

LABORATORY SENSORS



pH & Redox



HAMILTON 
THE MEASURE OF EXCELLENCE™

Product overview

To order products from this catalog, please contact your laboratory electrode distributor or HAMILTON directly. We will be happy to put you in contact with your nearest distributor.

Other product lines from HAMILTON:

- pH electrodes and armatures for process applications
- Customized sensors and accessories
- Syringes
- SoftGrip™ pipettes
- SofTouch™ pipettes, SoftAide™ pipettes
- SofTop dispensers
- Diluters and dispensers
- Valves
- OEM components
- Pipetting robots
- Automated analyzers
- HPLC and GC columns
- GC liners

Innovations in electrochemistry	4
Electrode Selection Table	6
GLP Laboratory electrodes	8
Electrodes for general laboratory applications	9
Electrodes for special laboratory applications	12
Electrodes for foodstuff applications	13
Electrodes for portable equipment applications	14
Electrodes for Portamess equipment	15
Accessories - Cables, electrolytes, solutions	16
pH simulators and temperature sensors	17
Conductivity standards	18
DURACAL pH buffers	20
Practical advice for pH and Redox electrodes	22
Specifications	24
pH meter cross reference	26
Alphabetical index	27

Innovations in electrochemistry

HAMILTON pH sensors offer you more! Our electrochemical sensors are reliable tools characterized by the highest quality, long life, and outstanding accuracy of measurement. In order to continue meeting these rigorous requirements, HAMILTON constantly strives toward new horizons in sensor technology. Thanks not only to the efforts of our R&D department, but also to their close relationship with colleagues in production, HAMILTON is able to offer the following innovative solutions:



SINGLE PORE

The SINGLE PORE concept

Precise, reliable, and rapid readings with a patented system that ensures contact between the electrolyte and the sample. Since its introduction in 1991, the patented SINGLE PORE concept just continues to become more and more successful. The advantage of this solution is clear to see: Instead of the many tiny pores in a ceramic diaphragm, a SINGLE PORE about 200 times larger in cross-section (in the form of a capillary) performs the task. This SINGLE PORE is practically impossible to clog. In combination with a dedicated electrolyte, the flow rate through the pore is defined, resulting in enhanced contact between the reference electrode and the measurement medium. This leads to a faster electrode response and more accurate readings.

However, even after 15 very successful years, HAMILTON has found a way to improve the design of the SINGLE PORE, so that today the SINGLE PORE GLASS electrode is even more robust and user-friendly than ever.

Note: The PTB (Physikalisch-Technische Bundesanstalt (Physical-Technical Federal Institute)) in Braunschweig, Germany, in a very wide-ranging and well documented study, determined the SINGLE PORE pH electrode to be the most accurate laboratory electrode in the test. Further information can be found in "Traceability of pH measurement" by Petra Spitzer: ISBN 3-89429-877-4 or ISSN 0947-7063.



POLISOLVE and POLISOLVE PLUS electrolyte

The innovative polymer reference electrolyte that solves so many application problems

Contrary to the widespread belief that pH electrodes with a polymer electrolyte cannot be used over the entire pH or temperature range, HAMILTON has succeeded in developing the innovative POLISOLVE polymer electrolyte that can be used over the complete pH range from 0 to 14, and in a temperature range from -10°C to 130°C.

POLISOLVE is compatible with most organic solvents, and is completely Acrylamide free. The combination of POLISOLVE electrolyte with the modified SINGLE PORE concept results in an extremely versatile laboratory electrode that is perfectly suited to pH measurement in a wide range of uses, for example in:

- Ground water and coolants
- Solutions containing color pigments
- Suspensions
- Galvanic baths
- Samples containing oil and fat
- Solutions containing protein

And now, with POLISOLVE PLUS, HAMILTON has achieved an important new development that means even more stable reference signals. Thanks to an ingenious integrated filter system, reference poisons remain harmless for even longer. At the same time, troublesome diffusion potentials are minimized and measurement accuracy is enhanced. In short: POLISOLVE PLUS represents a significant improvement in extending the life of pH sensors.



The EVEREF reference system

Long electrode life, thanks to stable reference potentials

Stable reference systems are at the heart of reliable, long-life electrodes. This is why many HAMILTON electrodes are equipped with reference systems from the EVEREF family. The silver chloride reservoir is separated from the reference electrolyte by a diffusion distance that prevents the loss of silver chloride during temperature swings which allows the use of silver-free electrolyte.

The EVEREF® B labyrinth system used in the POLILYTE LