approximately 200 hours of continuous use without backlight (50 hours with backlight). auto-off after 20 minutes of non-use (can be disabled)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions		185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight		300 g (10.6 oz.)

ORDERING INFORMATION

HI 9126 is supplied with HI 1230B pH electrode, HI 7662 temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer sachet, HI 700661 electrode cleaning solution sachet, 100 mL plastic beaker, batteries, instructions and hard carrying case.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3230B	PEI body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL

For a complete list of Solutions and Electrodes, see the end of this section.

HI 9126V

pH Meter for Wine Analysis

WINE line

- **Dedicated 3.00 pH buffer for calibration in the wine pH range**
- **Clog-resistant electrode**
- **Exclusive pH Calibration Check™**
- **Electrode condition monitoring**
- **Tutorial messages displayed on LCD**
- **Backlit, multi-level LCD display**
- **User-selectable calibration reminder**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings.
- **Battery % displayed on startup.**

HANNA's HI 9126V advanced pH/ORP meter and HI 1048P pH electrode with CPS™ (Clogging Prevention System) are designed specifically for precise wine analysis. The backlit display provides clear readings in the darkest environments. In addition to the HI 9126V's seven memorized buffer values, user's can program two custom buffer values, in order to best fit the characteristics of the sample.

If you are going to measure wine and must, you can custom calibrate using HI 5003 pH 3.00 buffer and enter the value into the meter for calibration. When calibration is complete, the electrode condition is displayed so the user can be sure the electrode is working properly or that it needs to be cleaned or replaced.

The supplied HI 1048B electrode with CPS™ technology is ideal for pH measurements in wine and must. With an optional ORP electrode, the HI 9126V can also measure ORP with a resolution up to 0.1 mV.

ORDERING INFORMATION

HI 9126V is supplied with HI 1048B CPS™pH electrode, HI 7662 temperature probe, pH 3.00 buffer solution, HI 70007 pH 7.01 buffer solution sachet, HI 700636 wine stain electrode cleaning solution sachet, HI 700635 wine deposit electrode cleaning solution sachet, HI 7082 electrolyte solution (30 mL) with syringe, 100 mL plastic beaker, batteries, rugged carrying case and instructions.

SOLUTIONS

HI 5003	pH 3.00 custom buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 70300L	Storage solution, 500 mL
HI 70635L	Electrode cleaning solution for wine deposits, 500 mL
HI 70636L	Electrode cleaning solution for wine stains, 500 mL
HI 731312	Red wine decolorization kit (25 pcs)

SPECIFICATIONS		HI 9126V
Range	pH	-2.00 to 16.00 pH
	mV	±699.9 mV; ±1999 mV
	Temperature	-20.0 to 120.0°C / -4.0°F to 248.0°F
Resolution	pH	0.01 pH
	mV	0.1 mV; 1 mV
	Temperature	0.1°C / 0.1 °F
Accuracy (@20°C)	pH	±0.01 pH
	mV	±0.2 mV; ±1 mV
	Temperature	±0.4°C/±0.8°F (excluding probe error)
pH Calibration Check		yes, check of the electrode status during calibration
pH Calibration		automatic, one or two point with seven memorized buffer values (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) + two custom buffers
Offset Calibration		±1 pH
Slope Calibration		from 80 to 108%
Temperature Compensation		automatic or manual, -20 to 120°C (-4 to 248°F) without temperature probe
pH Electrode		HI 1048B glass-body pH electrode with CPS™ technology, BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)
Input Impedance		10^{12} Ohm
Battery Type / Life		1.5V (3) AAA / approximately 200 hours of continuous use without backlight (50 hours with backlight). auto-off after 20 minutes of non-use (can be disabled)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions		185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight		300 g (10.6 oz.)

For a complete list of Solutions and Electrodes, see the end of this section.

HANNA instruments

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HI 9124 • HI 9125

Portable pH Meters

- **User-selectable "calibration time out"**
- **Automatic calibration**
- **Automatic Temperature Compensation**
- **Tutorial messages on LCD**
- **BEPS**
  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup.**

The HI 9124 and HI 9125 are waterproof pH meters. The HI 9125 can utilize ORP (oxidation reduction potential) electrodes.

A large dual-level LCD displays both the pH and temperature along with an operational guide. Graphic symbols are displayed to help the users during the calibration process.

The pH calibration procedure is automatic with five memorized pH buffer values and buffer recognition to simplify the calibration process.

These meters utilize the HI 1230B double junction pH electrode. The double junction helps to minimize junction contamination for accurate, consistent results.

SPECIFICATIONS		HI 9124	HI 9125
Range	pH	-2.00 to 16.00 pH	
	mV	–	±699.9 mV; ±1999 mV
	Temperature	-20.0 to 120.0°C/-4.0°F to 248.0°F	
Resolution	pH	0.01 pH	
	mV	–	0.1 mV; 1 mV
	Temperature	0.1°C/0.1°F	
Accuracy (@20°C/60°F)	pH	±0.01 pH	
	mV	–	±0.2 mV; ±1 mV
	Temperature	±0.4°C/±0.8°F (excluding probe error)	
pH Calibration		automatic, one or two point with five standard buffer values (pH 4.01, 6.86, 7.01, 9.18, 10.01)	
Offset Calibration		±1 pH	
Slope Calibration		from 80 to 108%	
Temperature Compensation		automatic or manual, -20.0 to 120.0°C/-4.0 to 248.0°F without temperature probe	
Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Temperature Probe		HI 7662 stainless steel temperature probe with 1 m (3.3') cable (included)	
Input Impedance		10^{12} Ohm	
Battery Type / Life		1.5V AAA (3) / approximately 200 hours of continuous use. auto-off after 20 minutes of non-use (can be disabled)	
Environment		0 to 50°C (32 to 122°F); RH max 100%	
Dimensions		185 x 72 x 36 mm (7.3 x 2.8 x 1.4")	
Weight		300 g (10.6 oz.)	

ORDERING INFORMATION

HI 9124 and **HI 9125** are supplied with HI 1230B pH electrode, HI 7662 temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, 100 mL plastic beaker, batteries, instructions and hard carrying case.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3131B	Glass body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7662	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL

For a complete list of Solutions and Electrodes, see the end of this section.

HI 991001 • HI 991002 • HI 991003

pH/pH-mV/ORP and Temperature Meters

- **pH Sensor Check™**
  (HI 991003) Allows users to check electrode status at any time
- **Multi-level LCD display**
  Display the current measurement simultaneously with the current temperature.
- **On-screen tutorial messages**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **HI 1297 pH/ORP/Temperature and HI 1296 pH/Temperature probe in titanium enclosure**
- **BEPS**
  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**.
- **Compact, heavy-duty, and waterproof**

HI 991001, HI 991002 and HI 991003 are ideal for plating baths, wastewater, swimming pool and spa water quality and environmental applications.

HI 991003 is a portable pH/pH-mV/ORP/temperature meter with our unique Sensor Check™ feature that allows the user to determine the electrode status at any time. HI 991002 measures pH/ORP/temperature while the HI 991001 measures pH/temperature.

The HI 1296D pH/temperature and HI 1297D pH/ORP/temperature probes feature an easy to clean recessed tip that prevents solids in solutions from collecting on the sensor. The AISI 316 stainless steel and titanium body of these probes function as a potential matching pin for increased stability of readings and extended sensor life.

These compact instruments fit in the palm of your hand and the bottom probe connection ensures the electrode cable doesn't get in your way.

HANNA instruments

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Pre-amplified pH electrodes

The HI 1297D pH/ORP electrode (HI 991003 and HI 991002) and HI 1296D pH electrode (HI 991001) have an internal temperature sensor and also contains a pre-amplifier to render measurements impervious to noise and electrical interferences.

- **Protective Rubber Boot**
  The optional rubber boot helps protect your meter

SPECIFICATIONS		HI 991001	HI 991002	HI 991003
Range	pH		-2.00 to 16.00 pH	
	pH-mV	–	–	±825 mV (pH-mV)
	ORP	–	±1999 mV	±1999 mV
	Temperature		-5.0 to 105.0°C; 23.0 to 221.0°F	
Resolution	pH		0.01 pH	
	pH-mV	–	–	1 mV
	ORP	–	1 mV	1 mV
	Temperature		0.1°C/0.1°F	
Accuracy (@20°C)	pH		±0.02 pH	
	pH-mV	–	–	±1 mV
	ORP	–	±2 mV	±2 mV
	Temperature		±0.5°C up to 60°C; ±1.0°C outside; ±1.0°F up to 140°F; ±2.0°F (outside)	
pH Calibration			automatic one or two point calibration with two sets of memorized buffers (standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)	
Temperature Compensation			automatic, -5.0 to 105.0°C (23.0 to 221.0°F)	
Electrode			HI 1296D pre-amplified pH probe with internal temperature sensor, DIN connector and 1 m (3.3') cable (included)	HI 1297D pre-amplified pH/ORP probe with internal temperature sensor, DIN connector and 1 m (3.3') cable (included)
Battery Type / Life			1.5V (3) AAA / approximately 1200 hours of continuous use. auto-off after eight minutes of non-use	
Environment			0 to 50°C (32 to 122°F); RH max. 100%	
Dimensions			152 x 58 x 30 mm (6.0 x 2.3 x 1.2")	
Weight			205 g (7.2 oz.)	

ORDERING INFORMATION

HI 991001 is supplied with HI 1296D pH/ORP probe with internal temperature sensor, HI 70004 pH 4.01 buffer sachet, HI 70007 pH 7.01 buffer sachet, HI 700661 electrode cleaning solution sachet (2), batteries, instructions and rugged carrying case.
HI 991002 and **HI 991003** are supplied with HI 1297D pH/ORP probe with internal temperature sensor, HI 70004 pH 4.01 buffer sachet, HI 70007 pH 7.01 buffer sachet, HI 700661 electrode cleaning solution sachet (2), batteries, instructions and rugged carrying case.

ELECTRODES

HI 1296D	Stainless steel body, Pre-amplified pH electrode with internal temperature sensor, DIN connector and 1 m (3.3') cable (for HI 991001)
HI 1297D	Titanium body, Pre-amplified pH/ORP electrode with internal temperature sensor, DIN connector and 1 m (3.3') cable (for HI 991002 and HI 991003)

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7020L	ORP test solution @200/275 mV, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

For a complete list of Solutions and Electrodes, see the end of this section.

HI 99121

Direct Soil pH Measurement Kit

- **Dedicated to soil pH measurement**
- **Specialized soil pH electrode**
- **Multi-level LCD display**
- **User friendly operation using only 2 buttons**
- **On-screen tutorial messages**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**
- **Compact, heavy-duty, and waterproof**

With the HI 99121 and HI 1292D direct soil pre-amplified pH and temperature probe, users can test both the pH of soil directly or after preparation of a diluted sample.

The HI 1292D features a conical, rugged tip that can be directly inserted in moist or soft soil. For harder soils, the kit includes a plastic auger to perforate the ground.

- **Soil Preparation Solution**

  For higher degrees of accuracy, or for stony ground where the electrode may be damaged, use the included HI 7051M soil preparation solution

ORDERING INFORMATION

HI 99121 is supplied with HI 1292D pH electrode, HI 721319 soil auger, HI 7051M soil preparation solution, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700663 cleaning solution sachet for inorganic soil deposits, HI 700664 cleaning solution sachet for organic soil deposits, 100 mL plastic beaker, batteries, instructions and a hard carrying case.

ELECTRODES

HI 1292D	Glass body, pre-amplified pH electrode for soil measurement with internal temperature sensor, DIN connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 7051M	Soil preparation solution, 230 mL
HI 700661P	Electrode cleaning solution for agriculture, 20 mL sachets (25)
HI 700663P	Electrode cleaning solution for inorganic soil deposits, 20 mL sachets (25)
HI 700664P	Electrode cleaning solution for organic soil deposits, 20 mL sachets (25)
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 721319	Ground auger
HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

SPECIFICATIONS		HI 99121
Range	**pH**	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	**pH**	0.01 pH
	Temperature	0.1°C/0.1°F
Accuracy (@20°C)	**pH**	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1.0°C (outside) / ±1.0°F (up to 140°F); ±2.0°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Electrode		HI 1292D glass body, pre-amplified pH electrode for soil measurement with internal temperature sensor, DIN connector and 1 m (3.3') cable (included)
Battery Type / Life		1.5V AAA (3) / approximately 1200 hours of continuous use. auto-off after 8 minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

For a complete list of Solutions and Electrodes, see the end of this section.

HI 99131

pH Meter for Plating Baths

- **Flat-tipped, pre-amplified pH probe with titanium body**
- **Multi-level LCD display**
- **On-screen tutorial messages for calibration and set-up**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**
  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**.
- **Compact, heavy-duty, and waterproof**
- **Easy to clean sensor**
  The flat tip sensor is easy to clean and keep clean by design

HI 99131 is a waterproof, portable pH and temperature meter supplied with a flat tip probe specifically designed for use in plating baths.

The HI 62911D pre-amplified, double junction pH probe features a recessed flat tip that is easy to clean and prevents solids in solutions from collecting on the sensor. The titanium body of the HI 62911D functions as a potential matching pin for increased stability of readings and extended sensor life.

- **Titanium probe body**
  The HI 62911D is encased in a titanium casing for maximum protection and shielding

SPECIFICATIONS		HI 99131
Range	pH	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	pH	0.01 pH
	Temperature	0.1°C/0.1°F
Accuracy (@20°C)	pH	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1.0°C (outside) / ±1.0°F (up to 140°F); ±2.0°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Electrode		HI 62911D titanium body, pre-amplified pH probe with internal temperature sensor, DIN connector and 1 m (3.3') cable (included)
Battery Type / Life		1.5V AAA (3) / approximately 1200 hours of continuous use. auto-off after 8 minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

ORDERING INFORMATION

HI 99131 is supplied with HI 62911D pH probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachets (2), batteries, instructions and hard carrying case.

ELECTRODES

HI 62911D	Titanium body, pre-amplified pH probe with internal temperature sensor, DIN connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

For a complete list of Solutions and Electrodes, see the end of this section.

HI 99141

pH Meter for Boiler and Cooling Towers

- **Dedicated to boiler and cooling tower applications**
- **Flat-tipped, pre-amplified pH probe with titanium body**
- **Multi-level LCD display**
- **On-screen tutorial messages for calibration and set-up**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**
  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**.
- **Compact, heavy-duty, and waterproof**
- **Easy to clean flat-tip sensor**

HI 99141 is a waterproof, portable pH/temperature meter supplied with a flat tip probe specifically designed for boiler and cooling tower applications.

The HI 72911D pre-amplified double junction pH probe features a recessed flat tip that is easy to clean and prevents solids in solutions from collecting on the sensor. The titanium body of the HI 72911D functions as a potential matching pin for increased stability of readings and extended sensor life.

- **Titanium probe body**
  The HI 72911D is encased in a titanium casing for maximum protection and shielding.

ORDERING INFORMATION

HI 99141 is supplied with HI 72911D pH/temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachets (2), batteries, instructions and hard carrying case.

ELECTRODES

HI 72911D	Titanium body, pre-amplified pH electrode with internal temperature sensor, DIN connector, 1 m (3.3' cable)

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 700670P	Electrode cleaning solution for salt deposits, 20 mL sachets (25)
HI 700671P	Electrode cleaning and disinfection solution for algae, fungi and bacteria, 20 mL sachets (25)

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

SPECIFICATIONS		HI 99141
Range	**pH**	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	**pH**	0.01 pH
	Temperature	0.1°C/0.1°F
Accuracy (@20°C)	**pH**	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1.0°C (outside) / ±1.0°F (up to 140°F); ±2.0°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Electrode		HI 72911D titanium body, pre-amplified pH electrode with internal temperature sensor, DIN connector and 1 m (3.3' cable) (included)
Battery Type / Life		1.5V AAA (3) / approximately 1200 hours of continuous use. Auto-off after eight minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

For a complete list of Solutions and Electrodes, see the end of this section.

pH Meter for Leather and Paper

- **Dedicated to leather and paper applications**
- **Flat-tipped glass probe**
- **Multi-level LCD display**
- **On-screen tutorial messages for calibration and set-up**
- **Stability indicator**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**
- **Compact, heavy-duty, and waterproof**
- **Easy to clean flat-tip sensor**

Direct pH measurement on paper and leather is fast and accurate with the HI 99171N pH meter. HI 99171N utilizes a flat tip probe designed to optimize surface contact with the sample.

pH measurement of papers and cartons is important, not only in the production phase, but also in the packaging phase. The food industry, for example, perform pH compatibility tests.

- **Flat-tipped glass probe**

  The HI 1414D maximizes surface contact with the sample to provide accurate, consistent results.

SPECIFICATIONS		HI 99171
Range	pH	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	pH	0.01 pH
	Temperature	0.1°C / 0.1°F
Accuracy (@20°C)	pH	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1°C (outside) ±1.0°F (up to 140°F), ±2°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Electrode		HI 1414D Glass body, pre-amplified pH electrode with flat tip, internal temperature sensor, DIN connector and 1 m (3.3') cable (included)
Battery Type / Life		1.5V AAA (3) / approximately 1200 hours of continuous use. Auto-off after eight minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

ORDERING INFORMATION

HI 99171 is supplied with HI 1414D flat tipped pH/temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700680 electrode cleaning solution for cellulose deposits sachets (2), HI 70960 conductive electrolyte solution for pH measurement (30 mL), batteries, instructions and hard carrying case..

ELECTRODES

HI 1414D	Glass body, pre-amplified pH electrode with flat tip, internal temperature sensor, DIN connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 700680P	Electrode cleaning solution for cellulose deposits, 20 mL sachets (25)
HI 700681P	Electrode cleaning solution for ink stains, 20 mL sachets (25)

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

For a complete list of Solutions and Electrodes, see the end of this section.

HI 99161

HACCP pH Meter for Food and Dairy

- **Easy to clean and keep clean**
- **Specialized dairy electrode**
- **Multi-level LCD display**
- **On-screen tutorial messages for calibration and set-up**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup.**
- **Compact, heavy-duty, and waterproof**

Monitoring pH in dairy processes is critical to ensure the quality of products.

The HI 99161 is a portable, pH and temperature meter is specifically designed for dairy applications.

FC 202D pH electrode features a rugged, easy to clean, PVDF body with a conical tip ideal for measurements in semi-solids such as meats and cheeses. The FC 202D is also provided with a free diffusion sleeve type reference junction which prevents the typical problems of clogging in viscous liquids such as milk or condiments. The electrolyte used in the FC 202D electrode is free from poisonous silver chloride which, in turn, effectively eliminates food contamination by the electrode.

- **Protective rubber boot**

  The optional protective boot helps protect your meter

- **Specialized electrode**

  The FC 202D is the ideal electrode to measure the pH of milk, yogurt, meats, cheeses, fruit, sushi rice, jams, jellies, dough, ice cream, yogurt, beverages, and juice

ORDERING INFORMATION

HI 99161 is supplied with FC 202D pH/temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700642 electrode cleaning solution sachets (2), batteries, instructions and hard carrying case.

ELECTRODES

FC 202D	PVDF body, pre-amplified pH electrode with internal temperature sensor, DIN connector, 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 700641P	Electrode cleaning & disinfection solution for dairy products, 20 mL sachets (25)
HI 700642P	Electrode cleaning solution for cheese deposits, 20 mL sachets (25)
HI 700640P	Electrode cleaning solution for milk products, 20 mL sachets (25)

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

SPECIFICATIONS		HI 99161
Range	**pH**	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	**pH**	0.01 pH
	Temperature	0.1°C/0.1°F
Accuracy (@20°C)	**pH**	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1.0°C (outside) / ±1.0°F (up to 140°F); ±2.0°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Electrode		FC 202D PVDF body, pre-amplified pH electrode with internal temperature sensor, DIN connector, 1 m (3.3') cable
Battery Type / Life		1.5V (3) AAA / approximately 1200 hours of continuous use. auto-off after 8 minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

For a complete list of Solutions and Electrodes, see the end of this section.

HACCP Compliant pH Meter for Meat

- **Two blade lengths available**

  Use the optional FC 098 (20 mm) or the included FC 099 (35 mm) stainless steel meat penetration blades for meat processing applications

- **Specialized pre-amplified pH probe with stainless steel penetration blade**
- **Multi-level LCD display**
- **On-screen tutorial messages for calibration and set-up**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**
- **Compact, heavy-duty, and waterproof**
- **Easy to clean and keep clean**

HI 99163 is a portable pH/temperature meter designed for the meat processing industry to ensure a quality product.

The FC 232D pre-amplified pH electrode and removable stainless steel blade enables users to perform unintrusive measurements on meat products inside and out. The free diffusion junction helps to avoid a clogged reference and the external body material is non-toxic and food compatible.

SPECIFICATIONS		HI 99163
Range	pH	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	pH	0.01 pH
	Temperature	0.1°C/0.1°F
Accuracy (@20°C/68°F)	pH	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1.0°C (outside) / ±1.0°F (up to 140°F); ±2.0°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Electrode (included)		FC 432D pre-amplified pH probe with internal temperature sensor, DIN connector and 1 m (3.3' cable)
Battery Type / Life		1.5V AAA (3) / approximately 1200 hours of continuous use. auto-off after eight minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

ORDERING INFORMATION

HI 99163 is supplied with FC 432D pH/ temperature probe with FC 099 stainless steel blade tip, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700630 electrode acid cleaning solution sachets for meat, grease and fats (2), batteries, instructions and hard carrying case.

ELECTRODES

FC 432D	PVDF body, pre-amplified pH electrode with internal temperature sensor, DIN connector, 1 m (3.3') cable
FC 098	20 mm stainless steel blade
FC 099	35 mm stainless steel blade

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5068L	pH 6.86 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL
HI 700630P	Acid cleaning solution for meat, grease and fats, 20 mL sachets (25)
HI 70631L	Alkaline cleaning solution for meat grease and fats, 500 mL
HI 70632L	Cleaning & disinfection solution for blood products, 500 mL

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

For a complete list of Solutions and Electrodes, see the end of this section.

HI 99181

pH Meter for Skin

- **Pre-amplified flat-tip pH electrode with built-in temperature sensor allows for maximum surface contact**
- **Multi-level LCD display**
- **On-screen tutorial messages for calibration and set-up**
- **Automatic Temperature Compensation**
- **Automatic one or two point calibration**
- **BEPS**

  (Battery Error Prevention System) alerts the user in the event that low battery power could adversely affect readings
- **Battery % displayed on startup**
- **Compact, heavy-duty, and waterproof**
- **Easy to clean and keep clean**

HI 99181 is a pH meter specifically designed for skin analysis. Essential for labs researching the biological compatibility of cosmetics and pharmaceuticals. HI 99181 provides quick and simple measurements without compromising precision.

The amplified HI 1414D/50 probe has been specially designed with a flat tip for accurate skin pH measurement with maximum surface contact.

ORDERING INFORMATION

HI 99181 is supplied with HI 1414D/50 flat tipped pH/temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700620 electrode cleaning and disinfection solution for skin residuals sachets (2), HI 700621 electrode cleaning solution for skin grease and sebum sachets (2), batteries, instructions and hard carrying case.

ELECTRODES

HI1414D/50	Glass body, pre-amplified pH electrode with flat tip, internal temperature sensor, DIN connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 700620P	Electrode cleaning & disinfection solution for skin residuals, 20 mL sachets (25)
HI 700621P	Electrode cleaning solution for skin grease and sebum, 20 mL sachets (25)
HI 70960	Electrolyte solution for sample preparation, 30 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710023	Orange protective rubber boot
HI 710024	Blue protective rubber boot

SPECIFICATIONS		HI 99181
Range	**pH**	-2.00 to 16.00 pH
	Temperature	-5.0 to 105.0°C/23.0 to 221.0°F
Resolution	**pH**	0.01 pH
	Temperature	0.1°C/0.1°F
Accuracy (@20°C)	**pH**	±0.02 pH
	Temperature	±0.5°C (up to 60°C), ±1.0°C (outside) / ±1.0°F (up to 140°F); ±2.0°F (outside)
pH Calibration		automatic one or two point calibration with two sets of memorized buffers (Standard 4.01, 7.01, 10.01 or NIST 4.01, 6.86, 9.18)
Temperature Compensation		automatic, -5.0 to 105.0°C (23 to 221°F)
Probe (included)		HI 1414D/50 glass body, pre-amplified pH electrode with flat tip, internal temperature sensor, DIN connector and 1 m (3.3') cable
Battery Type / Life		1.5V AAA (3) / approximately 1200 hours of continuous use. auto-off after eight minutes of non-use
Environment		0 to 50°C (32 to 122°F); RH max. 100%
Dimensions		152 x 58 x 30 mm (6.0 x 2.3 x 1.2")
Weight		205 g (7.2 oz.)

For a complete list of Solutions and Electrodes, see the end of this section.

HI 8424

pH/ORP Meter

- **Automatic calibration**
- **Automatic Temperature Compensation**
- **Automatic buffer recognition**
- **Three standard buffer values**
- **Calibration tags on LCD**
- **Low battery indicator**
- **Auto shut-off**
- **HOLD function**
- **°C and °F measurements**

HI 8424 is one of the most popular pH meters on the market. This instrument is able to perform pH, ORP and temperature measurements with a high degree of accuracy and fast response.

Calibration is automatic at one or two points with three memorized buffer values (pH 4.01, pH 7.01 and pH 10.01). Once the instrument has been calibrated, the buffer values used during calibration are displayed with tags on the LCD. This feature keeps users informed of the current calibration and helps to avoid taking measurements that are out of range.

Exchange the pH probe for an ORP probe to obtain ORP readings in the mV range.

SPECIFICATIONS		HI 8424
Range	pH	-2.00 to 16.00 pH
	mV	±699.9 mV; ±1999 mV
	Temperature	-20.0 to 120.0°C / -4.0 to 248.0°F
Resolution	pH	0.01
	mV	0.1 mV; 1 mV
	Temperature	0.1°C / 0.1°F
Accuracy (@20°C)	pH	±0.01
	mV	±0.2 mV; ±1 mV
	Temperature	±0.4°C / ±0.8°F
Calibration	pH	automatic, one or two point with three memorized buffer values (pH 4.01, 7.01, 10.01)
	Offset	±1 pH
	Slope	75 to 110%
Input Impedance		10^{12} Ohm
Temperature Compensation		automatic, -20 to 120°C (-4 to 248°F) or manual without temperature probe
pH Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7662 stainless steel temperatures probe with 1 m cable (included)
Battery Type / Life		9V / approximately 150 hours of continuous use; auto-off after 20 minutes of non-use or disabled (user-selectable)
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions		164 x 76 x 45 mm (6.5 x 3.0 x 1.8")
Weight		180 g (6.3 oz.)

ORDERING INFORMATION

HI 8424 is supplied with HI 1230B pH electrode, HI 7662 temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachets (2), battery, protective case and instructions.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3230B	PEI body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7662	Temperature probe

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710015	Shockproof rubber boot, blue
HI 710016	Shockproof rubber boot, orange

For a complete list of Solutions and Electrodes, see the end of this section.

HI 83141

Analog pH/ORP Meter

- **Easy manual one or two point calibration**
- **Automatic Temperature Compensation**
- **Low battery indicator**

HI 83141 is a handheld pH/mV/°C meter designed to be reliable and easy-to-use.

HI 83141 uses the HI 1230B pH electrode and HI 7669AW temperature probe using separate connections (both included).

Manual calibration is performed at one or two points by adjusting the knobs on the front panel. This instrument is ideal for applications that require a custom calibration point. Manual calibration can be extremely useful in order to achieve better accuracy.

ORDERING INFORMATION

HI 83141 is supplied with HI 1230B pH electrode and HI 7669AW temperature probe, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachets (2), calibration screwdriver, battery, protective case and instructions.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3230B	PEI body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 3131B	Glass body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable
HI 7669AW	Stainless steel temperature probe with 1 m (3.3') cable

SOLUTIONS

HI 7004L	pH 4.01 buffer solution, 500 mL
HI 7007L	pH 7.01 buffer solution, 500 mL
HI 7010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710007	Shockproof rubber boot, blue
HI 710008	Shockproof rubber boot, orange

SPECIFICATIONS		HI 83141
Range	pH	0.00 to 14.00 pH
	mV	±1999 mV
	Temperature	0.0 to 100.0°C
Resolution	pH	0.01 pH
	mV	1 mV
	Temperature	0.1°C
Accuracy (@20°C)	pH	±0.01 pH
	mV	±1 mV
	Temperature	±0.4°C (excluding probe error)
pH Calibration		manual, two point, through trimmers (offset ±1 pH; slope: 80 to 110%)
Temperature Compensation		automatic, 0 to 70°C (32 to 158 °F)
pH Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)
Temperature Probe		HI 7669AW stainless steel temperature probe, BNC connector (included)
Input Impedance		10^{12} Ohm
Battery Type / Life		9V / approximately 100 hours of continuous use
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions		145 x 80 x 36 mm (5.7 x 3.1 x 1.4")
Weight		230 g (8.1 oz.)

For a complete list of Solutions and Electrodes, see the end of this section.

Analog pH/ORP Meter

- **Pre-amplified pH electrode**
- **Easy manual one or two point calibration**
- **Automatic Temperature Compensation**
- **Low battery indicator**

HI 8314 is a handheld pH/mV/°C meter designed to be reliable and easy-to-use.

HI 8314 uses the HI 1217D pre-amplified pH electrode and internal temperature sensor.

Manual calibration is performed at one or two points by adjusting the trimmers on the front panel. This instrument is ideal for applications that require a custom calibration point. Manual calibration can be extremely useful in order to achieve better accuracy.

SPECIFICATIONS		HI 8314
Range	pH	0.00 to 14.00 pH
	mV	±1999 mV
	Temperature	0.0 to 100.0°C
Resolution	pH	0.01 pH
	mV	1 mV
	Temperature	0.1°C
Accuracy (@20°C)	pH	±0.01 pH
	mV	±1 mV
	Temperature	±0.4°C (excluding probe error)
pH Calibration		manual, two point, through trimmers (offset ±1 pH; slope: 80 to 110%)
Temperature Compensation		automatic, 0 to 70°C (32 to 158 °F)
pH Electrode		HI 1217D PEI body, pre-amplified pH electrode with internal temperature sensor, DIN connector and 1 m cable (included)
Input Impedance		10^{12} Ohm
Battery Type / Life		9V / approximately 100 hours of continuous use
Environment		0 to 50°C (32 to 122°F); RH max 100%
Dimensions		145 x 80 x 36 mm (5.7 x 3.1 x 1.4")
Weight		230 g (8.1 oz.)

ORDERING INFORMATION

HI 8314 is supplied with HI 1217D pH electrode, HI 70004 pH 4.01 buffer solution sachet, HI 70007 pH 7.01 buffer solution sachet, HI 700661 electrode cleaning solution sachets (2), calibration screwdriver, battery, protective case and instructions.

ELECTRODES

HI 1217D	PEI body, preamplified pH electrode with internal temperature sensor, DIN connector and 1 m (3.3') cable
HI 3618D	Glass body, preamplified ORP electrode with platinum sensor, internal temperature sensor and BNC connector with 1 m (3.3') cable

SOLUTIONS

HI 7004L	pH 4.01 buffer solution, 500 mL
HI 7007L	pH 7.01 buffer solution, 500 mL
HI 7010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710015	Shockproof rubber boot, blue
HI 710016	Shockproof rubber boot, orange

For a complete list of Solutions and Electrodes, see the end of this section.

HI 8010 • HI 8014

Educational pH Meters

- **Manual calibration**
- **Easy mode selection**
- **Rugged for heavy use**

HI 8010 and HI 8014 are rugged, handheld pH meters specifically designed with ease of use in mind. These affordable meters are ideal for education and field applications.

HI 8010 and HI 8014 perform pH measurements with Manual Temperature Compensation. HI 8014 also performs ORP measurements.

Two-point calibration can be performed with trimmers on the front panel. The set values are stored even when the meter is shut off.

These rugged, manual pH meters are perfect for teaching students the fundamentals of pH measurement.

ORDERING INFORMATION

HI 8010 and **HI 8014** are supplied with HI 1230B pH electrode, calibration screwdriver, battery and instructions.

ELECTRODES

HI 1230B	PEI body pH electrode with BNC connector and 1 m (3.3') cable
HI 3230B	PEI body ORP electrode with platinum sensor, BNC connector and 1 m (3.3') cable

SOLUTIONS

HI 5004L	pH 4.01 buffer solution, 500 mL
HI 5007L	pH 7.01 buffer solution, 500 mL
HI 5010L	pH 10.01 buffer solution, 500 mL
HI 7061L	Electrode cleaning solution, 500 mL
HI 70300L	Electrode storage solution, 500 mL

ACCESSORIES

HI 710009	Shockproof rubber boot, blue
HI 710010	Shockproof rubber boot, orange
HI 710001	Soft carrying case
HI 721311	Rugged carrying case
HI 8427	pH/mV electrode simulator
HI 931001	pH/mV electrode simulator with display

SPECIFICATIONS		HI 8010	HI 8014
Range	**pH**	0.00 to 14.00 pH	
	mV	–	±1999 mV
Resolution	**pH**	0.01 pH	
	mV	–	1 mV
Accuracy (@20°C)	**pH**	±0.01pH	
	mV	–	±1 mV
pH Calibration		manual, two point, through trimmers (offset ±1 pH; slope: 85 to 105%)	
Temperature Compensation		manual, 0 to 100°C (32 to 212°F)	
pH Electrode		HI 1230B PEI body pH electrode with BNC connector and 1 m (3.3') cable (included)	
Input Impedance		10^{12} Ohm	
Battery Type / Life		9V / approximately 100 hours of continuous use	
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		185 x 82 x 53 mm (7.3 x 3.2 x 2.1")	
Weight		265 g (9.3 oz.)	

For a complete list of Solutions and Electrodes, see the end of this section.

pH and mV Precision Simulators

- **Simulate output to discover malfunctions**
- **Simulate temperature**
- **Provided with universal BNC connector**

HI 8427 is designed specifically to simulate pH and ORP electrodes to confirm proper functioning of your meter. Standard pH electrode ranges are selectable with a dial on the front panel.

Provided with a universal BNC connector, this unit is also a high impedance tester, for cable and connector inspection with a leakage sensitivity of 10^9 ohm. This unique tester is a "one of a kind" in the industry that eliminates the need for very expensive MΩ meters.

Sometimes it is difficult to recognize whether a particular malfunction is due to the meter or the electrode. By simply connecting **HI 931001** to your meter's input socket and turning the dials, pH readings can be simulated from 0 to 14 pH in 0.01 steps. The output signals all correspond to pH values at 25°C and your pH meter should be able to check the span of your pH meter.

For the mV range, HI 931001 can simulate output from -1000 to +1000 mV in 1 mV steps.

HI 710010
Shockproof Boot

SPECIFICATIONS		HI 8427	HI 931001
Range	pH	0, 2, 4, 7, 10, 12, 14	0.00 to 14.00
	mV	-1900, -350, 350, 1900	-1000 to 1000
Resolution	pH	–	0.01
	mV	–	1
Accuracy (@ 20°C)	pH	±0.1	±0.01
	mV	±5	±1
Impedance test		10^9 Ohm	–
Temperature Compensation		manual, 0 to 50°C (32 to 122°F)	all output values are simulated at 25°C
Battery Type / Life		9V / approximately 100 hours of use	9V / approximately 500 hours of use
Environment		0 to 50°C (32 to 122°F); RH max 95%	
Dimensions		185 x 82 x 53 mm (7.3 x 3.2 x 2.1")	
Weight		255 g (9.0 oz.)	320 g (11.3 oz.)

ORDERING INFORMATION

HI 8427 and **HI 931001** are supplied with HI 7858/1 BNC/BNC coaxial cable

ELECTRODES

HI 7863	DIN/BNC connection cable, 1 m (3.3')
HI 7858/1	BNC/BNC connection cable, 1 m (3.3')
HI 7858/3	BNC/BNC connection cable, 3 m (9.8')
HI 7858/5	BNC/BNC connection cable, 5 m (16.4')
HI 7858/10	BNC/BNC connection cable, 10 m (33')
HI 7858/15	BNC/BNC connection cable, 15 m (49')

ACCESSORIES

HI 710009	Shockproof rubber boot, blue
HI 710010	Shockproof rubber boot, orange
HI 710001	Soft carrying case
HI 721316	Rugged carrying case

Designed and Manufactured by HANNA

pH Electrodes

At The Forefront of Electrode Technology

HANNA is the largest family-owned manufacturer of scientific analytical instrumentation, and a major European producer of electrodes. HANNA has helped propel the field of sensor technology with it's innovative methodology. The HANNA line of pH electrodes are produced in state of the art manufacturing facilities, and are available with glass or thermal plastic bodies.

In 1981, HANNA developed it's own formulations for sensing glass with the help of the Experimental Institute for Glass in Murano Italy. From that point forward, the company has continued to offer these premium pH sensing glass electrodes that cannot be imitated. While other companies have reduced their offerings, HANNA has continued to expand their electrode line to support a multitude of specific applications to get the job done right. An extensive variety of cleaning and maintenance solutions are also available to keep electrodes at peak performance.

Different Shaped Membranes (Tips)

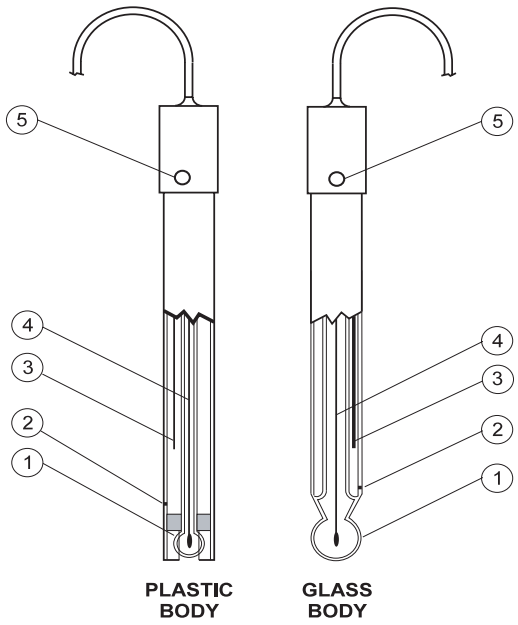
The pH membranes used as the sensor on pH electrodes can be fabricated with different shaped membranes; spherical, conical, and flat tips are used in HANNA's products. For analysis of small samples, microelectrodes are also available.

A spherical tip is recommended for general use in aqueous or liquid solutions and provides a wide surface of contact with the sample.

A conical tip is recommended for semi-solid products, emulsions, cheese, meat and food in general.

A flat tip is recommended for direct surface measurement on skin, leather, paper, etc.

Combination pH Electrode



Electrodes are housed in either plastic or in an all-glass body configuration. They can be either single cells or as shown in the diagram, combined into one body for ease-of-use. Regardless of the configuration, there are several features common to all electrodes.

1. Sensing Membrane Glass: Performs actual measurement.
2. Reference Junction: Acts as a liquid path electrical conductor.
3. Internal Reference: Supplies a constant equilibrium voltage.
4. pH Internal Element: Supplies a voltage based on the pH value of the sample.
5. Reference Fill Hole: Used to replace the reference electrolyte solution (not in GEL or SOLID-filled references).

Feature Guide: A Quick Glance

Calibration Check™ System

When used in tandem with a HANNA Calibration Check™ meter, our Calibration Check™ equipped electrodes allow users to be informed if they have performed a proper calibration. In the event of a dirty or broken electrode or contaminated buffer solution, the system alerts the user to either check the electrode, replace the buffer solution or both. The system also reminds users when the instrument should be recalibrated.

Smart Electrodes

With models that feature our SMART circuitry, an exclusive microchip embedded inside the electrode retains the calibration data and assigns an identity code to the host unit. As soon as the electrode is connected to a pH meter in the SMART series, it is recognized and its characteristics retrieved. The meter then uses the accessed calibration data as a reference for future measurements. Once each SMART electrode is calibrated, these electrodes can be used in succession without requiring new calibration. HANNA's intelligent electrodes help eliminate errors and will save time when working with more than one electrode.

Pre-amplified Electrodes

Integral pre-amplifiers are encapsulated in this series of HANNA's pH electrodes. The pre-amplifier converts the high impedance signal from the pH glass to a low impedence signal thus allowing the user to use long runs of sensor cable with ordinary connectors without noisy or voltage drops resulting in erroneous measurements.

Clogging Prevention System (CPS™)

Conventional pH electrodes use ceramic junctions that may clog quickly when used in biological samples such as wine. When the junction is blocked, the entire electrode will not function properly. Electrodes that feature CPS™ technology utilize a ground glass/ PTFE sleeve junction which controls a steady, predictable flow of fill solution thus keeping the junction open. The hydrophobic property of PTFE sleeve repels wetness and coatings.

Titanium Casings

Our electrodes that feature titanium bodies offer durability and shielding required in many industrial applications.

pH Measurement

The most common pH measurement system utilizes glass pH electrodes. The system consists of a pH sensor (whose voltage varies proportionately to the hydrogen ion activity of the solution), a reference electrode (which provides a stable and constant reference voltage), a conductive measurement solution and a special meter to display and measure the pH.

The pH sensor incorporates a thin membrane of hydrogen sensitive glass blown on the end of an inert glass tube. This tube is filled with a buffered electrolyte, and a Ag/AgCl wire. This is called a pH half cell.

A complimentary system produces a constant voltage; it also contains a Ag/AgCl wire and an electrolyte (often a KCl solution saturated with AgCl). A small "filter", often a porous ceramic piece, connects this tube to the external sample. This system is called a reference half cell.

The meter measures the voltage difference between the pH half cell and the reference half cell in DC millivolts. The reading is read by the meter and displayed in either mV or pH units.

The remarkable glass pH measurement system is capable of measuring over fourteen decades of hydrogen ion concentration! The system has a proven track record for reliability and predictability. Several companies have marketed ion selective field effect transistors (ISFET technology) as a response to the need for glass free measurements (such as the use of glass in food processing). An ISFET is a chemically coated transistor that responds to hydrogen ions as well as oxidation and reduction voltages. These electrodes also require a reference electrode. ISFETS are reported to suffer from drift and instability but may still have a niche market. The glass pH sensor is still the far better choice for the majority of applications.

Electrode Body

Until the seventies, it was a common practice to offer two half cells separately, a glass pH sensor and separate reference electrode. Today it is more common to use a single combined electrode that has both of the components. Reference electrodes still enjoy use in other electrochemical techniques and are often preferred with ion selective electrodes (ISE) half cells.

Combination pH electrodes are often made entirely of glass. The bodies of these electrodes are lead free glass, which is not pH sensitive. All glass electrodes are ideal for routine laboratory work because they respond quickly to temperature changes, are easily cleaned and are compatible with organic solvents. However, in the hands of some, glass can be very breakable.

The electrode body can be made less fragile by incorporating an outer body made from a thermoplastic. HANNA uses PEI resin, PVDF and PP as examples of materials utilized for outer body construction.

Some industrial sensors utilize additional materials such as PVC and titanium, the space age metal. A titanium body increases immunity to electrostatic and magnetic fields and features strong corrosion resistance (even in sea water). Our titanium bodied electrodes' outer casing also serves as a matching pin.

Matching Pin

A matching pin is a differential measurement technique used to eliminate ground loops and common mode perturbations for the measurement system. In a system without a matching pin, electrical currents in the sample can affect the reference half cell voltage that is connected via the liquid junction with the sample.

In this case, the reference electrode picks up the electromagnetic fields and the measurement of the pH is altered. The matching pin isolates these current/magnetic fields from the reference electrode.

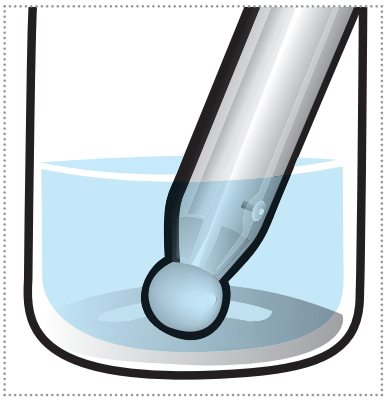
HANNA manufactures a number of models with the matching pin design for safe precise pH measurements.

Measurement Preparation Procedure

A coated measurement sensor or reference may yield slow responding and erroneous results. To ensure the best pH measurements possible, preventative maintenance and storage practices are strongly advised. A clean, conditioned HANNA pH electrode will provide the best measurements possible.

When using a new electrode, remove the protective bulb cap and inspect the electrode. As water may have evaporated during shipping or storage, salt crystals may be found in the cap or on the pH bulb. Rinse off with water.

During transport, air bubbles may have formed inside the glass bulb. Shake down the electrode as you would an old style mercury thermometer.



Condition the sensing tip; soak the pH bulb and junction in HI 70300 Storage Solution for at least one hour or longer. If possible, an overnight soak is best. This will hydrate a dehydrated glass sensor, thoroughly wetting a dried reference junction (wick, ceramic etc).

Water Conductivity and pH Measurement

pH measurement is the measurement of hydrogen ions. Ultrapure water is the perfect solvent, and readily dissolves many things. The pH glass surface can actually become dehydrated if stored or used in deionized or distilled water as ions are leached from the sensing surface. pH electrodes require ions in a solution, preferably with a conductivity of or exceeding 200 µS/cm to function properly.

In the case of low conductivity samples or when working below 200 µS/cm, we suggest the use of specific electrodes, such as our HI 1053B.

pH Measuring System

HANNA has put a lot of effort in the development of efficient pH measuring systems. Some of the changes made to our pH sensors are not immediately apparent to the user. These things include better pH glass, stem glass, liquid junctions, seals, internal buffers systems, cables and caps. Changes in our instrumentation are more obvious to the user. We strive for user friendly interfaces with state of the art electronics. The required components for a pH measurement system are as follows:

pH Electrode
Sensor half cell of an electrochemical cell that typically contains a special glass composition membrane that responses to hydrogen ion concentration.

Reference Electrode
Half cell of the electrochemical cell that supplies a stable voltage that is known, constant and completely insensitive to the measurement solution. Changes in voltages generated from the pH sensor are measured versus this electrode's voltage.

High Input Impedance Meter
It is the measurement device that processes the voltage from the electrochemical cell and converts it into a meaningful measurement unit (pH). The measurement is done with virtually zero current flow to prevent polarization of the electrodes. Modern pH meters also may provide sensor diagnostics, automatic buffer recognition, calibration reminders and user prompts.

Chemical pH Buffers
Stable well characterized standards for calibration. Two or more pH buffers that bracket the sample pH range are suggested for the most accurate results.

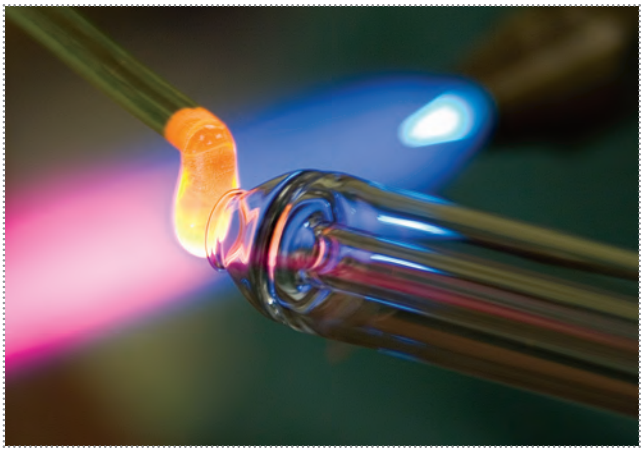
Thermometer or Temperature Probe
The temperature is required to calibrate the electrode properly, as buffers have different values at different temperatures. An auxiliary or built-in temperature probe and automatic buffer recognition ensures the calibration and measurement is automatically temperature compensated, thus eliminating error.

Magnetic Stirrer
Used in a laboratory setting, a magnetic stirrer together with magnetic stir bars continually agitate the buffer and/or samples to keep them homogenous without temperature or sample gradients.

pH Electrode Manufacturing

Other producers use the continuous fusion technique in crucibles with induction furnaces. In this case the glass is exposed to the fusion temperature for hours and it is difficult to retain the quality of the product due to the evaporation of some of its components.

HANNA uses glass blowing technology, typical of the Murano masters, with sensitive glass sticks fused in controlled batches. Only this technique, which exposes the sensitive glass to the high fusion temperature for a few seconds, can guarantee the consistency and quality of the pH half cell.



HANNA Offers 4 Different pH Sensitive Glass Formulations

Application driven design has influenced our offering of pH glass formulations. HANNA has selected the best glass compositions possible for each sensor to ensure the most accurate measurements in a given application. The characteristics of the sensitive glass used in the manufacture of pH electrodes is extremely important in determining how the electrode will respond. Characteristics of pH glass include workability (what shapes can be made with a certain glass composition), impedance of the glass (shape also influences this), pH range, alkaline error, acid error, hydrofluoric acid resistance and abrasion resistance.

HANNA utilizes 4 different types of pH sensitive glass to cover the vast number of applications HANNA electrodes service. Our manufacturing processes are specific for each design of pH electrode. For instance, some electrodes with low impedance glass are particularly suited at performing measurements in solutions with low conductivity or cold solutions. For industrial grade electrodes, HANNA produces a specific range of sensitive glass that guarantees a linear response over a wide pH range as well as being resistant to harsh environments.

To optimize a pH measurement for a particular application, the pH glass characteristics are considered as well as materials of construction including reference junctions, wetted materials and internal seals. HANNA provides the best material and performance for a particular application to ensure reliability of measurement. For example, when measuring at temperature extremes, glass impedance is an important factor to consider. As a general rule, the pH glass impedance doubles for every 10°C (50°F) drop in temperature. Very high impedance results in a very noisy, erratic signal that is prone to errors in measurement. HANNA offers LT a low impedance glass for these applications. At elevated temperatures, glass can dissolve readily, shortening the life and performance of the sensor. HANNA offers HT glass for these applications.

GLASS MEMBRANE	APPLICATION
GP	General Purpose
HT	High Temperature
LT	Low Temperature
HF	Samples with Fluoride

GP Glass

HANNA's GP (general purpose) hydrogen sensitive glass provides the best response over the entire pH range and can be used for a wide range of applications. Great results are obtained with a sphere geometry with diameter of 9.5 mm (0.37"). This achieves a system with 100 MΩ, impedance. The GP glass is also used on smaller diameter spheres.

As the diameter of the sphere is reduced, the system impedance increases, the response time can increase from the usual 2 seconds for the 9.5 mm (0.37") sphere to about 6 seconds with a 3 mm (0.12") sphere. The glass is green.

LT Glass

LT glass is used on our flat and conical shaped membranes as well as sensors used at cold temperatures because the glass has lower impedance. If an electrode has very high impedance, the measurement response will be sluggish, and a voltage drop causing error can occur. At temperatures below -8°C (17°F) the internal buffer may freeze and expand and cause the mechanical destruction of the sensor. This glass has a more limited pH range. This glass is dark green.

HT Glass

Designed for extended use at elevated temperature. The glass impedance has a temperature coefficient of about 14.3% per degree Celsius.

HT sensitive glass has an impedance of 400 MΩ at approximately 25°C (77°F). At extremely high temperatures the impedance drops significantly. This glass makes it possible to obtain accurate, high temperature pH measurements for extended periods of time 90°C (194°F) and for a few weeks at 100°C (212°F). At room temperature the response time may increase so additional time for equilibration in buffers should be allowed. This glass is clear.

HF Glass

Hydrofluoric acid can dissolve glass rapidly. HANNA uses HF resistant glass for aggressive applications that have fluoride ions. Electrodes manufactured with this glass live ten times longer than electrodes made with standard pH glass formulations (from 10 days to 100 days). The alkaline error is very high for this glass so it is not suited for pH measurements above pH 10. The recommended pH range with this glass is 2-10 pH.

How Temperature Effects pH Measurements

Samples change pH as a function of temperature due to changes in ion dissociation and increased ion activity with increases in temperature. An example of this is pH buffers whose well-characterized values are published on the buffer bottles. With very pure water, a change in ~1.3 pH is observed between 0 and 100°C. This example shows that even a neutral solution can have a large temperature coefficient. All samples have a temperature coefficient that is variable for actual samples. Changes in pH due to the sample temperature coefficient are not compensated for.

There is an exception to this; because buffers are well characterized, on intelligent pH meters, during calibration, the buffers are compensated for. They will display a 25°C value during calibration but will change after the calibration to read their actual pH at the temperature of measurement.

pH Compensation

A well-made pH electrode together with modern pH instrumentation can compensate for changes in temperature related pH measurements due to thermodynamic changes demonstrated by the Nernst equation. The electrode itself is made with an isothermal point close to pH 7 and a slope that closely follows the Nernst equation.

The majority of pH meters HANNA manufactures incorporate either automatic or manual temperature compensation.

When temperature compensation is made with a pH meter. The slope (or gain) of the meter is changed to compensate for the Nernst slope change exhibited by the electrodes. On models with manual compensation the user can change the temperature with a dial or software entry to correspond to the sample temperature.

Nernst Equation

$E_{obs} = E_c + \mathbf{ln(10)RT / nF} \log(a_{H+})$

E_{obs} = Observed potential (sum of reference and liquid junction potentials)
E_c = Reference potential including other stable and fixed potentials
a_{H+} = The hydrogen ion activity
T = Temperature in Kelvin (C° + 273.15)
n = Valency of the ion measured (1)
F = Faraday's constant (9.6485×10^4)
R = Gas constant (8.31432J / KMol)

From this equation one can see if the temperature T changes the term ln(10)RT / nF, which is known as the slope factor, will change also. The table below illustrates the change in slope factor for changes in temperature.

TEMPERATURE (°C)	SLOPE FACTOR (mV/pH)
05	55.18
10	56.18
15	57.18
20	58.17
25	59.16
30	60.15
35	61.14

pH meter with separate pH and temperature probes

pH meter with pH electrode incorporating an internal temperature sensor

Automatic Temperature Compensation

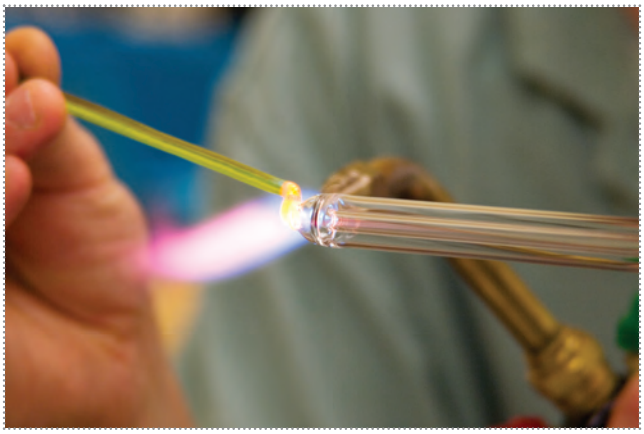
The ability to compensate for changes in the Nernst slope factor in the least possible time requires the measurement of temperature automatically. HANNA supplies many pH meters with either a separate temperature sensor or one integrated with the pH sensor. This elegant design, which has the advantage of space conservation and convenience, is used with all process sensors and many of our handheld devices. In 1988, HANNA incorporated pre-amplifiers in some of their pH electrodes used with portable instrumentation. This popular design has permitted HANNA to use slimmer cables and has the advantage of the integral sensor incorporated with the pH. The pre-amplifier converts the high impedance signal to a low impedance signal and the bulky insulated cables are not needed.

Other intelligent enhancements to pH measurement

Other functions can also be added to the electronic circuit's memory. Electrode production data and the recognition of the model code of the electrode are two examples of intelligence that has been added to some models of sensors. The instrument can use this data to compare previous data with the present calibration thus avoiding calibration errors.

When the user has to use a different electrode for a different application, the instrument will recognize the new electrode and can tell if it has been previously calibrated and proceed correctly.

This technology has spread from industrial to portable and laboratory measurements.



Alkaline Error

Alkaline error exists in high pH solutions when the hydrogen ions in the gel layer are partially or completely substituted with alkali ions, and the resulting pH is lower than it actually should be. The difference between the theoretical and experimental pH is called the alkaline error. Sodium ions are typically the ions that are responsible but potassium and lithium ions can also contribute to this error. In earlier glass compositions, the alkaline error was seen to start at pH 9. Newer glass formulations and ones especially formulated to minimize this error now exhibit an error starting at pH 12 or 13 pH.

To solve the problem of alkaline error, HANNA's HT glass minimizes alkali error in highly alkaline solutions. The tables below show the sodium error that exists with HANNA glass types at ambient temperatures:

ALKALI ERROR WITH 0.1 M SODIUM				
pH	**GP**	**HT**	**LT**	**HF**
10.5				0.06
11.0				0.15
11.5			0.05	0.22
12.0	0.01		0.18	0.30
12.5	0.11	0.05	0.28	
13.0	0.23	0.11	0.35	
13.5	0.35	0.16	0.45	
14.0	0.48	0.20	0.54	

ALKALI ERROR WITH 1.0 M SODIUM				
pH	**GP**	**HT**	**LT**	**HF**
10.0			0.01	0.25
10.5			0.14	0.25
11.0	0.02		0.30	0.48
11.5	0.11	0.01	0.46	0.71
12.0	0.21	0.06	0.62	
12.5	0.32	0.11	0.79	
13.0	0.43	0.15		
13.5	0.45	0.21		
14.0	0.65	0.27		

Half Cell/Reference Electrodes

All potentiometric measurements are taken with two electrodes, one is a sensor with a potential that varies as a function of the concentration of the species to be measured and the second is a reference electrode which keeps its potential constant. The mV reading is the difference of the two values.

Reference Half Cell Junction

The reference half cell must be constructed so as to allow contact between the fill solution inside the half cell and the sample being measured. The fill solution must meet some requirements:

- The reference fill solution should not interfere with the measurement.
- The reference fill solution should not react with the solution measured (no precipitates or complexes).
- The reference solution should be miscible with the solution measured.
- The solution measured must not react chemically with the reference half cell.
- The mobility of the ions in the fill solution should be matched (equitransferent)
- Should be non-toxic

The junction (the part in contact between the two liquids) is typically made with inert materials that will not increase a junction potential or be chemically attacked by the measured solutions. The materials most commonly used are:

Porous Ceramic
Normally used in electrodes with glass bodies, because ceramic with the correct expansion coefficient is is easily welded to glass. Ceramic is available with different porosities and diameters. Also sometimes called a diaphragm.

Porous PTFE (PolyTetraFluoro-Ethylene)
Porous PTFE is a hydrophobic material that is available with different porosities. Because of its chemical advantages, PTFE is widely used in industrial applications.

Fiber wick
This type junction is often used on plastic bodied electrodes with gelled electrolytes. The advantage of this type junction is it is renewable; as the cloth like material is pulled out from its position, the junction is renewed with an uncontaminated fresh surface.

Cone Style
This junction is also renewable. As the sleeve or collar is moved fresh fill solution cleans out the junction with fresh electrolyte. This has a higher flow rate than a ceramic type and is often specified for ISE measurements.

Open junction
This type junction is found in reference half-cell is filled with a special gel which comes into direct contact with the solution to be measured An advantage of an open junction is low conta resistance and it is virtually impossible to clog.

Other types of junctions include:

Capillary junction
Can be made with smooth or frosted glass. The advantage of a capillary junction is a fast flow rate and a very open channel. Typically used with thickened electrolytes.

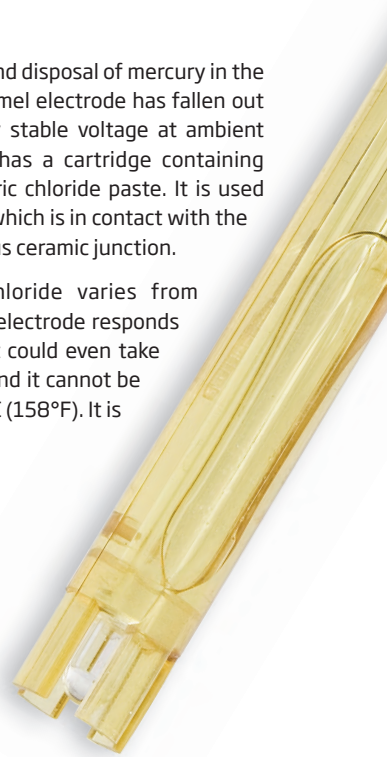
Open Platinum
This style junction is made by partially sealing fine Pt wires through the stem glass which creates a leakage path. These have high flow rates.

Fiberglass
This style junction is very similar to a fiber wick. The junction is typically renewable and may have a high flow rate depending on strand number in the bundle.

Calomel Electrode

There are concerns regarding the use and disposal of mercury in the environment. Because of this, the calomel electrode has fallen out of favor. It however has an extremely stable voltage at ambient temperature. The calomel electrode has a cartridge containing mercury in contact with a with mercuric chloride paste. It is used with a potassium chloride fill solution which is in contact with the sample to be measured through a porous ceramic junction.

The concentration of potassium chloride varies from saturated down to 0.1 M. The calomel electrode responds very slowly to temperature changes; it could even take hours to come to thermal equilibrium and it cannot be used for temperatures higher than 70°C (158°F). It is not reversible.



Silver/Silver Chloride Half Cell

The silver/silver chloride electrode is made of a pure silver wire electroplated with a layer of silver chloride and often dipped in molten AgCl. The wire is equilibrated in a solution of potassium chloride solution in contact with the sample to be measured, often through a porous ceramic junction. AgCl is soluble in concentrated potassium chloride, so the electrolyte is saturated with silver chloride to prevent the plating from dissolving off the wire.

The Ag/AgCl half cell responds to the temperature changes much faster than the calomel electrode and may be used at temperatures higher than 70°C (158°F) for a long period of time.

Both the fast reversible temperature response and wide range of operating temperatures have contributed to the popularity of this type electrode. It is also safer to handle and dispose of.

The table below tabulates the half cell voltage of the Ag/AgCl with different KCl concentrations versus a standard hydrogen electrode (SHE) at various temperatures.

°C	1.0 M	3.0 M	3.5 M	SATURATED
10	231.4	260.2	215.2	213.8
15	228.6	258.5	211.7	208.9
20	225.6	256.9	208.2	204.0
25	222.3	254.9	204.5	198.9
30	219.0	253.0	200.9	193.9
35	215.6	250.8	197.1	188.7
40	212.1	248.7	193.3	183.5

Non-Polluting Reference System

The HANNA double-junction electrodes with reference systems that contain no silver chloride (AgCl) are designed to prevent sample contamination and reduce clogging of the diaphragm.

Multiple or Open Junctions

The single ceramic junction (diaphragm) allows a low rate of electrolyte leakage and is suitable for general use in aqueous solutions. The triple ceramic junction allows a higher leakage rate and makes the reference system less sensitive to electrode "poisoning" which is suitable for emulsion and protein enriched solutions.

The free diffusion layer allows the greatest degree of contact. Recommended for the dairy and food industry.

Single Junction Reference

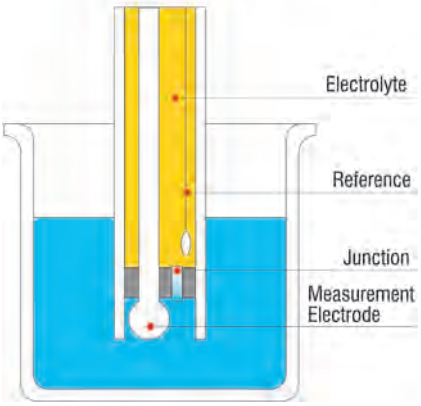
This is the most common model, where a Ag/AgCl wire is dipped into a 3.5 molar KCl + Ag Cl solution. As explained in the section on reference electrodes, the electrolyte must be saturated with AgCl to avoid dissolution in the KCl electrolyte. It allows the possibility that traces of AgCl will come into contact with the sample solution forming silver precipitates which may block the junction.

Double Junction Reference

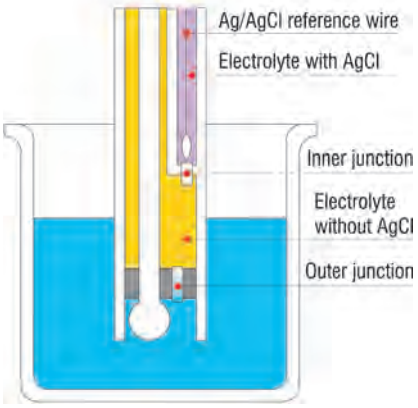
This silver/silver chloride based half cell has two chambers for electrolyte. The internal chamber houses the silver/silver chloride wire and electrolyte containing chloride and AgCl. It contacts the outer chamber through a porous ceramic junction. The outer chamber serves as a silver free buffer zone. The electrolyte may be 3.5 M KCl or 1 M KNO_3 for example. A second junction contacts the sample from this chamber. Since silver reacts with tris buffer and heavy metals to form a precipitate, the absence of silver in the electrolyte gives the double junction reference a big advantage. Keeping the silver within the inner chamber and KCl in the outer chamber prevents the precipitation and results in a cleaner junction, free from silver precipitates.

The disadvantage is, such an electrode has a greater heat capacity, which may be a problem when measuring laboratory samples at different temperatures. The double junction reference is widely used with process electrode designs, especially when taking measurements inside pipes with operating pressures up to 8 bar.

SINGLE JUNCTION
REFERENCE SYSTEM



DOUBLE JUNCTION
REFERENCE SYSTEM



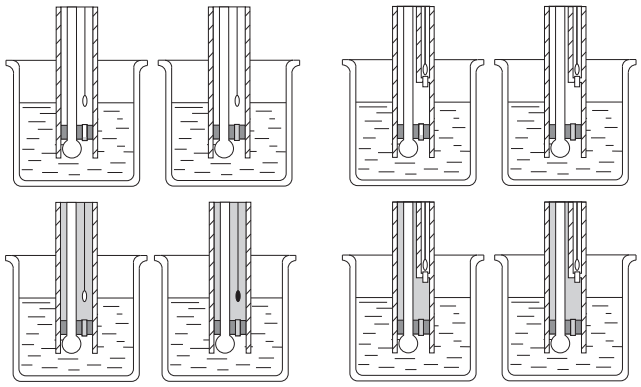
Improved Performance Through Innovation

HANNA has continually been at the forefront of sensor research and development since the 1980's. The increasing demand for reliable, durable and high quality electrodes for the laboratory, water treatment and process industries has motivated us to persist in our commitment to the creation of new technologies, and improvement of existing methods and designs. The most common sensing problems related to pH electrodes are the contamination and clogging of the reference junction, resulting in slow, drifty and noisy measurements. HANNA's vast experience in the manufacturing of electrodes has enabled us to introduce innovative ideas, developing dedicated answers to specific problems in the measurement of pH.

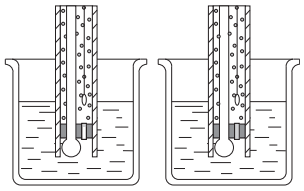
a) Minimizing Contamination

Conventional electrodes are normally single junction. As depicted by the figures below, these electrodes have only a single junction which serves to put the reference electrode system in contact with the sample. Under adverse conditions e.g., high pressure, high temperature, highly acidic or alkaline solutions etc., the positive flow of the electrolyte through the junction is often reversed resulting in the ingress of sample solution into the reference compartment. If this is left unchecked, the reference electrode ultimately is contaminated, leading to complete electrode failure.

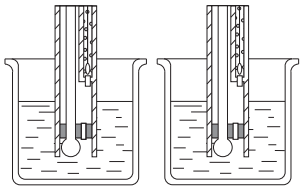
HANNA's double junction system, as the name implies, has two junctions, only one of which is in contact with the sample. As illustrated in the figures below, under adverse conditions, the same tendency of sample ingress is evident. However, as the reference electrode system is separated physically from the intermediate electrolyte area, the contamination of the electrode is minimized. This leads to long electrode life. The chances of recovery are also higher if proper maintenance procedures are taken.



b) Reduction in Clogging of Junctions



A common cause of clogged junctions in conventional electrodes is due to the common ion effect. AgCl is less soluble in the sample than the reference electrolyte solution. Therefore, when the electrolyte solution makes contact with the sample, some AgCl will precipitate on the external face of the junction. Even though regular maintenance procedures and backflushing eliminates clogging, often the severity of this problem is not comprehended. The result is drifty readings obtained from the sensor.



In HANNA's double junction electrodes, the secondary compartment electrolyte which contacts the sample through the junction does not contain any silver chloride ions. As such, this problem is nonexistent. Though the primary compartment contains heavy ions, the contact across the primary junction is purely by ionic diffusion and as such in contrast to the high flow junctions in contact with the sample, the clogging effect is negligible.

c) Reference Electrolyte Compatibility

At times, the incompatibility of the electrolyte and sample leads to a chemical reaction at the junction creating clogging and measurements that drift. In conventional electrodes, the types of reference electrolytes that can be used are extremely limited to the inherent characteristics of the electrode system.

With double junction electrodes, one can easily substitute a compatible reference electrolyte in the secondary chamber to ensure accurate measurements of difficult samples without damaging the electrode reference system, thus eliminating the problems of conventional electrodes.

pH Electrodes and Signal Strength

A pH electrode is made of a half cell of pH sensitive glass and a reference electrode. From the tip of each electrode a connecting wire comes out. A pH electrode needs therefore 2 conductors.

A special insulated cable is required to carry the high impedance mV signal from the pH sensor without experiencing a voltage drop and error in pH value. pH glass impedance is found to vary from a few MΩ up to 800 MΩ depending on glass type and temperature. To ensure a precise measurement (0.001 pH), the connecting cable requirement is extremely important and must have an impedance 14,000 times greater than that of the glass electrode (800 MΩ x 14,000 = 11.2 x 10^{12}Ω).

Any insulation of less than 10^{12}Ω will result in wrong readings. In case of leakage a drained current from the electrode occurs. A pH measurement must be made with no current flow.

Leakage currents higher than 2 pA (picoamps) will damage the electrode and cause it to polarize. An electrode that has supplied a few picoamps just for a few seconds, will take hours to regain its capacity to take measurements.

At the end of the cable there is a two-conductor connector. The most common version, capable of holding the high value of the required insulation, is the BNC connector with PTFE insulation.

Cable Limitations and Solutions

Because of the limitations that have been mentioned, cables longer than 5 meters (16') should be avoided with standard electrodes.

In industrial installations, a signal from the sensor often has to travel much greater distances than 5 meters (16'). Often a device known as a 2 wire transmitter is used to convert the voltage from the sensor to a current for transmission. The current can travel long distances to a recording device, controller or other devices that can use the 4-20 mA signal. The HI 8614 and HI 8614L are two wire transmitters that have water-tight cases and galvanically isolated power requirements. (HI 8614: 18 to 30 VDC, HI 8614L: 20 to 36 VDC). These transmitters carry the 4-20 mA signal over the same two wires as power. The local indication of pH near the sensor makes installation of the pH electrode quick and easy. The downside of this technology is the receiving device must accept and utilize the current input.

Another approach for carrying a pH signal a long distance without loss of signal or noise is realized with the HANNA AmpHel® sensor. This preamplified pH sensor contains its own high impedance pH amplifier with required batteries. The typical high impedance signal from a pH bulb is reduced to a low impedance signal. The low impedance signal can be carried long distances (100 m; 328') without degradation in signal. The preamplifier has a life of approximately 3 years from the date of production. This long life exceeds the typical life of a pH glass bulb.

Electrode Connectors

Most HANNA meters accept pH or ORP probes with one of the connectors on the left.

The **BNC connector** is the most versatile since it can be used with any meter that utilizes BNC regardless of brand.

BNC + PIN connectors are used specifically with meters that utilize HANNA's exclusive Calibration Check™ system.

DIN, **Screw** and **T-type** connections are for the most part proprietary to the meters they are supplied with.

Screw and **T-Type** connectors attach directly to the meter.

Electrodes with BNC, BNC + PIN or DIN connectors feature cable lengths that can be ordered in a variety of lengths.

Even though both screw and T-type connectors attach directly to the meter, they can also be made interchangeable with other meters by using a HANNA BNC extension cables.

B BNC

P BNC + PIN

D DIN

S SCREW

T T-TYPE

Take Time for Routine Electrode Maintenance

Calibration

There are many different industries that rely upon the use of a pH meter to make decisions about a process. Calibration is an important function that must be done routinely to standardize the electrode the face of its ever-changing characteristic. That is, when the meter is calibrated, it is done to compensate for the changes that have taken place to the electrode since the previous calibration. There are many influences including aging, temperature, coatings, and chemicals used that will affect the characteristic. So the question becomes 'what is a typical probe characteristic and how do you check it?'

A pH meter is a very sensitive voltmeter, in that when a pH probe is placed into a solution a mV potential is generated in response to the hydrogen ion concentration [H^+]. The theoretical voltage generated can be determined by the Nernst equation. Theoretically at 25 °C, a pH 7.0 solution will generate 0 mV and there will be a 59.16 mV change for each pH unit. So at pH 4.0, which is characterized by a higher concentration of H^+, a +177.48 mV will be generated while at pH 10.0, with a lower H^+ concentration relative to pH 7.0, a -177.48 mV will be generated. Again, this is theoretical and does not represent the real world behavior. In fact, a new pH electrode will generate between +/- 10 mV in pH 7.0 and will have a slope percentage between 95 and 105%. The slope percentage is determined by dividing the actual voltage generated by the theoretical and then multiplied by 100.

The following are two examples of different electrodes having different characteristics. The voltage generated is determined by using a pH meter that has a mV option.

Example 1: An electrode in pH 7.0 buffer generates +15 mV. When placed in pH 4.0 buffer it generates +175 mV. The net difference between the two buffers is +160 mV which is then divided by +177.48 mV. The result, 0.901, is then multiplied by 100 to give a slope percentage of 90.1%.

Example 2: An electrode in pH 7.0 buffer generated -45 mV while in pH 4.0 it generated +115 mV. The net difference is 160 mV and as seen from example 1 equates to a 90.1% slope.

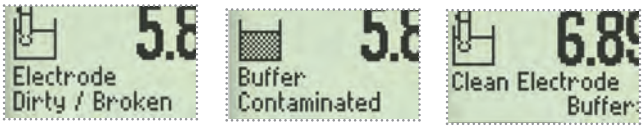
Example 2 is a prime example of how a probe can be calibrated but not be operating with an acceptable probe characteristic. That is, generally speaking, a slope of 90% is acceptable but the offset of -45 mV is not. An offset shift can be the result of a build up on the probe. This will not only affect the response time but also if the coating then comes off with use, then the characteristic will change and the calibration will no longer be valid. Typically the offset voltage should fall within +/-25 mV and the slope between 85 and 105%. The greater the accuracy needed, the closer the readings should be to the theoretical.

Exclusive Calibration Check™

Proper calibration of both the pH meter and pH electrode system is critical in order to achieve accurate, reliable results. HANNA's exclusive Calibration Check™ diagnostics system includes several features to help reach that goal.

By alerting users of potential problems during the calibration process, Calibration Check™ diagnostics system eliminates erroneous readings due to dirty or faulty pH electrodes or contaminated buffer solutions. Users are guided step-by-step through the calibration process by an on-screen tutorial. After calibration, a probe condition indicator is displayed on the LCD informing the user of the overall electrode status and any associated messages.

Typical Calibration Check Displays



General guidelines for pH electrode use:

All HANNA electrodes are shipped with a cap that protects the bulb and junction from damage. The cap must be REMOVED and set aside.

Remove any salt deposits that may have formed on the surface of the electrode during storage and shipping by thoroughly rinsing with water. The presence of salt deposits is normal and generally indicates that the reference junction is open and free-flowing.

Verify that the electrode is connected properly to meter and the meter is powered.

During measurement, always operate the electrode with the fill hole open. This does not apply to gel and solid filled electrodes which do not have reference fill hole.

During normal use, fill solution will slowly drain out of the junction located on the side of the electrode; excessive loss (> 2 cm drop within 24 hours) is not normal.

Add fill solution daily to maintain a good head pressure. For optimum reference response, this level should be maintained and not be allowed to drop more than 2 cm below fill hole.

The electrode glass should always be kept wet. If dry, the tip should be soaked in electrode storage solution (HI 70300) or in absence, pH 4.01(7.01) buffer, or water for 2 hours to hydrate the pH glass membrane before use or calibration.

Calibration buffers and sample solution should be at the same temperature.

Periodically re-check calibration (if possible every 1-2 hours) to ensure maximum performance.

Rinse electrode with deionized or distilled water between samples and dab dry with lab wipe or soft disposable absorbent towel.

Calibration standards and sample solutions should be stirred at the same rate using identical sized stir bars.

Clean pH Electrodes

A clean pH electrode provides the most accurate measurements. HANNA has studied the effects of a soiled pH surface on electrode efficiency and has solved the problem of how to clean a pH glass surface properly.

As mentioned previously, a pH measurement requires two half cell potentials. The pH sensor is sensitive to changes in hydrogen ion concentration and is normally made from a special gas membrane bulb. Inside the glass bulb, a buffered (close to pH 7) chloride containing solution is permanently sealed with a silver wire coated with silver chloride. This forms a stable internal pH sensor voltage. If the external bulb surface was placed into this same buffered solution, the voltage difference would be zero or very small. As the hydrogen concentration was changed on the outside of the bulb (sample side), the glass bulb produces an electrical potential equal to 58.17 mV for each unit of pH (at 20°/68°F). The actual value that is generated depends on the exact pH glass composition used in producing the pH sensor. Each manufacturer uses slightly different compositions of components but most pH glass contains these components in these proportions: 21.6% Na_2O, 6.4% CaO and 72% SiO_2.

A Dirty Bulb

When the surface of a pH bulb is not perfectly clean, for example, if it is 10% coated, there is a 10% reduction in sample contact with the external bulb. Let us assume the pH sensor is in a sample of pH 4 but has a greasy deposit (value pH 7) on 10% of it. The voltage (EMF) the sensor will generate can be calculated.

90% of the sphere: pH 7 inside and pH 4 outside
= 0.9 x 3 x 59.16 mV = 159.732 mV

10% of the sphere: pH 7 inside and pH 7 outside
= 0.1 x 0 x 59.16 mV = 0 mV (portion of the dirty sphere)

The available EMF will then be 157.059 mV. In the case of a clean electrode, the EMF would have been:

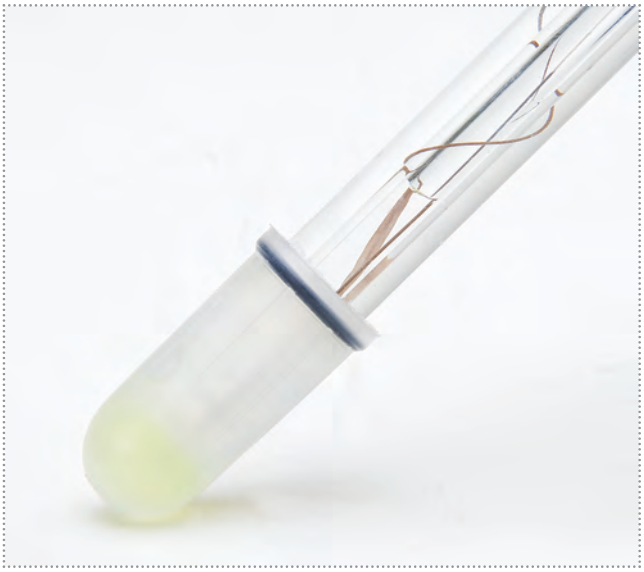
100% of the sphere: pH 7 inside and pH 4 outside
= 1 x 3 x 59.16 mV = 177.48 mV

Therefore a dirty electrode supplies less EMF than a clean one.

Dirt Could Come From Anywhere

Eyeglasses are commonly used and it is well known how easily they become dirty. Each small spot represents a percentage error when it comes to measuring the pH.

HANNA offers instruments that are capable of detecting calibration errors due to spots. In addition, HANNA has developed a wide range of cleaning solutions for pH electrodes that makes this operation easy for users.



pH Electrode Conditioning and Conservation

The glass electrode should not be used when it is dry. The bulb must always be hydrated or the active layer degenerates and it will then take hours to restore equilibrium.

The electrode should be kept in a HI 70300 pH storage solution or in a buffer solution at pH 4 or pH 7. We do not advise storage of the electrode in alkaline buffer solutions with values higher than pH 9.18 or deionized water.

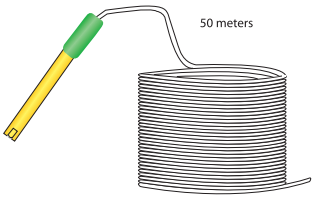
Reference electrodes also benefit from being kept wet with HI 70300 solution. If the reference is stored dry, evaporation of electrolyte results in salt crystals forming around the ceramic junction. These crystals are easily washed off but there is also danger of the porous junction developing air pockets. Instability results until the ceramic is thoroughly wetted.

With ceramic diaphragms, this equilibrium can be achieved by immersion in HI 70300 solution for a few hours. When PTFE is used, an immersion of 24 hours may be necessary. Avoid the use of deionized water to store glass and reference electrodes. Deionized water promotes osmosis with the salty solution inside the reference electrode and a higher rate of diffusion.

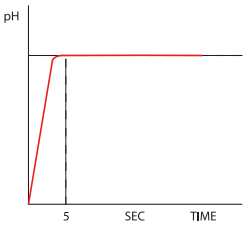
Reference electrodes have both gels and liquid filling solutions (typical for laboratory electrodes). When liquid fill solutions are used, the fill hole on the electrode body must be kept open during measurements to ensure positive head pressure and promote flow of electrolyte through the junction from inside the electrolyte reservoir to the outside of it. This promotes the formation of a good stable liquid junction. Unscrew the fill hole cap during measurements and close it afterward for storage.

The liquid filling solution level should be restored to just below the fill hole level by using the appropriate electrolyte and a syringe. The level should not drop below 50% of the electrode length and should always be above the level of the immersed sensor.

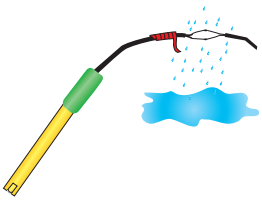
AmpHel®: an Extraordinary Advantage



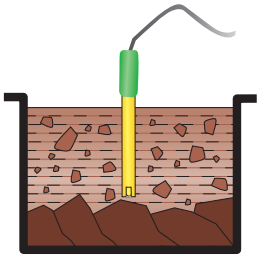
Long Unshielded Cable



Fast and Stable Reponse



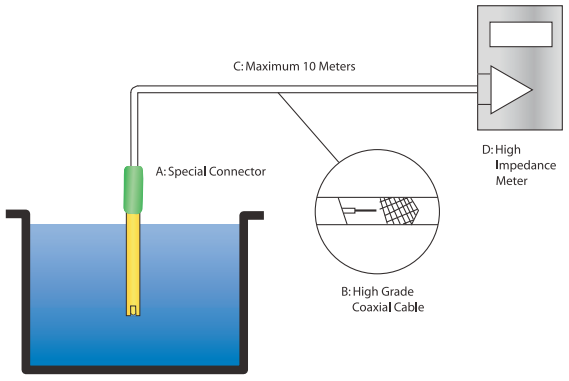
Simple Connection, Immune to Humidity and noise



Minimal Contamination

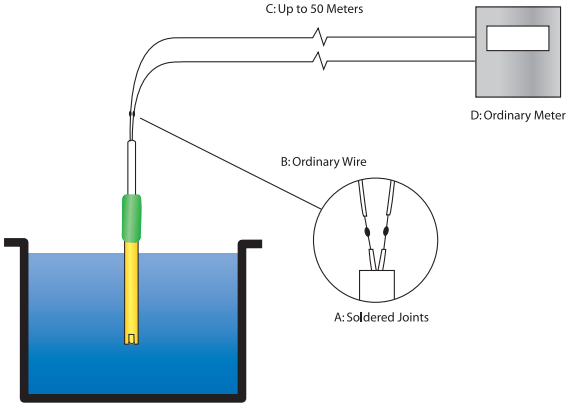
Characteristics and Advantages

- **Combination Ag/AgCl sensor & reference system.**
- **Rugged design with epoxy body housing and sensor protection.**
- **Battery life of 2 years.**
- **Very low output impedance (typically 10 Kohms) for:**
  1) instantaneous response
  2) unsurpassed stability
  3) connections with long unshielded cables (up to 50 meters)
  4) high mechanical and electrical noise immunity
  5) compatibility with existing pH meters in the market
  6) on-line process control applications
- **Double junction reference system for minimization of contamination due to clogged pores or ingress of sample.**
- **Refillable external reference system for versatility and durability.**
- **High flow rate fiber junction for optimum ionic conduction.**
- **Complete pH range from 0 to 14 and from 0 to 80°C.**



Conventional pH Technology

Due to the high resistance of the glass membrane of a pH electrode, conventional pH measuring systems utilize high impedance signal transmission. Bad insulation of the electrode connectors (A) and cables (B) results in high susceptibility to leakage, stray noise and humidity which tends to give erroneous pH readings. As a result, particular care has to be taken in connecting the electrode to the metering system. For this conventional system, the cable length (C) is restricted to typically less than 10 meters because of the low signal transmission. For measurements to be accurate the use of a high impedance meter is required and it is necessary to provide for high insulation in the meter connections. For these reasons, the conventional pH measuring system is delicate.



The Amphel™ Breakthrough

With an amplifier built into the electrode, the problems associated with high impedance is now isolated to one location (see figure on the left). The high impedance circuitry is now located at the top of the electrode which is completely encapsulated. As a result you now have low output impedance signals from the electrode to the metering system. This means you can use ordinary connectors (A) with long unshielded cables (B, C) and an ordinary meter (D). This breakthrough in pH technology provides you with a rugged system for all industrial pH measurements and monitoring.

ORP Electrodes

Similar to the manner in which acidic or alkaline solutions are quantified by pH measurements, solutions can also be graded as oxidizing or reducing ability based on measurements of ORP (sometimes called "REDOX").

When an oxidizing and/or reducing agent is dissolved into an aqueous sample, they may react with materials present and produce a voltage (EMF) that is related to the ratio of oxidized to reduce species in the sample. An electron exchange can develop between this solution and an inert metal sensor immersed in the solution, and the voltage can be measured (when compared to a reference electrode) with a pH/mV meter. This type of measurement is known as redox or ORP. The units of measurement are the mV. At a glance, an ORP electrode may look very similar to a pH electrode. Like a combined pH electrode, both the "sensor" and the reference are housed in a common body. A common use for this type of sensor is as an indicator in an ORP type titration.

The scale of measurement may be positive (indicating oxidizing) or negative (indicating reducing). It should be noted that when zero mV is observed, it is really an oxidizing situation because the reference voltage (~200 mV for an Ag/AgCl with KCl electrolyte) is included in the observed mV value. In some cases the user may wish to offset the reading to remove the reference contribution. The mV is then said to be approaching the absolute mV scale that references a SHE (standard hydrogen electrode). This type of calibration is called relative mV calibration.

An ORP sensor must be chemically inert; it cannot be oxidized or reduced itself. It must also have the proper surface characteristics to promote rapid electron exchange, a property known as high exchange current density. Two noble metals have proven to work well for this purpose. Pure platinum and pure gold are both used in the construction of ORP sensors.

The platinum sensor is often preferred because it is mechanically simpler and safer to produce. Platinum can be welded to glass and has the same thermal coefficient.

Platinum Ring

Platinum Pin

Sensors made of gold cannot be welded to the glass and are often placed in plastic supports applied to the glass or plastic tube by means of tiny elastomeric bungs. The gold or platinum sensor signal is carried through the electrode body, and together with the reference signal is conducted to the measurement meter via a coaxial cable with BNC connector.

An ORP system does not have a high impedance source (like a pH bulb), but is a potentiometric device that produces a voltage (like pH). It also uses similar cables, connectors and calibration solutions. For this reason a high impedance electronic meter (pH) with many user friendly features are a benefit for this measurement also.

Because of the close relationship between pH and ORP, there is a scale that takes into account the ratio (mV) ORP/pH, the rH scale. The rH range varies from 0 to 42, where the extreme values represent the reducing effect of an atmosphere of pure hydrogen (rH=0) and to the oxidizing effect of an atmosphere of pure oxygen (rH=42), respectively.

This is the formula for obtaining the rH value:

$$\mathbf{rH} = \frac{\text{mV}}{0.0992\,(273.14 + \text{T})} + 2\,\text{pH}$$

where T is the temperature (°C) of the sample, mV is the ORP (mV) reading, and pH is the pH value of the sample.

The rH scale is not used in the instruments available on the market and the direct mV reading from the electrode is preferred, within the ±2000 mV range, without compensation/correlation with the pH/temperature value.

ORP Applications

ORP measurements are based on the potential difference measured between the platinum or gold electrode and a reference electrode. The identical reference system utilized for the pH electrode (Ag/AgCl) is also used for redox measurements.

Redox electrodes are used to monitor many chemical processes particularly those involving reversible reactions. Common applications include the following:

Industrial Waste Water Treatment

The redox systems used in water treatment are the reduction of chromates and oxidation of cyanides. Waste hexavalent chromium is reduced to trivalent chromium by the addition of sodium bisulfite or sulphur dioxide. In the case of cyanide, chlorine or sodium hypochlorite is used to oxidize the cyanide, followed by the hydrolysis of cyanogen chloride to form cyanate.

Water Sanitation

ORP measurements are being increasingly used as an effective measure of the sanitizing activity in pool, spa and potable water. The kill time of E.Coli bacteria in water depends on the ORP value. ORP is a reliable indicator of bacteriological water quality. Water having an ORP value equal to or higher than 650 mV are well within accepted bacterial parameter for pool and spa waters.

pH Electrode Application Guide

* Spheric (S) Conic (C) Flat(F)
** Glass (G) Plastic (P) Metal (M)

APPLICATION	RECOMMENDED ELECTRODES	Tip Shape*	Body Material**	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Viscolene Electrolyte	Gel Electrolyte	KCL 3.5M Electrolyte	KCL 3.5M + AgCl Electrolyte	Refillable	"Intelligent"	Temperature Sensor	Amplifier	Pressure (Bar)	PAGE
Acids, Strong	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
Alkaline, Strong	HI 2111B + HI 5311	S	G		•		•				•						0.1	3.90+3.92
Aquariums	HI 1332B/P, HI 1312S	S	P		•		•				•		•				0.1	3.80
Base, Strong	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
Beauty Cream	FC 212D	C	G	•				•	•					•	•	•	0.1	3.85
Beer	HI 1131B/P, HI 1111S	S	G	•			•					•	•				0.1	3.73
Biotechnology (< 100 µl)	HI 1083B/P	S	G	•				•	•								0.1	3.72
Boilers and Cooling Towers	HI 72911D	F	M		•		PTFE			Polymer					•	•	3	3.88
Cheese	FC 100B	S	P		•		•				•		•				0.1	3.81
	FC 240B	C	M	•				•	•								0.1	3.83
	FC 250B	C	G	•				•	•								0.1	3.83
Chemicals	HI 1332B/P, HI 1312S	S	P		•		•				•		•				0.1	3.80
Conductivity, Low	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
	HI 1617D	C	G	•			•					•	•	•	•	•	0.1	3.76
Conductivity, High	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
Creams	FC 211D, FC 213D	C	G	•				•	•						•	•	0.1	3.82
	FC 210B	C	G		•			•	•								0.1	3.82
	FC 220B	S	G	•			•					•	•				0.1	3.82
	FC 212D	C	G	•				•	•					•	•	•	0.1	3.85
	FC 911B	S	P		•		•				•					•	0.1	3.84
Dairy Products	HI 2031B, HI 2020S	C	G	•			•					•	•				0.1	3.75
	FC 211D	C	G	•				•	•						•	•	0.1	3.82
	FC 200B/S	C	P	•				•	•								0.1	3.81
	FC 240B	C	M	•				•	•								0.1	3.83
	FC 250B	C	G	•				•	•								0.1	3.83
	FC 201D, FC 202D	C	P	•				•	•					•	•	•	0.1	3.85
Emulsions	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
	HI 1617D	C	G	•			•					•	•	•	•	•	0.1	3.76
	HI 1612D	C	G	•			•					•	•		•	•	0.1	3.79
	HI 1413B, HI 1410S	F	G	•				•	•								0.1	3.87
	HI 1414D	F	G	•				•	•						•	•	0.1	3.87
Environmental	HI 1217-6D	S	P	•			•			•					•	•	2	3.79
Fats and Creams	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
	HI 1617D	C	G	•			•					•	•	•	•	•	0.1	3.76
Flasks	HI 1331B, HI 1311S	S	G	•			•					•	•				0.1	3.74
Fluoride, Samples with	HI 1143B	S	G		•		•				•		•				0.1	3.73
Food Industry (General Use)	FC 100B	S	P		•		•				•		•				0.1	3.81
	FC 911B	S	P		•		•				•		•			•	0.1	3.84
Food, Semi Solid	FC 201D, FC 202D	C	P	•				•	•					•	•	•	0.1	3.85
	FC 200B/S	C	P	•				•	•								0.1	3.81

*Unsure about which electrode to choose? Give your local HANNA office a call for assistance.

pH Electrode Application Guide

* Spheric (S) Conic (C) Flat(F)
** Glass (G) Plastic (P)

APPLICATION	RECOMMENDED ELECTRODES	Tip Shape*	Body Material**	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Viscolene Electrolyte	Gel Electrolyte	KCL 3.5M Electrolyte	KCL 3.5M + AgCl Electrolyte	Refillable	"Intelligent"	Temperature Sensor	Amplifier	Pressure (Bar)	PAGE
Fruit	FC 200B/S	C	P	•				•	•								0.1	3.81
	FC 230B	C	P	•				•	•								0.1	3.83
	FC 202D	C	P	•				•	•						•	•	0.1	3.85
Fruit Juices, Organic	FC 220B	S	G	•			•					•	•				0.1	3.82
	FC 911B	S	P		•		•				•		•			•	0.1	3.84
Frozen, Semi	FC 230B	C	P	•				•	•								0.1	3.83
Ham and Sausages	FC 200B/S	C	P	•				•	•								0.1	3.81
	FC 202D	C	P	•				•	•						•	•	0.1	3.85
	FC 230B	C	P	•				•	•								0.1	3.83
Horticulture and Nurseries	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
	HI 1292D	C	G	•			•					•	•		•	•	0.1	3.87
Humidity, High	FC 911B	S	P		•		•				•		•			•	0.1	3.84
Hydrocarbon	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
Laboratory (General Use)	HI 1131B/P, HI 1111S	S	G	•			•					•	•				0.1	3.73
	HI 1230B, HI 1210S	S	P		•		•			•							2	3.74
	HI 1615D	S	G	•			•					•	•	•	•	•	0.1	3.76
	HI 1618D	S	P	•		•				•				•	•	•	3	3.76
	HI 1217D/S, HI 1217-6D	S	P	•			•			•					•	•	2	3.79
	HI 12170	S	P	•			•			•					•		2	3.89
	HI 1610D	S	G	•			•					•	•		•	•	0.1	3.79
	HI 1332B/P, HI 1312S	S	P		•		•				•		•				0.1	3.80
	HI 1333B	S	P		•		•				•		•				0.1	3.89
	HI 2112 + HI 5311	S	G		•		•				•		•				0.1	3.90+3.92
	HI 1010S	S	G	•			•					•	•				0.1	3.73
	HI 1110B	S	G	•			•			•							2	3.89
	HI 1211S	S	P	•			•					•	•				0.5	3.74
Leather	HI 1413B, HI 1410S	F	G	•				•	•								0.1	3.87
	HI 1414D	F	G	•				•	•						•	•	0.1	3.87
Meat	FC 230B	C	P	•				•	•								0.1	3.83
	FC 400B, FC 204B	C	P	•				•	•								0.1	3.84
	FC 231D, FC 232D	C	P	•				•	•					•	•	•	0.1	3.85
	FC 431D	C	P		•			•	•					•	•	•	0.1	3.86
	FC 201D, FC 202D	C	P	•				•	•					•	•	•	0.1	3.85
Milk and Yogurt	FC 211D, FC 213D	C	G	•				•	•						•	•	0.1	3.82
	FC 200B/S	C	P	•				•	•								0.1	3.81
	FC 210B	C	G		•			•	•								0.1	3.82
	FC 201D, FC 202D	C	P	•				•	•					•	•	•	0.1	3.85
	FC 212D	C	G	•				•	•					•	•	•	0.1	3.85
Monitoring, Continuous	HI 1135B	S	G		•		•				•		•				3	3.73
	HI 1616D	S	G	•			•			•				•	•	•	2	3.76
	HI 1611D	S	G	•			•			•					•	•	2	3.79
NMR Tubes	HI 1093B	S	G	•			•		•								0.1	3.72
Paint	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72

pH Electrode Application Guide

* Spheric (S) Conic (C) Flat(F)
** Glass (G) Plastic (P) Metal (M)

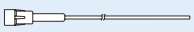
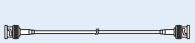
APPLICATION	RECOMMENDED ELECTRODES	Tip Shape*	Body Material**	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Viscolene Electrolyte	Gel Electrolyte	KCL 3.5M Electrolyte	KCL 3.5M + AgCl Electrolyte	Refillable	"Intelligent"	Temperature Sensor	Amplifier	Pressure (Bar)	PAGE
Paper	HI 1413B, HI 1410S	F	G	•				•	•								0.1	3.72
	HI 1414D	F	G	•				•	•						•	•	0.1	3.87
Photographic Chemicals	HI 1230B, HI 1210S	S	P		•		•			•								3.74
Plating Baths	HI 62911D	F	M		•		PTFE				Polymer				•	•	3	3.88
Quality Control	HI 1332B/P, HI 1312S	S	P		•		•				•		•				0.1	3.80
Sauces	FC 220B	S	G	•			•					•	•				0.1	3.82
	FC 911B	S	P		•		•				•		•			•	0.1	3.84
Seawater	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
Semi-solid Products	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
	HI 1617D	C	G	•			•					•	•	•	•	•	0.1	3.76
	HI 1612D	C	G	•			•					•	•		•	•	0.1	3.79
	FC 200B/S	C	P	•				•	•								0.1	3.81
	FC 201D, FC 202D	C	P	•				•	•					•	•	•	0.1	3.85
	HI 2031B, HI 2020S	C	G	•			•					•	•				0.1	3.75
Skin, Scalp	HI 1413B, HI 1410S	F	G	•				•	•								0.1	3.87
	HI 1413B/50, HI 1413S/50	F	G	•				•	•								0.1	3.87
	HI 1414D/50	F	G	•				•	•						•	•	0.1	3.87
Soil, Direct	HI 1292D	C	G	•			•					•	•		•	•	0.1	3.87
Soil Samples	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
	HI 1230B, HI 1210S	S	P		•		•			•							2	3.74
	HI 1617D	C	G	•			•					•	•	•	•	•	0.1	3.76
	HI 1292D	C	G	•			•					•	•		•	•	0.1	3.87
Solvents	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
Surface Measurements	HI 1413B, HI 1410S	F	G	•				•	•								0.1	3.87
	HI 1414D	F	G	•				•	•						•	•	0.1	3.87
Swimming Pools	HI 1297D	C	M	•		•				•					•	•	3	3.87
	HI 1134B/3, HI 1134B/5, HI 1114S	S	P		•	•				•							3	3.75
Titration	HI 2110B + HI 5311	S	G		•		•				•		•				0.1	3.90+3.92
Tris Buffer	HI 1043B/P, HI 1040S	S	G		•		•				•		•				0.1	3.72
	HI 1144B	S	G	•			•				•		•				0.1	3.74
	HI 1343B	S	P	•			•				•						0.1	3.75
Vials and Test tubes	HI 1330B/P, HI 1310S	S	G	•			•				•		•				0.1	3.75
Wastewater	HI 1296D	S	M	•		•				•					•	•	3	3.88
	HI 1297D	C	M	•		•				•					•	•	3	3.88
Water, High Purity	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
Water, Mineral	HI 1153B	S	G		•		•				•		•				0.1	3.84
Water, Municipal	HI 1297D	S	M	•		•				•					•	•	3	3.88
Water, Potable	HI 1053B/P, HI 1050S	C	G	•			•					•	•				0.1	3.72
Water Treatment	HI 1297D	C	M	•		•				•					•	•	3	3.88
Wine and Must	HI 1048B/P	S	G		•			•			•		•				0.1	3.84

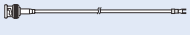
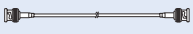
ORP Electrode Application Guide

* Platinum (Pt) Gold (Gl)
** Glass (G) Plastic (P) Metal (M)

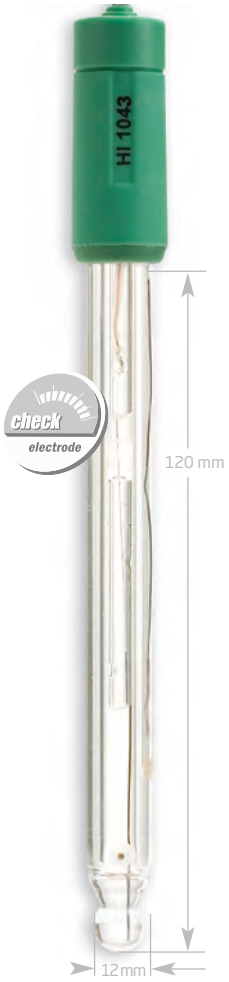
APPLICATION	RECOMMENDED ELECTRODES	Pin Material*	Body Material**	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Gel Electrolyte	KCL 3.5M Electrolyte	KCL 3.5M + AgCl Electrolyte	Refillable	"Intelligent"	Temperature Sensor	Amplifier	Pressure (Bar)	PAGE
Disinfection	HI 3619D	Pt	G	•			•				•	•	•		•	0.1	3.77
Disinfection, with Ozone	HI 4619D	Gl	G	•			•		•					•	•	2	3.78
Laboratory (General Use)	HI 3131B/P, HI 3111S	Pt	G	•			•				•	•				0.1	3.78
	HI 3619D	Pt	G	•			•				•	•	•		•	0.1	3.77
	HI 3618D	Pt	G	•			•				•	•		•	•	0.1	3.78
	HI 3620D	Pt	P	•			•		•				•		•	2	3.77
	HI 3133B (half cell)	Pt	G														3.91
Oxidants	HI 4430B, HI 4410S	Gl	P	•			•		•							2	3.80
Oxidants, Strong	HI 4619D	Gl	G	•			•		•					•	•	2	3.78
Ozone	HI 4430B, HI 4410S	Gl	P	•			•		•							2	3.80
Plating Baths	HI 4110S	Gl	G	•			•		•							2	3.78
	HI 3410S	Pt	M		•	•			•							3	3.88
Quality Control	HI 3230B, HI 3210S	Pt	P	•			•		•							2	3.80
Swimming Pools	HI 3620D	Pt	P	•			•		•				•		•	2	3.77
Titrations, Argentometric	HI 5110B (half cell)	Gl	G														3.91
Titrations, ORP	HI 3131B/P, HI 3111S	Pt	G	•			•				•	•				0.1	3.78
Titrations, Potentiometric	HI 3133B (half cell)	Pt	G														3.91
Water, Municipal	HI 3230B, HI 3210S	Pt	P	•			•		•							2	3.80
Wine	HI 3148B	Pt	G		•			•		•		•				0.1	3.86

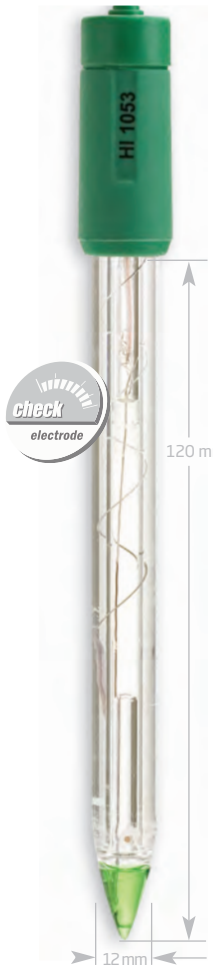
Electrode Extension Cables

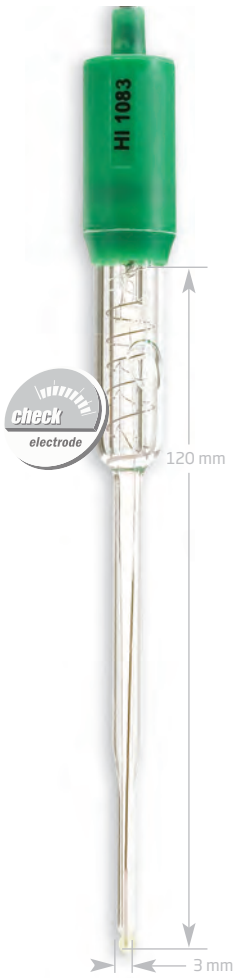
PART #	CABLE LENGTH	CABLES / CONNECTORS	DESCRIPTION
HI 7854/1 HI 7854/3 HI 7854/5 HI 7854/10 HI 7854/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with screw type connectors
HI 7855/1 HI 7855/3 HI 7855/5 HI 7855/10 HI 7855/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with screw type and BNC connectors
HI 7856/1 HI 7856/3 HI 7856/5 HI 7856/10 HI 7856/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with screw type and US Standard connectors
HI 7857/1 HI 7857/3 HI 7857/5 HI 7857/10 HI 7857/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with screw type and DIN connectors
HI 7858/1 HI 7858/3 HI 7858/5 HI 7858/10 HI 7858/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with BNC connectors

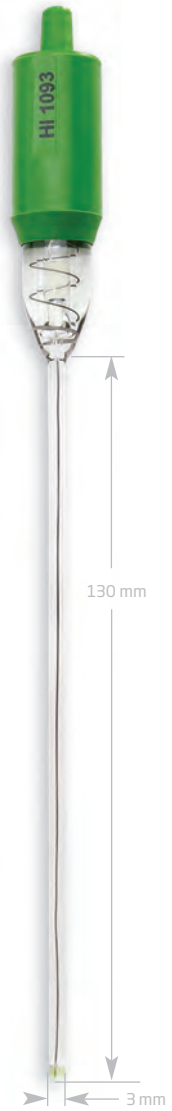
PART #	CABLE LENGTH	CABLES / CONNECTORS	DESCRIPTION
HI 7859/1 HI 7859/3 HI 7859/5 HI 7859/10 HI 7859/15	1 m (3.3') 3 m (9.9') 5 m (16.5) 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with BNC and DIN connectors
HI 7860/1 HI 7860/3 HI 7860/5 HI 7860/10 HI 7860/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with BNC and US Standard connectors
HI 7861/1 HI 7861/3 HI 7861/5 HI 7861/10 HI 7861/15	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		3.0 mm (0.12") cable with BNC and spade lug connectors
HI 778P/1 HI 778P/3 HI 778P/5 HI 778P/10 HI 778P/15 HI 778P/50	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5') 50 m (164')		5.0 mm (0.2") cable with screw type connectors
HI 778P/1B HI 778P/3B HI 778P/5B HI 778P/10B HI 778P/15B	1 m (3.3') 3 m (9.9') 5 m (16.5') 10 m (33') 15 m (49.5')		5.0 mm (0.2") cable with BNC type connectors

Combination pH and ORP Electrodes









CODE	HI 104XX	HI 105XY	HI 1083X	HI 1093B
Description	refillable, combination pH electrode w/ double junction	refillable, combination pH electrode w/ conical tip	combination pH electrode w/ micro bulb for small samples	combination pH electrode w/ extended length and micro bulb
Reference	double, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, triple / 40-50 µL/h	open	open
Electrolyte	KCl 3.5M	KCl 3.5M + AgCl	viscolene	viscolene
Max Pressure	0.1 bar	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 14	pH: 0 to 12	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	30 to 85°C (86 to 185°F)	-5 to 30°C (23 to 86°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	spheric (dia: 9.5 mm)	conic (12 x 12 mm)	spheric (dia: 3 mm)	spheric (dia: 3 mm)
Temperature Sensor	no	no	no	no
Amplifier	no	no	no	no
Body Material	glass	glass	glass	glass
Cable**	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	hydrocarbon, paints, solvents, sea water, strong acid and base, high conductivity samples, Tris buffer	fats and creams, soil samples, potable water, semi solid products, low conductivity solutions, emulsions	biotechnology, samples < 100 µl	NMR tubes

* For pH meters with CAL CHECK™ system
** Not for screw cap models.

CONNECTION	
HI 1043B	BNC
HI 1043D	DIN
HI 1043U	US standard
HI 1040S	screw cap
HI 1043P	BNC + pin*

CONNECTION	
HI 1053B	BNC
HI 1053P	BNC + pin*
HI 1050S	screw cap
HI 1053D	DIN
HI 1053U	US standard

CONNECTION	
HI 1083B	BNC
HI 1083P	BNC + pin*
HI 1083D	DIN
HI 1083U	US standard

CONNECTION	
HI 1093B	BNC

HANNA instruments

With Great Products, Come Great Results™

Combination pH and ORP Electrodes

CODE	HI 1010S • HI 1111S	HI 1131X	HI 1135B	HI 1143X
Description	refillable, combination pH electrode	refillable, combination pH electrode	refillable, combination pH electrode side arm construction & fast flow rate	refillable, combination pH electrode for fluoride applications
Reference	single, Ag/AgCl	single, Ag/AgCl	double, Ag/AgCl	double, Ag/AgCl
Junction / Flow Rate	ceramic, double / 30-40 µL/h	ceramic, single / 15-20 µL/h	ceramic, double / 30-40 µL/h	ceramic, single / 15-20 µL/h
Electrolyte	KCl 3.5M + AgCl	KCl 3.5M + AgCl	KCl 3.5M	KCl 3.5M
Max Pressure	0.1 bar	0.1 bar	3 bar with back pressure	0.1 bar
Range	pH: 0 to 13	pH: 0 to 13	pH: 0 to 14	pH: 0 to 10
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	30 to 85°C (104 to 185°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	spheric (dia: 9.5 mm)	spheric (dia: 9.5 mm)	spheric (dia: 9.5 mm)	spheric (dia: 9.5 mm)
Temperature Sensor	no	no	no	no
Amplifier	no	no	no	no
Body Material	glass	glass	glass	glass
Cable**	–	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	laboratory general purpose	laboratory general purpose, beer	continuous monitoring with remote filling	samples with fluoride (max 2 g/L @ pH 2 and temperature < 60°C)

* For pH meters with CAL CHECK™ system
** Not for screw cap models.

CONNECTION	
HI 1010S	screw cap
HI 1111S	screw cap

CONNECTION	
HI 1131B	BNC
HI 1131P	BNC + pin*
HI 1131D	DIN
HI 1131U	US standard

CONNECTION	
HI 1135B	BNC

CONNECTION	
HI 1143B	BNC
HI 1143D	DIN

Laboratory • Combination pH and ORP Electrodes

CODE	HI 1144X	HI 12X0Y	HI 1211S	HI 13X1Y
Description	refillable, combination pH electrode with calomel references	combination pH electrode	pH electrode	combination pH electrode
Reference	single, Hg/Hg_2Cl_2	double, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic / 15-20 µL/h	ceramic, single / 15-20 µL/h	ceramic, single / 15-20 µL/h	ceramic, single / 15-20 µL/h
Electrolyte	KCl 3.5M	gel	KCl 3.5M + AgCl	KCl 3.5M + AgCl
Max Pressure	0.1 bar	2 bar	0.1 bar	0.1 bar
Range	pH: 0 to 14	pH: 0 to 13	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	spheric (dia: 9.5 mm)	spheric (dia: 7.5 mm)	spheric (dia: 7.5 mm)	spheric (dia: 7.5 mm)
Temperature Sensor	no	no	no	no
Amplifier	no	no	no	no
Body Material	glass	PEI	PEI	glass
Cable**	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	–	coaxial; 1 m (3.3')
Recommended Use	tris buffer	field applications	general purpose	specific for flasks

** Not for screw cap models.

CONNECTION	
HI 1144B	BNC
HI 1144D	DIN

CONNECTION	
HI 1230B	BNC
HI 1210S	screw cap
HI 1230D	DIN
HI 1230U	US standard

CONNECTION	
HI 1211S	screw cap

CONNECTION	
HI 1331B	BNC
HI 1311S	screw cap
HI 1331D	DIN
HI 1331U	US standard

Laboratory • Combination pH and ORP Electrodes

CODE	HI 13X0Y	HI 1343X	HI 11X4Y(/Z)	HI 20XYZ
Description	combination pH electrode	combination pH electrode	combination pH electrode	refillable, conical tip combination pH electrode
Reference	single, Ag/AgCl	single, Hg/Hg_2Cl_2	double, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, single / 15-20 µL/h	cloth	ceramic, single / 15-20 µL/h
Electrolyte	KCl 3.5M + AgCl	KCl 3.5M	gel	KCl 3.5M + AgCl
Max Pressure	0.1 bar	0.1 bar	3.0 bar	0.1 bar
Range	pH: 0 to 12	pH: 0 to 14	pH: 0 to 13	pH: 0 to 12
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	spheric (dia: 5 mm)	spheric (dia: 7.5 mm)	spheric (dia: 7.5 mm)	conic (6 x 10 mm)
Temperature Sensor	no	no	no	no
Amplifier	no	no	no	no
Body Material	glass	PEI	PEI	glass
Cable**	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 3 m (9.8'); /5: 5 m (16')	coaxial; 1 m (3.3')
Recommended Use	specific for vials and test tubes	specific for Tris buffer	swimming pools	dairy and semi-solid products

* For pH meters with CAL CHECK™ system
** Not for screw cap models.

CONNECTION	
HI 1330B	BNC
HI 1330P	BNC + pin*
HI 1310S	screw cap
HI 1330D	DIN
HI 1330U	US standard

CONNECTION	
HI 1343B	BNC
HI 1343D	DIN

CONNECTION	
HI 1134B/3	BNC
HI 1134B/5	BNC
HI 1114S	screw cap

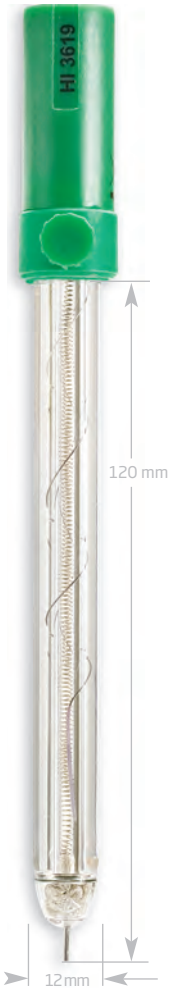
CONNECTION	
HI 2031B	BNC
HI 2020S	screw cap
HI 2031D	DIN
HI 2031U	US standard

Laboratory • pH and ORP SMART Electrodes

CODE	H 1615D	HI 1616D	HI 1617D	HI 1618D
Description	pH electrode	pH electrode	pH electrode	pH electrode
Reference	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, single	ceramic, triple / 40-50 µL/h	cloth
Electrolyte	KCl 3.5M + AgCl	gel	KCl 3.5M + AgCl	gel
Max Pressure	0.1 bar	up to 2 bar	0.1 bar	2 bar
Range	pH: 0 to 13	pH: 0 to 14	pH: 0 to 12	pH: 0 to 13
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	-5 to 30°C (23 to 86°F)	20 to 40°C (68 to 104°F)
Tip /Shape	spheric (dia: 9.5 mm)	spheric (dia: 9.5 mm)	conic (12 x 12 mm)	spheric (dia: 5 mm)
Temperature Sensor	yes	yes	yes	yes
Amplifier	yes	yes	yes	yes
Body Material	glass	glass	glass	PEI
Cable**	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')
Recommended Use	laboratory general use	continuous monitoring	fats and creams, soil samples, semi solid products, low conductivity solutions, emulsions	field applications

* Recommended for use with HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.

CONNECTION		CONNECTION		CONNECTION		CONNECTION	
HI 1615D	7-pin DIN*	**HI 1616D**	7-pin DIN*	**HI 1617D**	7-pin DIN*	**HI 1618D**	7-pin DIN*



Smart Electrodes

HANNA's SMART electrodes incorporate microchips that memorize calibration data.

The SMART electrode is recognized the moment it is connected to the meter. Once calibrated, several electrodes can be used in series without requiring new calibration. The meter can provide timely prompts about electrode status and even decide when to replace it. These SMART pH electrodes also incorporate a temperature sensor for Automatic Temperature Compensation.

Installing and checking ORP electrodes

ORP electrodes can be used on any HANNA pH/ORP meter.

1) After removing the protective cap from the electrode and opening the fill hole cover, soak the tip in warm tap water. This will enhance the flow of the reference junction.

2) To check the function of the electrode, immerse the tip in HI 7020 ORP test solution. The value should be between 200 and 275 mV. Oxidizing or reduction treatment with HI 7092 or HI 7091 will prepare the electrode's surface and speed initial response time.

ORP for sanitation

ORP measurements are used as an effective measure of the sanitation of pool, spa and potable water. E. Coli bacteria presence in water depends on the ORP value. ORP is a reliable indicator of bacteriological water quality.

CODE	HI 3619D	HI 3620D
Description	ORP electrode	ORP electrode
Reference	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, single
Electrolyte	KCl 3.5M + AgCl	gel
Max Pressure	0.1 bar	2 bar
Range	ORP: ±2000 mV	ORP: ±2000 mV
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	platinum pin	platinum pin
Temperature Sensor	no	no
Amplifier	yes	yes
Body Material	glass	PEI
Cable**	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')
Recommended Use	laboratory general use, disinfection	field applications, swimming pools

* Recommended for use with HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.

CONNECTION	
HI 3619D	DIN*

CONNECTION	
HI 3620D	DIN*

Laboratory • Special ORP Electrodes

CODE	HI 3618D	HI 31X1Y	HI 4619D	HI 4110S
Description	ORP combination electrode	refillable combination ORP electrode	ORP combination electrode	ORP combination electrode
Reference	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, single / 15-20 µL/h	ceramic, single	ceramic, single
Electrolyte	KCl 3.5M + AgCl	KCl 3.5M + AgCl	gel	gel
Max Pressure	0.1 bar	0.1 bar	2 bar	1.5 bar
Range	ORP: ±2000 mV	ORP: ±2000 mV	ORP: ±2000 mV	ORP: ±2000 mV
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	platinum pin	platinum pin	gold pin	gold pin
Temperature Sensor	yes	no	yes	no
Amplifier	yes	no	yes	no
Body Material	glass	glass	glass	glass
Cable**	5-pole; 1 m (3.3')	coaxial; 1 m (3.3')	5-pole; 1 m (3.3')	–
Recommended Use	laboratory	laboratory general use, ORP titrations	strong oxidants, disinfection with ozone	plating baths

* For pH meters with CAL CHECK™ system
** Not for screw cap models.

CONNECTION

HI 3618D DIN

Recommended for use with HI 8314 pH meter.

CONNECTION

HI 3131B BNC
HI 3131P BNC + pin*
HI 3111S screw cap
HI 3131D DIN
HI 3131U US standard

CONNECTION

HI 4619D DIN

Recommended for use with HI 8314 pH meter.

CONNECTION

HI 4110S screw cap

HANNA instruments

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Laboratory • Electrodes with Temperature Sensor

CODE	HI 1217X	HI 1610D	HI 1611D	HI 1612D
Description	pH electrode	pH electrode	pH electrode	pH electrode
Reference	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single	ceramic, single / 15-20 µL/h	ceramic, single	ceramic, triple / 40-50 µL/h
Electrolyte	gel	KCl 3.5M + AgCl	gel	KCl 3.5M + AgCl
Max Pressure	2 bar	0.1 bar	2 bar	0.1 bar
Range	pH: 0 to 13	pH: 0 to 13	pH: 0 to 14	pH: 0 to 12
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (86 to 104°F)	30 to 85°C (104 to 185°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	spheric (dia: 5.0 mm)	spheric (dia: 9.5 mm)	spheric (dia: 9.5 mm)	conic (12 x 12 mm)
Temperature Sensor	yes	yes	yes	yes
Amplifier	yes	yes	yes	yes
Body Material	PEI	glass	glass	glass
Cable**	5-pole; 1 m (3.3')	5-pole; 1 m (3.3')	5-pole; 1 m (3.3')	5-pole; 1 m (3.3')
Recommended Use	general purpose	laboratory general use	continuous monitoring	emulsions, semi solid samples

CONNECTION	CONNECTION	CONNECTION	CONNECTION
HI 1217D DIN ***	HI 1610D DIN	HI 1611D DIN	HI 1612D DIN
HI 1217S screw cap ‡			
Recommended for use with HI 8314 pH meter.			

*** To be used with HI 8314 pH meter.
‡ To be used with HI 9214

Rugged pH and ORP Electrodes

CODE	HI 13X2Y	HI 32X0Y	HI 44X0Y
Description	pH electrode	ORP electrode	gel filled, combination ORP electrode with gold contact
Reference	double, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, single	ceramic, single
Electrolyte	KCl 3.5M	gel	gel
Max Pressure	0.1 bar	2 bar	2 bar
Range	pH: 0 to 13	ORP: ±2000 mV	ORP: ±2000 mV
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	spheric (dia: 7.5 mm)	platinum pin	gold pin
Temperature Sensor	no	no	no
Amplifier	no	no	no
Body Material	PEI	PEI	PEI
Cable**	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	chemicals, field applications, quality control	municipal water, quality control	oxidants, ozone

* For pH meters with CAL CHECK™ system
** Not for screw cap models.

CONNECTION	
HI 1332B	BNC
HI 1332P	BNC + pin*
HI 1312S	screw cap
HI 1332D	DIN
HI 1332U	US standard

CONNECTION	
HI 3230B	BNC
HI 3210S	screw cap
HI 3230D	DIN
HI 3230U	US standard

CONNECTION	
HI 4430B	BNC
HI 4410S	screw cap
HI 4430D	DIN
HI 4430U	US standard

HANNA instruments

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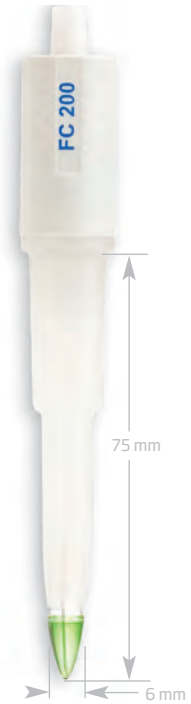


CODE	FC 100X	FC 200X	FC 430B
Description	pH electrode	pH electrode	combination pH electrode with PVDF outer body
Reference	double, Ag/AgCl	single, Ag/AgCl	double, Ag/AgCl
Junction / Flow Rate	ceramic, single / 15-20 µL/h	open	open
Electrolyte	KCl 3.5M	viscolene	viscolene
Max Pressure	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 13	pH: 0 to 12	pH: 0 to 12
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	spheric (dia: 7.5 mm)	conic (6 x 10 mm)	conic (6 x 10 mm)
Temperature Sensor	no	no	no
Amplifier	no	no	no
Body Material	PVDF	PVDF	PVDF
Cable**	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')*	coaxial; 1 m (3.3')
Recommended Use	cheese	milk, yogurt, dairy products, semi solid foods	meat, semi frozen products

** Not for screw cap models.

CONNECTION	
FC 100B	BNC
FC 100D	DIN
FC 100U	US standard

CONNECTION	
FC 200B	BNC
FC 200S	screw cap
FC 200D	DIN
FC 200G	DIN, green cap
FC 200U	US standard

CONNECTION	
FC 430B	BNC

Food Industry • Electrodes for Specific Use

CODE	FC 210X	FC 211D	FC 213D	FC 220X
Description	pH electrode	pH electrode	pH electrode	pH electrode
Reference	double, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	open	open	open	ceramic, triple / 40-50 µL/h
Electrolyte	viscolene	viscolene	viscolene	KCl 3.5M + AgCl
Max Pressure	0.1 bar	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	-5 to 30°C (23 to 86°F)	-5 to 30°C (23 to 86°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	conic (12 x 12 mm)	conic (12 x 12 mm)	conic (12 x 12 mm)	spheric (dia: 9.5 mm)
Temperature Sensor	no	yes	yes	no
Amplifier	no	yes	yes	no
Body Material	glass	glass	glass	glass
Cable	coaxial; 1 m (3.3')	5-pole; 1 m (3.3')	7-pole; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	milk, yogurt, creams	milk, yogurt, cream	milk, yogurt, cream	creams, fruit juices, sauces

CONNECTION	
FC 210B	BNC
FC 210D	DIN
FC 210U	US standard

CONNECTION	
FC 211D	DIN

Recommended for use with HI 9210N and HI 8314 pH meters.

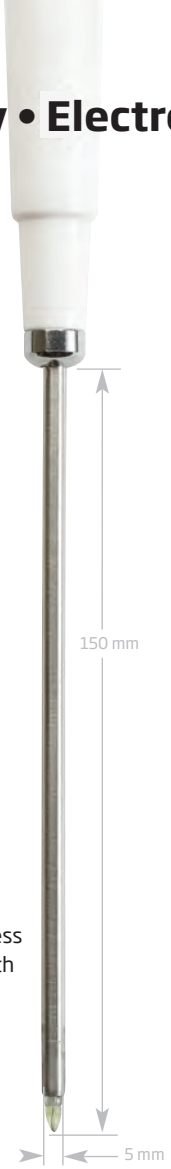
CONNECTION	
FC 213D	DIN

Recommended for use with HI 99161N pH meter.

CONNECTION	
FC 220B	BNC
FC 220D	DIN
FC 220U	US standard

Food Industry • Electrodes for Specific Use

FC 098 and FC 099 stainless steel blades for meat penetration (optional)



AISI stainless steel sheath

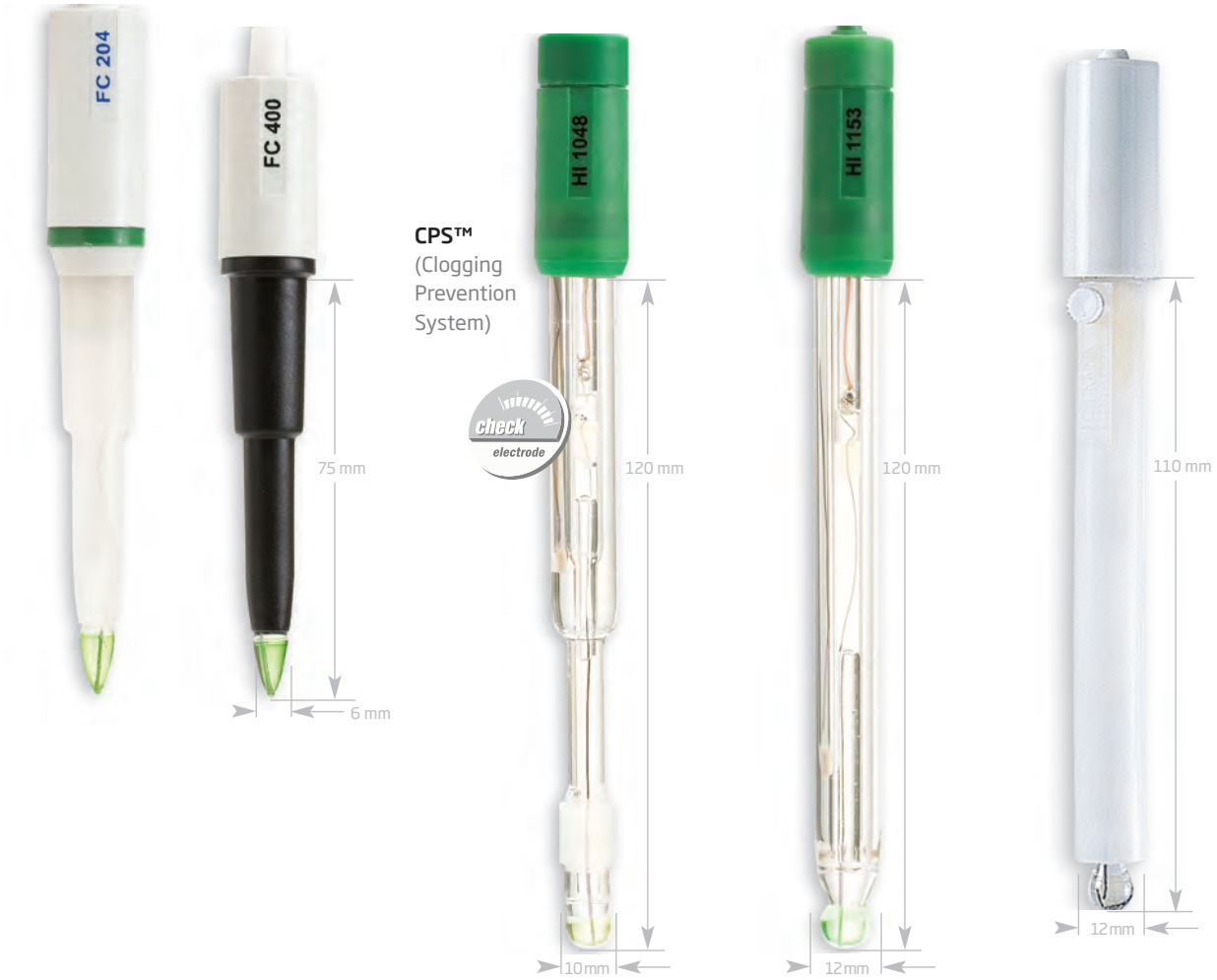
CODE	FC 230X	FC 240B	FC 250B
Description	combination pH electrode with PVDF outer body	combination pH electrode with stainless steel sheath	combination pH electrode with long, thin body
Reference	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	open	open	open
Electrolyte	viscolene	viscolene	viscolene
Max Pressure	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 12	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	conic (6 x 10 mm)	conic (3 x 5 mm)	conic (3 x 5 mm)
Temperature Sensor	no	no	no
Amplifier	no	no	no
Body Material	PVDF	AISI 316	glass
Cable	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	meat, semi frozen products	dairy products, cheese quality control	dairy products, semi mature cheese

CONNECTION	
FC 230B	BNC
FC 230D	DIN
FC 230U	US standard

CONNECTION	
FC 240B	BNC

CONNECTION	
FC 250B	BNC

Food Industry • Electrodes for Specific Use



CODE	FC 400X	HI 1048X	HI 1153X	FC 911X
Description	pH electrode	pH electrode with CPS™ (Clogging Prevention System)	pH electrode	pH electrode with amplifier
Reference	double, Ag/AgCl	double, Ag/AgCl	double, Ag/AgCl	double, Ag/AgCl
Junction / Flow Rate	open	open, CPS™	ceramic, triple / 40-50 µL/h	ceramic, single / 15-20 µL/H
Electrolyte	viscolene	KCl 3.5M	KCl 3.5M	KCl 3.5M
Max Pressure	0.1 bar	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 12	pH: 0 to 13	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	-5 to 30°C (23 to 86°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	conic (6 x 10 mm)	spheric (dia: 8 mm)	spheric (dia: 9.5 mm)	spheric (dia: 7.5 mm)
Temperature Sensor	no	no	no	no
Amplifier	no	no	no	yes
Body Material	PVDF	glass	glass	PVDF
Cable**	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	meat	wine, must	mineral water	creams, fruit juices, sauces

* For pH meters with CAL CHECK™ system
** Not for screw cap models.

CONNECTION	
FC 400B	BNC
FC 400D	DIN
FC 204B	BNC

CONNECTION	
HI 1048B	BNC
HI 1048B/50	BNC
HI 1048P	BNC + PIN*
HI 1048S	scew cap
HI 1048D	DIN

CONNECTION	
HI 1153B	BNC
HI 1153D	DIN

CONNECTION	
FC 911B	BNC
FC 911D	DIN
FC 911U	US standard

Food Industry • SMART Electrodes

CODE	FC 20XD	FC 40XD	FC 212D	FC 23XY
Description	pH SMART electrode	pH SMART electrode	pH SMART electrode	pH SMART electrode
Reference	single, Ag/AgCl	double, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	open	open	open	open
Electrolyte	viscolene	viscolene	viscolene	viscolene
Max Pressure	0.1 bar	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	-5 to 30°C (23 to 86°F)	-5 to 30°C (23 to 86°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	conic (6 x 10 mm)	conic (6 x 10 mm)	conic (12 x 12 mm)	conic (6 x 10 mm)
Temperature Sensor	yes	yes	yes	yes
Amplifier	yes	yes	yes	yes
Body Material	PVDF	PVDF	glass	PVDF
Cable	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')
Recommended Use	milk, yogurt, dairy products, meat, semi solid foods	milk, yogurt, dairy products, meat, semi solid foods	milk, yogurt, creams	meat

CONNECTION	
FC 201D	DIN †
FC 202D	DIN ‡
FC 203D	7-pin DIN

† Recommended for use with HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.
‡ Recommended for use with HI 99161 pH meter.

CONNECTION	
FC 401D	DIN †
FC 402D	DIN ‡

† Recommended for use with HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.
‡ Recommended for use with HI 99161 pH meter.

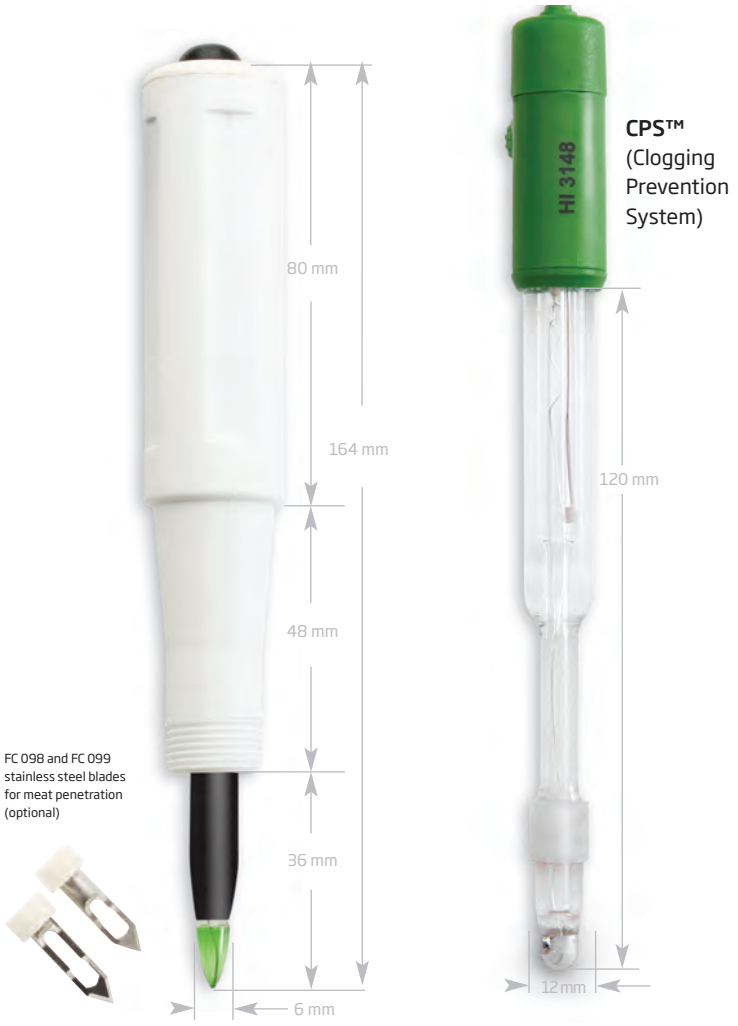
CONNECTION	
FC 212D	DIN

Recommended for use with HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.

CONNECTION	
FC 231D	DIN †
FC 232D	DIN ‡

† Recommended for use with the HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.
‡ Recommended for use with HI 99163 pH meter.

Food Industry • SMART Electrodes

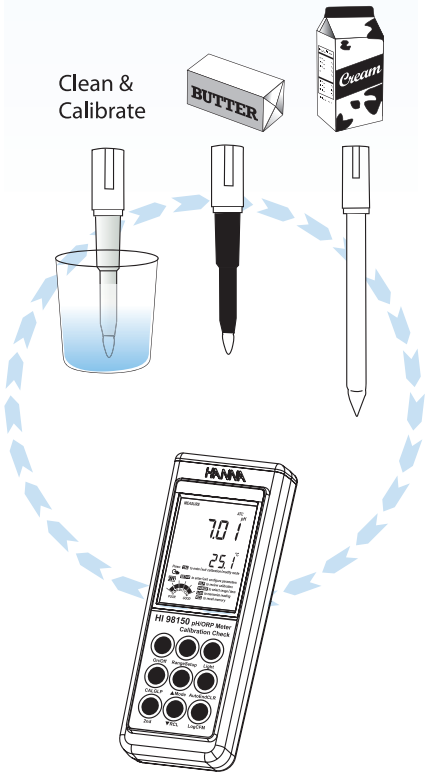


SMART Electrodes and the Food Industry

Smart electrodes are useful for users who have to measure several samples a day and do not have time for cleaning and recalibration; for example in the milk and dairy industry, where cross contamination has to be avoided and dirty bulbs may occur frequently.

By simply changing from one electrode to another for each batch, you can avoid cross contamination and measure samples accurately and efficiently.

SMART electrodes contain an embedded microchip inside to retain calibration data and assign an identity code to the host unit. As soon as a SMART electrode is connected to the host pH meter, they are recognized. Each time a SMART electrode is exchanged for another SMART electrode, the new SMART electrode characteristics are retrieved, and the host meter uses the accessed calibration data as a point of reference for future measurements.



CODE	FC 43XD	HI 3148B
Description	pH SMART electrode	ORP SMART electrode
Reference	single, Ag/AgCl	double, Ag/AgCl
Junction	open	open / CPS™
Electrolyte	viscolene	KCl 3.5M + AgCl
Max Pressure	0.1 bar	0.1 bar
Range	pH: 0 to 12	ORP: ±2000 mV
Recommended Operating Temp.	-5 to 30°C (23 to 86°F)	20 to 40°C (68 to 104°F)
Tip /Shape	conic (6 x 10 mm)	platinum ring
Temperature Sensor	yes	no
Amplifier	yes	no
Body Material	PVDF	glass
Cable	7-pole; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	meat	wine

CONNECTION	
FC 431D	DIN †
FC 432D	DIN ‡

CONNECTION	
HI 3148B	BNC
HI 3148B/50	BNC

† Recommended for use with the HI 98140, HI 98150, HI 98230 and HI 98240 pH meters.
‡ Recommended for use with HI 99163 pH meter.

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Special Applications • Specific Analysis

CODE	HI 1292D	HI 1413X	HI 1414D	HI 1413X/50	HI 1414D/50
Description	pH electrode	pH electrode	pH electrode	pH electrode	pH electrode
Reference	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl
Junction	ceramic, triple / 40-50 µL/h	open	open	open	open
Electrolyte	KCl 3.5M + AgCl	viscolene	viscolene	viscolene	viscolene
Max Pressure	0.1 bar	0.1 bar	0.1 bar	0.1 bar	0.1 bar
Range	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12	pH: 0 to 12
Recommended Operating Temp.	-5 to 30°C (23 to 86°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	conic (12 x 12 mm)	flat	flat	flat	flat
Temperature Sensor	yes	no	yes	no	yes
Amplifier	yes	no	yes	no	yes
Body Material	glass	glass	glass	glass	
Cable**	7-pole; 1 m (3.3')	coaxial; 1 m (3.3')	7-pole; 1 m (3.3')	coaxial; 1 m (3.3')*	7-pole; 1 m (3.3')
Recommended Use	direct soil pH measurement, soil solution	surfaces, skin, leather, paper, emulsions	surface, leather, paper, emulsions	skin, scalp	skin, scalp

** Not for screw cap models.

CONNECTION	CONNECTION	CONNECTION	CONNECTION	CONNECTION
HI 1292D 7-pin DIN	**HI 1413B** BNC **HI 1410S** screw type	**HI 1414D** 7-pin DIN	**HI 1413B/50** BNC **HI 1413S/50** screw cap	**HI 1414D/50** DIN
Recommended for use with HI 99121 pH mete		Recommended for use with HI 99171 pH meter.	Recommended for use with Skincheck™ series	Recommended for use with HI 99181 pH meter

Special Applications • Specific Analysis

CODE	HI 3410S	HI 1296D	HI 1297D	HI 62911D	HI 72911X
Description	ORP electrode	pH electrode	pH/ORP electrode	pH electrode	pH electrode
Reference	double, Ag/AgCl	single, Ag/AgCl	single, Ag/AgCl	double, Ag/AgCl	double, Ag/AgCl
Junction	cloth	cloth	cloth	PTFE	PTFE
Electrolyte	gel	gel	gel	polymer	polymer
Max Pressure	3 bar	3 bar	3 bar	3 bar	3 bar
Range	ORP: ±2000 mV	pH: 0 to 13	pH: 0 to 13; ORP	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	platinum pin	spheric (dia: 5 mm)	pH: conic (3 mm); ORP: platinum sensor	flat	flat
Temperature Sensor	no	yes	yes	yes	yes
Amplifier	no	yes	yes	yes	yes
Body Material	PEI	AISI 316 stainless steel	titanium	titanium body working as matching pin	
Cable	–	5-pole; 1 m (3.3')	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')	7-pole; 1 m (3.3')
Recommended Use	process	wastewater	wastewater, municipal water, water treatment, swimming pools	plating baths	cooling towers, boilers

CONNECTION	CONNECTION	CONNECTION	CONNECTION	CONNECTION
HI 3410S screw type	**HI 1296D** DIN*	**HI 1297D** DIN*	**HI 62911D** DIN*	**HI 72911D** DIN* **HI 72911B** BNC + phono**

Recommended for use with HI 991001 pH meter.

Recommended for use with HI 991002 and HI 991003 pH meters.

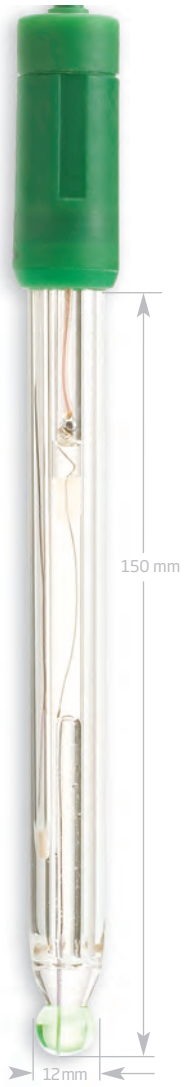
Recommended for use with HI 99131 pH meter.

* Recommended for use with HI 99141 pH meter.
** Recommended for use with HI 9818x family of meters

HANNA instruments

With Great Products, Come Great Results™

Electrodes for Specific Instruments



CODE	HI 12170	HI 1333B	HI 1110X
Description	spare electrode	spare electrode	pH electrode
Reference	single, Ag/AgCl	double, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	ceramic, single	ceramic, single / 15-20 µL/H	ceramic, single
Electrolyte	gel	KCl 3.5M	gel
Max Pressure	2 bar	0.1 bar	2 bar
Range	pH: 0 to 13	pH: 0 to 13	pH: 0 to 13
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)	20to 40°C (86 to 104°F)
Tip /Shape	spheric (dia: 5.0 mm)	spheric (dia: 7.5 mm)	spheric (dia: 9.5 mm)
Temperature Sensor	yes	no	no
Amplifier	no	no	no
Body Material	PEI	PEI	glass
Cable**	no	coaxial; 1 m (3.3')	coaxial; 1 m (3.3')
Recommended Use	general purpose	field applications	laboratory general use

** Not for screw cap models.

CONNECTION

HI 12170 3-pole; screw cap

Recommended for use with HI 9214N pH meter.

CONNECTION

HI 1333B BNC

Recommended for use with HI 9815 pH Turtle™

CONNECTION

HI 1110B BNC*
HI 1110S screw cap
HI 1110T PG 13.5 thread L=110 mm

*Recommended for use with pH 20 and pH 21 pH meters.

pH Half Cells

CODE	HI 2110B	HI 2111B	HI 2112B	FC 260B
Description	pH half-cell	pH half-cell	pH half-cell	pH half-cell
pH Half Cell	–	–	–	–
Range	pH: 0 to 12	pH: 0 to 14	pH: 0 to 13	pH: 0 to 12
Recommended Operating Temp.	-5 to 30°C (23 to 86°F)	30 to 85°C (86 to 185°F)	20 to 40°C (68 to 104°F)	-5 to 30°C (23 to 86°F)
Tip /Shape	spheric (dia: 9.5 mm)	spheric (dia: 9.5 mm)	spheric (dia: 7.5 mm)	spheric (dia: 9.5 mm)
Body Material	glass	glass	PEI	glass
Cable	coaxial	coaxial	coaxial	coaxial; 1 m (3.3')
Recommended Use	titration	general purpose, strong alkaline solutions	general purpose	milk
CONNECTION	**HI 2110B** BNC	**HI 2111B** BNC	**HI 2112B** BNC	**FC 260B** BNC

To be used in conjunction with HI 5315 ISE reference electrode. Recommended for use with the HI 84429 dairy minititrator.

Pt Electrodes

Platinum is a silvery-white metal when pure, and is malleable and ductile. It has a coefficient of expansion almost equal to that of soda-lime-silica glass, and is therefore used to make sealed electrodes in glass systems. The metal does not oxidize in air at any temperature, but is corroded by halogens, cyanides, sulfur, and caustic alkalis.

It is insoluble in hydrochloric and nitric acid, but dissolves when they are mixed as aqua regia, forming chloroplatinic acid.

Platinum electrodes consist of a small piece of platinum wire that is soldered or fused to wire made another metal. Platinum conducts electrons from the sample to the wire to which it is attached.

Platinum is used because it is assumed to be an inert metal; this means it does not give up its own electrons (does not oxidize) to the wire or sample. Iron containing materials such as steel will oxidize them selves and send their own electrons to the voltmeter. As a result the voltage we measure will not result solely from electrons being transferred to or from the sample. Metals such as copper and aluminum will oxidize and also cannot be used for ORP measurements. Stainless steel also may oxidize, but to a small extent, and should not be used.

CODE	HI 3133B	HI 5110B
Description	ORP half-cell	ORP half-cell
ORP Half Cell	platinum	Ag
Range	mV	mV
Recommended Operating Temp.	20 to 40°C (68 to 104°F)	20 to 40°C (68 to 104°F)
Tip /Shape	platinum pin	cylindric (dia: 3 mm)
Body Material	glass	glass
Cable	coaxial	coaxial
Recommended Use	general purpose, potentiometric titration	argentometric titration

CONNECTION	
HI 3133B	BNC

CONNECTION	
HI 5110B	BNC

Reference Electrodes

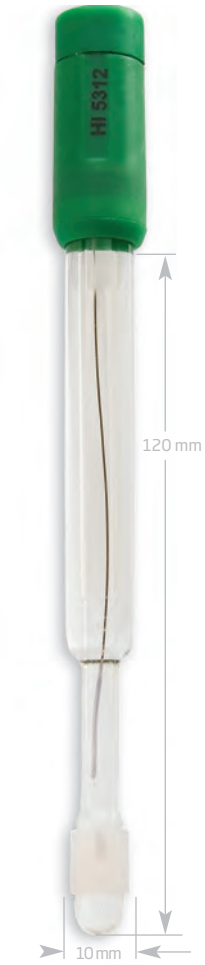
High pressure or high concentration of contaminants.

Because of the special electrode recharge system of the HI 5314 and HI 5414, it is possible to connect an outside container to increase the amount of electrolyte of the reference half cell and thus the pressure inside the electrode. By so doing, the junction will be able to work in high-pressure environments without the danger of implosion.

CODE	HI 5412	HI 5311	HI 5314	HI 5414
Description	reference electrode	reference electrode	reference electrode	reference electrode
Reference	single, Hg/Hg_2Cl_2	double, Ag/AgCl	double, Ag/AgCl	single, Hg/Hg_2Cl_2
Junction / Flow Rate	ceramic, single / 15-20 µL/h	ceramic, single / 15-20 µL/h	ceramic, double	ceramic, double
Electrolyte	KCl 3.5M	KCl 3.5M	KCl 3.5M	KCl 3.5M
Max Pressure	0.1 bar	0.1 bar	3 bar with back pressure	3 bar with back pressure
Recommended Operating Temp.	-5 to 30°C (23 to 86°F)	30 to 85°C (86 to 185°F)	30 to 85°C (86 to 185°F)	-5 to 30°C (23 to 86°F)
Body Material	glass	glass	glass	glass
Cable	1 m (3.3')	1 m (3.3')	1 m (3.3')	1 m (3.3')
Recommended Use	general purpose, ISE, titrations	general purpose (wide temperature range), titrations	measurements with remote filling	measurements with remote filling

CONNECTION		CONNECTION		CONNECTION		CONNECTION	
HI 5412	4 mm banana	**HI 5311**	4 mm banana	**HI 5314**	4 mm banana	**HI 5414**	4 mm banana

Reference Electrodes



CODE	HI 5413	HI 5312	HI 5313
Description	reference electrode	reference electrode	reference electrode
Reference	single, Hg/Hg_2Cl_2	double, Ag/AgCl	single, Ag/AgCl
Junction / Flow Rate	PTFE sleeve	PTFE sleeve	ceramic
Electrolyte	KCl 3.5M	KCl 3.5M	gel (KCl 1M + AgCl)
Max Pressure	0.1 bar	0.1 bar	0.1 bar
Recommended Operating Temp.	-5 to 30°C (23 to 86°F)	-5 to 30°C (23 to 86°F)	-5 to 30°C (23 to 86°F)
Body Material	glass	glass	PEI
Cable	1 m (3.3')	1 m (3.3')	1 m (3.3')
Recommended Use	samples with suspended solids, ISE	titrations, samples with suspended solids	used with FC 301B

CONNECTION	
HI 5413	4 mm banana

CONNECTION	
HI 5312	4 mm banana

CONNECTION	
HI 5313	4 mm banana

A Solution for Every Need

pH and ORP Solutions

Ready to Use Solutions

Buffer solutions that can be prepared in small batches from capsules, tablets or powders, are called "fresh" because they are prepared at the time of use. They are considered to be, but are not, very precise. The quality of buffer solutions depends on many factors that intervene during production: the quantity and quality of the chemicals and also distilled water that has been used in preparing the batches as well as the temperature and the instruments used to prepare them.

HANNA buffer solutions are prepared using chemicals that have been checked carefully, within an aseptic environment and with the highest precision reference instruments.

The main standard buffer solutions produced by HANNA are available in bottles or in sealed sachets, complete with or without a certificate of analysis.

HANNA solutions are more convenient than the so-called "fresh" solutions. The following pages show all the series of calibration solutions in the various types of packages that will satisfy every application need while always guaranteeing precise readings.

A Complete Range

The entire range of HANNA's solutions includes:

- **pH buffer solutions**
- **Standard solutions for conductivity, TDS, turbidity, salinity and ISE calibration**
- **ORP test and pretreatment solutions**
- **Reference fill solutions for refillable electrodes**
- **General and specific cleaning solutions for electrodes**
- **Solutions for electrode maintenance**
- **Solutions for sample preparation**

Solutions are available in many sizes from 20 mL sachets all the way to 3.78 L (1 Gallon) containers for the large quantities used in laboratories.

For safety and traceability, all HANNA solutions are provided with a label showing the batch number and expiration date.

Calibration and Cleaning Solutions

The fundamental use of calibration and cleaning solutions is to correctly maintain electrode operation to produce accurate and reproducible readings. Often readings are not correct because the sensors have not been properly handled. Using HANNA's wide range of solutions will help guarantee correct cleaning and calibration of electrodes and probes for maximum performance.

Our application engineered solutions have been produced with reference instruments calibrated with the highest precision NIST standards. Our range of buffer and cleaning solutions have been extended with 3 new lines: the HI 50xx series of technical buffer solutions which allow for calibration of pH meters from 1.00 to 13.00 pH; HI 60xx series of solutions with millesimal resolutions available for pH measurements with an accuracy of ±0.002 pH and application specific cleaning solutions available in bottles of 250 and 500 mL as well as in small sachets of 20 mL each.

A Wide Variety of Single Dose Sachets

Get the best out of your instruments using single-dose HANNA calibration and maintenance solutions. A wide range of solutions for pH, conductivity, TDS and cleaning is available in the form of practical 20 mL sachets.

Sachets are Practical, Safe and Ready to Use

Single-dose sachets are quick and easy to use. Each sealed, light-tight sachet holds just the right amount of solution.

Every time your instrument is calibrated using these HANNA sachets, it is like using a newly-opened bottle of solution.

Certified Solutions Sachets

Solutions in sachets are also available with a certificate of analysis. Just like in our bottled solutions, the certificate shows the date of production, batch number and expiration date.

Combination Kits in Bottles and Sachets

HANNA solutions are also available in combined kits for practicality. These kits are useful for multiparameter instruments or for two-point calibration.

°C	°F	pH
0	32	7.13
5	41	7.10
10	50	7.07
15	59	7.04
20	68	7.03
25	**77**	**7.01**
30	86	7.00
35	95	6.99
40	104	6.98
45	113	6.98
50	122	6.98
55	131	6.98
60	140	6.98
65	149	6.99
70	158	6.99
75	167	7.00
80	176	7.01
85	185	7.02
90	194	7.03
95	203	7.04

Table of Reference Temperatures

All calibration solutions are provided with a label presenting a reference table of the relationship between pH or conductivity values and temperature.

Bottles that Meet FDA Standards

For accuracy over an extended period of time, ask for HANNA solutions in FDA (US Food & Drug Administration) type light-tight bottles.

Certified Solutions

For those operators who request it, we provide standard solutions complete with certificate of analysis. These certificates are prepared against NIST standards to avoid any possible error in determining the actual pH value.

HI 50xx, HI 60xx and HI 80xx series solutions are provided with a certificate of analysis. HI 70xx series certified solutions are identified by the letter "C" at the end of the part number.

Safety Data Sheets

Download Safety Data Sheets (SDS) from our website at: www.hannainst.com.

HANNA Solution Series

To meet the requirements of various applications, the following categories of solutions are also available:

HI 50xx series, technical solutions: they allow for calibration at all units of pH from pH 1.00 to pH 13.00.

HI 60xx series, millesimal solutions: they allow for the correct calibration of pH meters with millesimal readings.

Cleaning Solution Series, cleaning solutions: an indispensable tool when electrodes are used continuously. Produced with the purpose of ensuring correct readings in widely varied areas of application, they guarantee precise measurement and long electrode life.

Electrode Cleaning, Calibrating and Maintenance

Step 1: Cleaning

Fig. A

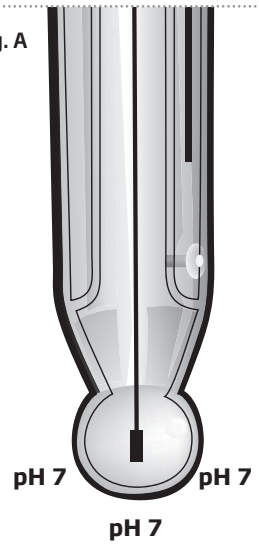


Fig A. pH reading from a properly cleaned electrode in pH 7 solution.

Fig. B

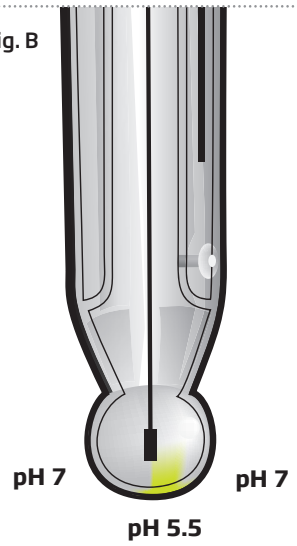


Fig B. pH reading from a dirty electrode in pH 7 solution.

Fig. C

A contaminated electrode could adversely effect not only the buffer solution, but the calibration of clean electrodes as well.

Just because you can't see contamination doesn't mean it isn't there.

An electrode generates a voltage of the average hydrogen ion concentration from the surface area outside the pH bulb tip. **Fig. A** above shows that the clean electrode is submersed in pH 7 from all areas of the bulb surface. When an electrode becomes dirty from use or neglect, the contaminated surface contributes to a voltage offset based on the surface area exposed to buffer as seen in **Fig. B**. Now the pH meter is mistakenly reading pH 6.5 instead of the actual pH 7.

Always clean your electrode before calibration. If a dirty electrode is used for calibration, all subsequent measurements will be in error.

A Dirty Electrode Can Contaminate Solutions

Always use fresh solutions with each calibration. Buffer solutions can be contaminated by dirty electrodes **Fig. C**, which can contaminate clean electrodes and so forth. Always clean your electrode before each use, each calibration, and always use fresh solutions.

Contamination can take time to work its way around the beaker. If your noticing fluctuations in your readings, it may be time to calibrate with fresh solutions.

Fresh Every Time

HANNA single-use sachets are a great way to ensure a fresh solution is used every time you calibrate. **Fig. D** shows just how easy it is to tear open the packet and insert the electrode. These light-tight sachets are also ideal for testers–they fit right in!

Fig. D

pH Cleaning Procedure

HANNA manufactures a full complement of cleaning solutions formulated to address general and specific cleaning needs.

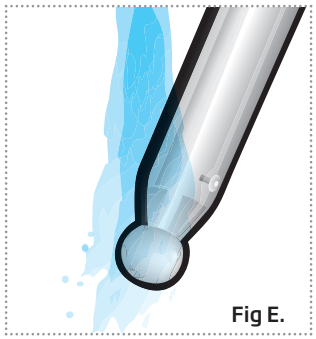


Fig E.

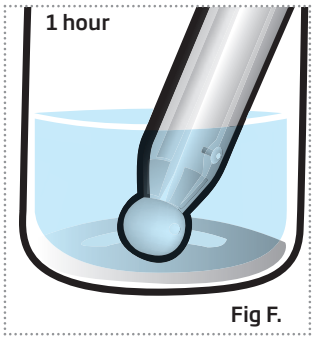


Fig F.

IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water, **Fig. E**, and soak the electrode in HI 70300 or HI 80300 Storage Solution for at least 1 hour before taking measurements, **Fig. F**.

General Cleaning

Soak in HANNA HI 7061 or HI 8061 General Cleaning Solution for approximately 30 minutes to dissolve mineral deposits and other general coatings.

Protein Coating

Soak in HANNA HI 7073 or HI 8073 Protein Cleaning Solution for 15 minutes to enzymatically dissolve deposits from protein sources.

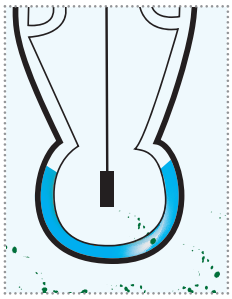
Inorganic Soak

Soak in HANNA HI 7074 Inorganic Cleaning Solution for 15 minutes. This cleaner is especially effective at removal of precipitates caused by reaction with the silver in the filling solution that may form in a ceramic junction.

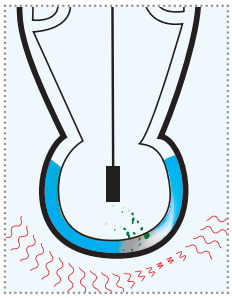
Oil/grease Rinse

Oil and grease removal require the correct chemicals to solubilize the coating but mild enough to leave the electrode unaffected. Use HANNA HI 7077 or HI 8077 Oil and Fat Cleaning Solution.

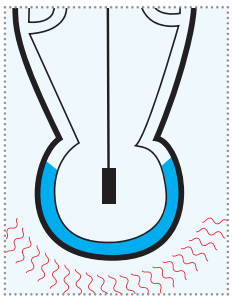
Step 2: Calibration



In time, particles during routine measurement can contaminate the sensor tip. Mishandled and aged solutions can also be affected.



If the electrodes sensor tip is not properly cleaned before calibration, your meter can be calibrated to an incorrect pH.



A proper cleaning and fresh solution ensures the whole surface of the sensor tip is reading correctly, ensuring an accurate calibration.

A pH electrode that is properly manufactured and kept clean will retain its measuring integrity for a long time. As a result of many factors such as age, use, poor maintenance or improper handling, any electrode will lose its integrity in time.

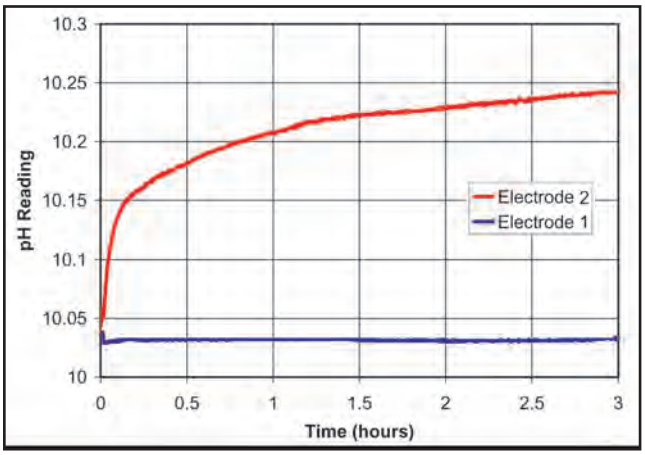
A proper calibration restores an electrodes ability to take professionally accurate measurements.

The most common cause for pH measurement inaccuracies is an unclean or improperly cleaned electrode. This is very important to note, because during calibration, the instrument assumes that the electrode is clean and that the standardization curve created during the calibration process will remain a valid reference until the next calibration. pH meters on the market today will allow an offset of approximately ±60 mV. The deviation from 0 mV is not unusual, in fact it represents the true characteristics of a normal pH electrode.

An offset can be compensated for by calibrating a pH meter with a properly cleaned electrode. Calibrating a meter with a dirty electrode will only compound the problem. An mV offset that continues to deviate on a properly cleaned electrode is a good indication that the electrode may need to be replaced.

Electrode Readings with Different Cleanings

Fig G.



Electrode 1 has been properly cleaned before calibration. Electrode 2 has not been properly cleaned.

Fig. G (above) shows that the pH measured by a dirty electrode changes over a short period of time. This results from the residue on the pH electrode bulb dissolving into the solution and the electrode gradually returning close to its true characteristics. The resulting pH measurements, based upon the calibration of a coated electrode, will then be incorrect.

Conventional pH meters do not warn the user when a pH electrode is dirty or when a solution may be contaminated. A common example of this occurs just *after* calibrating the instrument–the pH electrode is immersed into the pH 7 buffer and the reading is lower than expected (pH 6.8 or 6.9 instead of pH 7). HANNA meters that feature our exclusive Calibration Check™ electrode diagnostics automatically alerts the user of any potential electrode or solution problems *during* calibration.

Precision Solutions

HANNA's wide range of solutions will help guarantee correct cleaning and calibration of electrodes and probes for maximum performance. Our solutions have been manufactured with your application in mind.

Step 3: Maintenance

Measurement

Always calibrate the electrode and pH meter together before making measurements.

Rinse the pH electrode sensor tip with deionized or distilled water. 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 submerse the pH sensor tip and reference junction (~3 cm /1¼") in the stirred sample.

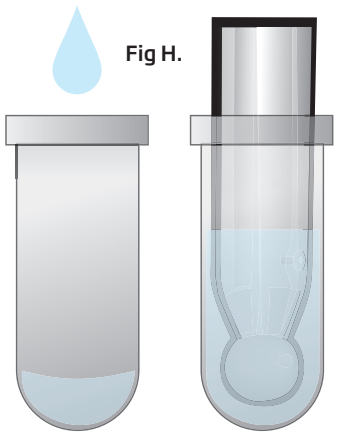
Storage

To ensure an optimum response time, the glass sensor tip and the reference junction of the pH electrode should be kept moist and not be 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, with pH 4 or pH 7 buffer, **Fig H**.

NOTE: *Never store the electrode in distilled or deionized water.*

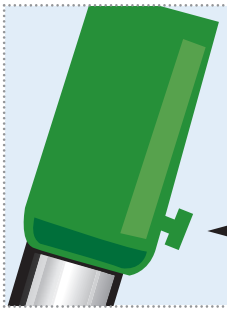
Fig H.



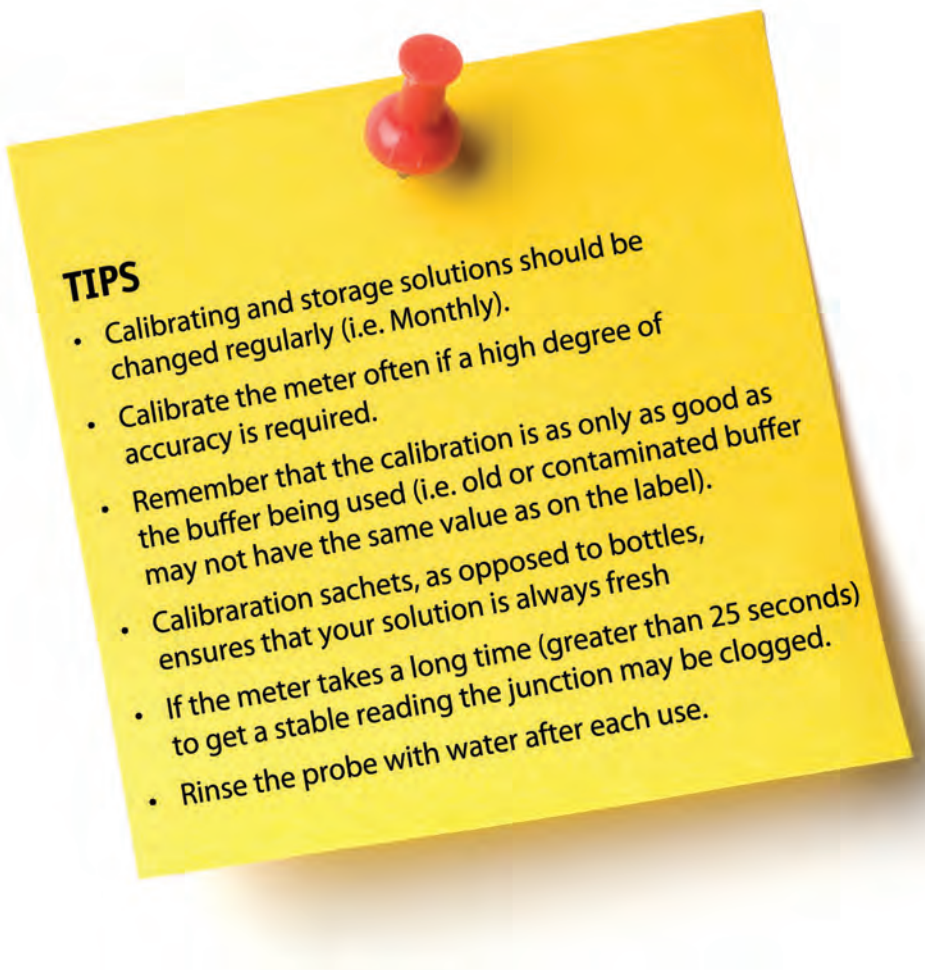
Inspect

Inspect and clean the electrode regularly to ensure the electrode will be ready when you need it. Coatings and reactions from samples result in decreased efficiency and longer response times.

Routine maintenance will ensure accurate readings while extending the life of your electrode.



The reference fill hole is used to replace the reference electrolyte solution (not in gel or solid-filled references).



Don't Let Your Electrode Dry Out

Ideally, pH electrodes should be stored in a storage solution when not in use. Placing the electrode in a small glass filled with storage solution is suitable. An option for pocket meters is to place a small piece of sponge into the meter's cap and pouring storage solution into the cap to wet the sponge. Pouring any excess solution beforehand, the cap can then be placed on the meter.

If a storage solution is not available the next best option is to use pH 4.01 buffer (pH 7.01 is also suitable to a lesser extent).

Clean Your Electrodes Before Use

Clean the liquid junction of your electrodes once a day or at least once a week to prevent junction clogging and to maintain accuracy. Immerse the electrode in the proper cleaning solution for at least 15-20 minutes. HANNA offers a wide range of cleaning solutions, for general purpose and specific applications.

Replace Your Electrode Once a Year

If your electrode takes too long to stabilize a reading, or readings fluctuate wildly, it is probably time to replace the electrode. 6 months to 1.5 years is the typical life span of any pH electrode.

Cleaning, Storage and Refilling Solutions

General Cleaning

Clean the liquid junction of your electrodes once a day or at least once a week to prevent junction clogging and to maintain accuracy. Immerse the electrode in the proper cleaning solution for at least 15-20 minutes.

HANNA offers a wide range of cleaning solutions, for general purpose and specific applications to dissolve many deposits from the electrode, and thus ensure correct measurements.

Electrode Storage Solutions

To minimize junction clogging and ensure fast response time, always keep the glass bulb and the junction of your pH electrode moist. Store the electrode with a few drops of HI 70300 storage or pH 4 or pH 7 buffer solution in the protective cap.

Electrode Fill Solutions

The electrolyte level in refillable electrodes should be checked before performing any measurement. If the level is low, refill with the proper electrolyte solution to ensure the correct electrode performance.

This simple maintenance helps guarantee adequate head pressure to promote efficiency and precision of your refillable electrodes.

Some electrolyte solutions are also available in FDA compliant bottles.

Electrode Cleaning Solutions for General Use

BOTTLES AND SACHETS		
CODE	**APPLICATION**	**PACKAGE**
HI 70000P	rinsing	20 mL sachet (25)
HI 70000P/5	rinsing	20 mL sachet (500)
HI 7061L	general purpose	500 mL bottle
HI 7061M	general purpose	230 mL bottle
HI 7073L	proteins	500 mL bottle
HI 7073M	proteins	230 mL bottle
HI 7074L	inorganic substances	500 mL bottle
HI 7074M	inorganic substances	230 mL bottle
HI 7077L	oil and fats	500 mL bottle
HI 7077M	oil and fats	230 mL bottle
HI 8061L	general purpose	500 mL FDA bottle
HI 8061M	general purpose	230 mL FDA bottle
HI 8073L	proteins	500 mL FDA bottle
HI 8073M	proteins	230 mL FDA bottle
HI 8077L	oil and fats	500 mL FDA bottle
HI 8077M	oil and fats	230 mL FDA bottle

Electrode Storage Solutions

BOTTLES		
CODE	**DESCRIPTION**	**PACKAGE**
HI 70300L	electrode storage solution	500 mL bottle
HI 70300M	electrode storage solution	230 mL bottle
HI 80300L	electrode storage solution	500 mL FDA bottle
HI 80300M	electrode storage solution	230 mL FDA bottle

Electrode Refilling Solutions

BOTTLES		
CODE	**DESCRIPTION**	**PACKAGE**
HI 7071	electrolyte solution, 3.5M KCl + AgCl	30 mL bottle (4)
HI 7071M	electrolyte solution, 3.5M KCl + AgCl	230 mL bottle
HI 7071L	electrolyte solution, 3.5M KCl + AgCl	500 mL bottle
HI 7072	electrolyte solution, 1M KNO_3	30 mL bottle (4)
HI 7072L	electrolyte solution, 1M KNO_3	500 mL bottle
HI 7075	electrolyte solution, 1.7M KNO_3, 0.7M KCl	30 mL bottle (4)
HI 7076	electrolyte solution, 1.0M NaCl	30 mL bottle (4)
HI 7078	electrolyte solution, 0.5M $(NH_4)_2 SO_4$	30 mL bottle (4)
HI 7082	electrolyte solution, 3.5M KCl	30 mL bottle (4)
HI 7082M	electrolyte solution, 3.5M KCl	230 mL bottle
HI 7082L	electrolyte solution, 3.5M KCl	460 mL bottle
HI 7093	electrolyte solution, 1M NaCl	30 mL bottle (4)
HI 70960M	conductivity electrolyte solution for pH for viscous fluids	230 mL bottle
HI 70960L	conductivity electrolyte solution for pH for viscous fluids	500 mL bottle
HI 8071	electrolyte solution, 3.5M KCl + AgCl	30 mL FDA bottle (4)
HI 8072	electrolyte solution, 1M KNO_3	30 mL FDA bottle (4)
HI 8082	electrolyte solution, 3.5M KCl	30 mL FDA bottle (4)
HI 8093	electrolyte solution, 1M KCl + AgCl	30 mL FDA bottle (4)

Specific Application Cleaning Solutions

BOTTLES

CODE	DESCRIPTION	SIZE
HI 70620L	cleaning and disinfection solution for skin residuals (cosmetic industry)	500 mL
HI 70620M	cleaning and disinfection solution for skin residuals (cosmetic industry)	230 mL
HI 70621L	cleaning solution for skin grease and sebum (cosmetic industry)	500 mL
HI 70621M	cleaning solution for skin grease and sebum (cosmetic industry)	230 mL
HI 70630L	acid cleaning solution for meat grease and fats (food industry)	500 mL
HI 70630M	acid cleaning solution for meat grease and fats (food industry)	230 mL
HI 70631L	alkaline cleaning solution for meat grease and fats (food industry)	500 mL
HI 70631M	alkaline cleaning solution for meat grease and fats (food industry)	230 mL
HI 70632L	cleaning and disinfection solution for blood products	500 mL
HI 70632M	cleaning and disinfection solution for blood products	230 mL
HI 70635L	cleaning solution for wine deposits (winemaking)	500 mL
HI 70635M	cleaning solution for wine deposits (winemaking)	230 mL
HI 70636L	cleaning solution for wine stains (winemaking)	500 mL
HI 70636M	cleaning solution for wine stains (winemaking)	230 mL
HI 70640L	cleaning solution for milk deposits (food industry)	500 mL
HI 70640M	cleaning solution for milk deposits (food industry)	230 mL
HI 70641L	cleaning and disinfection solution for dairy products (food industry)	500 mL
HI 70641M	cleaning and disinfection solution for dairy products (food industry)	230 mL
HI 70642L	cleaning solution for cheese deposits (food industry)	500 mL
HI 70642M	cleaning solution for cheese deposits (food industry)	230 mL
HI 70661L	cleaning solution for general purpose (agriculture)	500 mL
HI 70661M	cleaning solution for general purpose (agriculture)	230 mL
HI 70663L	cleaning solution for soil deposits (agriculture)	500 mL
HI 70663M	cleaning solution for soil deposits (agriculture)	230 mL
HI 70664L	cleaning solution for humus deposits (agriculture)	500 mL
HI 70664M	cleaning solution for humus deposits (agriculture)	230 mL
HI 70670L	cleaning solution for salt deposits (industrial processes)	500 mL
HI 70670M	cleaning solution for salt deposits (industrial processes)	230 mL
HI 70671L	cleaning and disinfection solution for algae, fungi and bacteria (industrial processes)	500 mL
HI 70671M	cleaning and disinfection solution for algae, fungi and bacteria (industrial processes)	230 mL
HI 70680L	cleaning solution for cellulose deposits	500 mL
HI 70680M	cleaning solution for cellulose deposits	230 mL
HI 70681L	cleaning solution for ink stains	500 mL
HI 70681M	cleaning solution for ink stains	230 mL

SACHETS

CODE	DESCRIPTION	QTY/SIZE
HI 700620P	cleaning and disinfection solution for skin residuals (cosmetic industry)	20 mL (25)
HI 700621P	cleaning solution for skin grease and sebum (cosmetic industry)	20 mL (25)
HI 700630P	acid cleaning solution for meat grease and fats (food industry)	20 mL (25)
HI 700635P	cleaning solution for wine deposits (winemaking)	20 mL (25)
HI 700636P	cleaning solution for wine stains (winemaking)	20 mL (25)
HI 700640P	cleaning solution for milk deposits (food industry)	20 mL (25)
HI 700641P	cleaning and disinfection solution for dairy products (food industry)	20 mL (25)
HI 700642P	cleaning Solution for cheese deposits (food industry)	20 mL (25)
HI 700661P	general purpose cleaning solution for agriculture	20 mL (25)
HI 700663P	cleaning solution for soil deposits (agriculture)	20 mL (25)
HI 700664P	cleaning solution for humus deposits (agriculture)	20 mL (25)
HI 700670P	cleaning solution for salt deposits (industrial processes)	20 mL (25)
HI 700671P	cleaning and disinfection solution for algae, fungi and bacteria (industrial processes)	20 mL (25)
HI 700680P	cleaning solution for cellulose deposits	20 mL (25)

Cleaning Solution Series

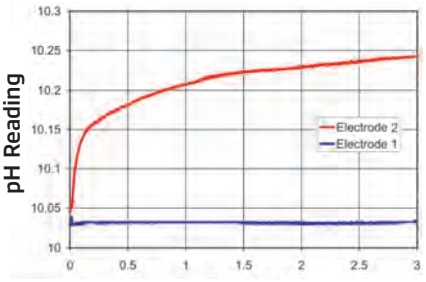
Focused Cleaning for A Top Performing Sensor

In many applications, electrodes become dirty from use and produce negative results on their efficiency. Since this dirt cannot be removed during normal use, special cleaning solutions are needed.

HANNA has prepared a complete line of cleaning and disinfection solutions that eliminate impurities and residues left on electrode surfaces when immersed in special samples. Such samples include wines, musts, oils, soil, industrial solutions, grease, algae, and dairy products.

The Cleaning Solution Series ensures the maximum efficiency and accuracy of your sensors when used for it's designated application.

Readings of electrodes cleaned with different procedures



Electrode 1 has been properly cleaned before calibration. Electrode 2 has not been properly cleaned.

The easy to open and always fresh sachet package is a practical and ideal solution for field measurements.

HI 5000 Series

pH Technical Calibration Solutions

Precise Measurements

To obtain precise and valid pH measurements, the pH meter and pH electrode must be calibrated at a minimum of 2 different points, close to the value of the sample to be tested.

HANNA offers a complete range of pH buffer solutions, that will satisfy all your calibration needs and which have been extended with two additional lines: the HI 50xx series of technical buffer solutions (shown on these pages,) and the solutions with millesimal resolution, HI 60xx.

Technical Solutions (±0.01 pH) for Each Point of the pH Scale

This complete scale of buffer solutions offers a higher degree of accuracy for pH measurements in specific areas of application, such as in monitoring the pH of must and wine. This line includes 13 solutions starting from a value of pH 1.00 up to pH 13.00 with an accuracy of ±0.01 pH, thus covering every point of the pH scale.

These solutions are dedicated to those applications that require extremely accurate pH monitoring, and are also available with certificate of analysis prepared by comparison against NIST standards.

Also available are solution bottles, that are colored according to a given standard calibration value: HI 5004-R (Red), HI 5007-G (Green) and HI 5010-V (Violet).

BOTTLES		
pH VALUE @25°C	CODE	PACKAGE
1.00	HI 5001	500 mL
1.68	HI 5016	500 mL
2.00	HI 5002	500 mL
2.00	HI 5002-01	1 L
2.00	HI 5002-36	500 mL (36)
3.00	HI 5003	500 mL
3.00	HI 5003-36	500 mL (36)
3.79	HI 5037	500 mL
4.01	HI 5004	500 mL
4.01	HI 5004-01	1 L
4.01	HI 5004-12	500 mL (12)
4.01	HI 5004-36	500 mL (36)
4.01	HI 5004-R	500 mL
4.01	HI 5004-R08	1 G (3.78 L) (2)
4.01	HI 5004-R36	500 mL (36)
4.63	HI 5046	500 mL
4.63	HI 5046-01	1 L
5.00	HI 5005	500 mL
5.00	HI 5005-01	1 L
6.00	HI 5006	500 mL
6.00	HI 5006-01	1 L
6.00	HI 5006-36	500 mL (36)
6.86	HI 5068	500 mL
7.01	HI 5007	500 mL
7.01	HI 5007-01	1 L
7.01	HI 5007-12	500 mL (12)
7.01	HI 5007-36	500 mL (36)
7.01	HI 5007-G	500 mL
7.01	HI 5007-G08	1 G (3.78 L) (2)
7.01	HI 5007-G36	500 mL (36)
7.41	HI 5074	500 mL
7.41	HI 5074-01	1 L
8.00	HI 5008	500 mL
8.00	HI 5008-01	1 L
8.00	HI 5008-36	500 mL (36)
9.00	HI 5009	500 mL
9.00	HI 5009-01	1 L
9.00	HI 5009-36	500 mL (36)
9.18	HI 5091	500 mL
10.01	HI 5010	500 mL
10.01	HI 5010-01	1 L
10.01	HI 5010-12	500 mL (12)
10.01	HI 5010-36	500 mL (36)
10.01	HI 5010-V	500 mL
10.01	HI 5010-V08	1 G (3.78 L) (2)
10.01	HI 5010-V36	500 mL (36)
11.00	HI 5011	500 mL
12.00	HI 5012	500 mL
12.45	HI 5124	500 mL
13.00	HI 5013	500 mL

SACHETS		
pH VALUE @25°C	**CODE**	**PACKAGE**
1.00	HI 50001-01	20 mL (10)
1.00	HI 50001-02	20 mL (25)
1.68	HI 50016-01	20 mL (10)
1.68	HI 50016-02	20 mL (25)
2.00	HI 50002-01	20 mL (10)
2.00	HI 50002-02	20 mL (25)
3.00	HI 50003-01	20 mL (10)
3.00	HI 50003-02	20 mL (25)
3.00	HI 50003P	20 mL (25)
3.79	HI 50037-01	20 mL (10)
3.79	HI 50037-02	20 mL (25)
4.01	HI 50004-01	20 mL (10)
4.01	HI 50004-02	20 mL (25)
4.63	HI 50046-01	20 mL (10)
4.63	HI 50046-02	20 mL (25)
5.00	HI 50005-01	20 mL (10)
5.00	HI 50005-02	20 mL (25)
6.00	HI 50006-01	20 mL (10)
6.00	HI 50006-02	20 mL (25)
6.86	HI 50068-01	20 mL (10)
6.86	HI 50068-02	20 mL (25)
7.01	HI 50007-01	20 mL (10)
7.01	HI 50007-02	20 mL (25)
7.01	HI 50021P	20 mL (25)
7.41	HI 50074-01	20 mL (10)
7.41	HI 50074-02	20 mL (25)
8.00	HI 50008-01	20 mL (10)
8.00	HI 50008-02	20 mL (25)
9.00	HI 50009-01	20 mL (10)
9.00	HI 50009-02	20 mL (25)
9.18	HI 50091-01	20 mL (10)
9.18	HI 50091-02	20 mL (25)
10.01	HI 50010-01	20 mL (10)
10.01	HI 50010-02	20 mL (25)
11.00	HI 50011-01	20 mL (10)
11.00	HI 50011-02	20 mL (25)
12.00	HI 50012-01	20 mL (10)
12.00	HI 50012-02	20 mL (25)
12.45	HI 50124-01	20 mL (10)
12.45	HI 50124-02	20 mL (25)
13.00	HI 50013-01	20 mL (10)
13.00	HI 50013-02	20 mL (25)

Easy to Use Single Dose Sachets

For the highest level of reliability of field instrumentation, technical solutions are also provided in convenient single-dose sachets.

Calibration solution sachets are sold in boxes containing 10 or 25 pieces to satisfy requirements for daily use.

HANNA Combo Kits

Use our combination kits for easy ordering and reordering.

SOLUTION COMBINATION KITS - BOTTLE		
CODE	**SOLUTIONS (pH VALUE @25°C)**	**BOTTLE**
HI 54710	pH 4.01, pH 7.01, pH 10.01	500 mL (3)
HI 54710-10	pH 4.01, pH 7.01, pH 10.01, HI 70300L	500 mL (4)
HI 54710-11	pH 4.01, pH 7.01, pH 10.01, HI 70300L, HI 7061L	500 mL (5)
HI 54710-12	pH 4.01, pH 7.01, pH 10.01, HI 70300L, HI 7061L, HI 7071L	500 mL (6)
HI 54710-13	pH 4.01, pH 7.01, pH 10.01, HI 70300L, HI 7061L, HI 7072L	500 mL (6)

HI 6000 Series

±0.002 pH Millesimal Calibration Solutions

Millesimal Calibration Solutions

This line of buffers with millesimal accuracy (±0.002 pH), HI 60xx, has been prepared to meet the increasing need for assured accuracy in pH measurements. Each bottle of the series HI 60xx is provided with a certificate of analysis, prepared by comparison with NIST standards.

Easy Range Identification

The colors on the HI 60xx series packaging correspond to a given standard pH value. They make it easy and safe to identify the buffers to be used.

Millesimal Calibration Solution Sachets

This series is also available in handy sachets to perform accurate calibrations on-site or in the field. Single dose sachet solutions are safe, easy to carry and always fresh.

MILLESIMAL BUFFER SOLUTIONS (±0.002 pH) - BOTTLE

pH VALUE @25°C	CODE	PACKAGE	pH VALUE @25°C	CODE	PACKAGE
1.000	HI 6001	500 mL	7.010	HI 6007	500 mL
1.000	HI 6001-01	1 L	7.010	HI 6007-01	1 L
1.679	HI 6016	500 mL	7.413	HI 6074	500 mL
1.679	HI 6016-01	1 L	7.413	HI 6074-01	1 L
2.000	HI 6002	500 mL	8.000	HI 6008	500 mL
2.000	HI 6002-01	1 L	8.000	HI 6008-01	1 L
3.000	HI 6003	500 mL	9.000	HI 6009	500 mL
3.000	HI 6003-01	1 L	9.000	HI 6009-01	1 L
3.788	HI 6037	500 mL	9.177	HI 6091	500 mL
3.788	HI 6037-01	1 L	9.177	HI 6091-01	1 L
4.010	HI 6004	500 mL	10.010	HI 6010	500 mL
4.010	HI 6004-01	1 L	10.010	HI 6010-01	1 L
4.630	HI 6046	500 mL	11.000	HI 6011	500 mL
4.630	HI 6046-01	1 L	11.000	HI 6011-01	1 L
5.000	HI 6005	500 mL	12.000	HI 6012	500 mL
5.000	HI 6005-01	1 L	12.000	HI 6012-01	1 L
6.000	HI 6006	500 mL	12.450	HI 6124	500 mL
6.000	HI 6006-01	1 L	12.450	HI 6124-01	1 L
6.862	HI 6068	500 mL	13.000	HI 6013	500 mL
6.862	HI 6068-01	1 L	13.000	HI 6013-01	1 L

MILLESIMAL BUFFER SOLUTIONS (±0.002 pH) - SACHET

pH VALUE @25°C	CODE	PACKAGE	pH VALUE @25°C	CODE	PACKAGE
1.000	HI 60001-01	20 mL (10)	7.010	HI 60007-01	20 mL (10)
1.000	HI 60001-02	20 mL (25)	7.010	HI 60007-02	20 mL (25)
1.679	HI 60016-01	20 mL (10)	7.413	HI 60074-01	20 mL (10)
1.679	HI 60016-02	20 mL (25)	7.413	HI 60074-02	20 mL (25)
2.000	HI 60002-01	20 mL (10)	8.000	HI 60008-01	20 mL (10)
2.000	HI 60002-02	20 mL (25)	8.000	HI 60008-02	20 mL (25)
3.000	HI 60003-01	20 mL (10)	9.000	HI 60009-01	20 mL (10)
3.000	HI 60003-02	20 mL (25)	9.000	HI 60009-02	20 mL (25)
3.788	HI 60037-01	20 mL (10)	9.177	HI 60091-01	20 mL (10)
3.788	HI 60037-02	20 mL (25)	9.177	HI 60091-02	20 mL (25)
4.010	HI 60004-01	20 mL (10)	10.010	HI 60010-01	20 mL (10)
4.010	HI 60004-02	20 mL (25)	10.010	HI 60010-02	20 mL (25)
4.630	HI 60046-01	20 mL (10)	11.000	HI 60011-01	20 mL (10)
4.630	HI 60046-02	20 mL (25)	11.000	HI 60011-02	20 mL (25)
5.000	HI 60005-01	20 mL (10)	12.000	HI 60012-01	20 mL (10)
5.000	HI 60005-02	20 mL (25)	12.000	HI 60012-02	20 mL (25)
6.000	HI 60006-01	20 mL (10)	12.450	HI 60124-01	20 mL (10)
6.000	HI 60006-02	20 mL (25)	12.450	HI 60124-02	20 mL (25)
6.862	HI 60068-01	20 mL (10)	13.000	HI 60013-01	20 mL (10)
6.862	HI 60068-02	20 mL (25)	13.000	HI 60013-02	20 mL (25)

pH Standard Calibration Solutions

1.68 Buffer Solution

Plating bath samples, food samples and waste samples are often acidic in nature. To increase accuracy of your measurment at lower pH, it is important to calibrate your electrode and meter at that pH also. HANNA pH 1.68 buffer is available to fufill this requirement. pH 1.68 buffer solution allows you to calibrate your measurement system in the acid pH range and bracket your acidic samples by using a second value at 4.01 pH or near 7.01 pH.

Our millesimal series offers ±0.002 certified accuracy and our HI 5016 technical grade solution offers ±0.01 pH certified accuracy. Standard NIST traceable (no certification included) 1.68 pH buffer with ±0.01 pH accuracy is available in two sizes.

BOTTLES

CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 7001L	1.68	500 mL	bottle		on request
HI 7001M	1.68	230 mL	bottle		on request

4.01 Buffer Solution

HANNA buffer solutions are prepared according to precise formulas and are standardized with a pH electrode and meter calibrated with NIST standards. This buffer value is widely used in water purification plants, in the food industry and where ever the pH is expected to be slightly acidic.

All pH 4.01 solutions show batch number, expiration date and the correlation table between pH and temperature.

BOTTLES

CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 7004/1G	4.01	1 gallon (3.78 L)	bottle		on request
HI 7004/1L	4.01	1 L	bottle		on request
HI 7004L	4.01	500 mL	bottle		on request
HI 7004L/C	4.01	500 mL	bottle		•
HI 7004M	4.01	230 mL	bottle		on request
HI 8004/1L	4.01	1 L	bottle	•	•
HI 8004L	4.01	500 mL	bottle	•	•
HI 8004L/C	4.01	500 mL	bottle	•	•

SACHETS

CODE	pH VALUE @25°C	SIZE	PACKAGE	CERTIFICATE OF ANALYSIS
HI 70004C	4.01	20 mL	sachets (25)	•
HI 70004P	4.01	20 mL	sachets (25)	
HI 7004P/5	4.01	20 mL	sachets (500)	
HI 77400C	4.01 & 7.01	20 mL	sachets (10, 5 ea)	•
HI 77400P	4.01 & 7.01	20 mL	sachets (10, 5 ea)	

Traceability with NIST Standard Reference

HANNA pH 4.01 buffers are carefully prepared using the highest quality ingredients available and are standardized with NIST references.

pH Standard Calibration Solutions

6.86 Buffer Solution

Many of our portable and benchtop instruments, may now be calibrated with both pH 6.86 or pH 7.01 buffers.

The HANNA range of pH 6.86 buffer solutions has been expanded and stability has been improved to match the stability of pH 7.01.

BOTTLES

CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 7006/1G	6.86	1 gallon (3.78 L)	bottle		on request
HI 7006/1L	6.86	1 L	bottle		on request
HI 7006L	6.86	500 mL	bottle		on request
HI 7006L/C	6.86	500 mL	bottle		•
HI 7006M	6.86	230 mL	bottle		on request
HI 8006/1L	6.86	1 L	bottle	•	•
HI 8006L	6.86	500 mL	bottle	•	•
HI 8006L/C	6.86	500 mL	bottle	•	•

SACHETS

CODE	pH VALUE @25°C	SIZE	PACKAGE	CERTIFICATE OF ANALYSIS
HI 70006C	6.86	20 mL	sachets (25)	•
HI 70006P	6.86	20 mL	sachets (25)	

Traceability with Reference to NIST Standards

The buffer solution at pH 6.86 is standardized with a pH electrode and meter calibrated with NIST buffer solutions. The buffer is certified against to NIST standards.

7.01 Buffer Solution

pH 7.01 is the most widely used among all buffer solutions. For this reason we have prepared it in a wider variety of sizes to meet application demand.

HANNA pH buffer solutions are standardized against NIST reference solutions.

FDA approved bottle

For maximum reliability choose our solutions in bottles that meet the FDA standards (US Food & Drug Administration) that protect the solutions from extended exposure to light.

BOTTLES

CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 7007/1G	7.01	1 gallon (3.78 L)	bottle		on request
HI 7007/1L	7.01	1 L	bottle		on request
HI 7007L	7.01	500 mL	bottle		on request
HI 7007L/C	7.01	500 mL	bottle		•
HI 7007M	7.01	230 mL	bottle		on request
HI 8007/1L	7.01	1 L	bottle	•	•
HI 8007L	7.01	500 mL	bottle	•	•
HI 8007L/C	7.01	500 mL	bottle	•	•

SACHETS

CODE	pH VALUE @25°C	SIZE	PACKAGE	CERTIFICATE OF ANALYSIS
HI 70007C	7.01	20 mL	sachets (25)	•
HI 70007P	7.01	20 mL	sachets (25)	
HI 7007P/5	7.01	20 mL	sachets (500)	
HI 770710C	10.01 & 7.01	20 mL	sachets (10, 5 ea)	•
HI 770710P	10.01 & 7.01	20 mL	sachets (10, 5 ea)	
HI 77100C	1413 µS/cm & pH 7.01	20 mL	sachets (20, 10 ea)	•
HI 77100P	1413 µS/cm & pH 7.01	20 mL	sachets (20, 10 ea)	
HI 77200C*	1500 mg/L (ppm) & pH 7.01	20 mL	sachets (20, 10 ea)	•
HI 77200P*	1500 mg/L (ppm) & pH 7.01	20 mL	sachets (20, 10 ea)	
HI 77300C	1382 mg/L (ppm) & pH 7.01	20 mL	sachets (20, 10 ea)	•
HI 77300P	1382 mg/L (ppm) & pH 7.01	20 mL	sachets (20, 10 ea)	
HI 77400C	4.01 & 7.01	20 mL	sachets (10, 5 ea)	•
HI 77400P	4.01 & 7.01	20 mL	sachets (10, 5 ea)	
HI 77700C	7.01	20 mL	sachets (10, 5 ea)	•
HI 77700P	7.01	20 mL	sachets (10, 5 ea)	

* TDS Conversion Factor 4-4-2: 0.65 ppm = 1 µS/cm (approximately).

pH Standard Calibration Solutions

BOTTLES					
CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 70082M	8.20	230 mL	bottle		
HI 70083M	8.30	230 mL	bottle		

8.20 and 8.30 Buffer Solution

To increase accuracy of your measurement, HANNA 8.20 pH and 8.30 pH buffer solution. The label indicates the batch code, expiration data and pH/temperature correlation table.

BOTTLES					
CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 7009/1G	9.18	1 gallon (3.78 L)	bottle		on request
HI 7009/1L	9.18	1 L	bottle		on request
HI 7009L	9.18	500 mL	bottle		on request
HI 7009L/C	9.18	500 mL	bottle		•
HI 7009M	9.18	230 mL	bottle		on request
HI 8009/L	9.18	500 mL	bottle	•	•
HI 8009/1L	9.18	1 L	bottle	•	•
HI 8009L/C	9.18	500 mL	bottle	•	•

SACHETS				
CODE	pH VALUE @25°C	SIZE	PACKAGE	CERTIFICATE OF ANALYSIS
HI 70009C	9.18	20 mL	sachets (25)	•
HI 70009P	9.18	20 mL	sachets (25)	

9.18 Buffer Solution

To increase accuracy of your measurement in an alkaline environment, it is important to calibrate your electrode and meter in that pH range and to preferably bracket your sample values. HANNA offers both pH 9.18 buffer and 10.01 buffer to fufill this requirement.

BOTTLES					
CODE	pH VALUE @25°C	SIZE	PACKAGE	FDA BOTTLE	CERTIFICATE OF ANALYSIS
HI 7010/1G	10.01	1 gallon (3.78 L)	bottle		on request
HI 7010/1L	10.01	1 L	bottle		on request
HI 7010L	10.01	500 mL	bottle		on request
HI 7010L/C	10.01	500 mL	bottle		•
HI 7010M	10.01	230 mL	bottle		on request
HI 8010/1L	10.01	1 L	bottle	•	•
HI 8010L	10.01	500 mL	bottle	•	•
HI 8010L/C	10.01	500 mL	bottle	•	•

SACHETS				
CODE	pH VALUE @25°C	SIZE	PACKAGE	CERTIFICATE OF ANALYSIS
HI 70010C	10.01	20 mL	sachets (25)	•
HI 70010P	10.01	20 mL	sachets (25)	
HI 70010P/5	10.01	20 mL	sachets (500)	
HI 770710C	10.01 & 7.01	20 mL	sachets (10, 5 ea)	•
HI 770710P	10.01 & 7.01	20 mL	sachets (10, 5 ea)	

10.01 Buffer Solution

pH 10.01 solution is commonly used to calibrate equipment used for analyzing basic samples. pH 10.01 buffer solution is available in various forms: choose the one that best fits your needs

ORP and Sample Preparation Solutions

ORP standard solutions allows users to test the precision of ORP electrodes. For example, by immersing the electrode in HI 7020 solution, readings should fall within the 200 to 275 mV range (@20°C/68°F).

If the reading is outside the indicated interval, clean and condition your ORP electrode in HANNA pretreatment solution.

Use HI 7092 for oxidizing or HI 7091 for reducing pretreatment.

ORP Test and Pretreatment Solutions

BOTTLES			
CODE	DESCRIPTION	SIZE	CERTIFICATE OF ANALYSIS
HI 7020L	ORP test solution @200 to 275 mV (@25°C)	500 mL	on request
HI 7020M	ORP test solution @200 to 275 mV (@25°C)	230 mL	on request
HI 7021L	ORP test solution @240 mV (@25°C)	500 mL	on request
HI 7021M	ORP test solution @240 mV (@25°C)	230 mL	on request
HI 7022L	ORP test solution @470 mV (@25°C)	500 mL	on request
HI 7022M	ORP test solution @470 mV (@25°C)	230 mL	on request
HI 7091L	reducing pretreatment solution	500 mL	
HI 7091M	reducing pretreatment solution	230 mL	
HI 7092L	oxidizing pretreatment solution	500 mL	
HI 7092M	oxidizing pretreatment solution	230 mL	

Sample Preparation Solutions

BOTTLES			
CODE	DESCRIPTION	SIZE	CERTIFICATE OF ANALYSIS
HI 7051M	soil sample preparation solution	230 mL	
HI 7051L	soil sample preparation solution	500 mL	
HI 70960	preparation solution for solid or semi-solid samples	30 mL	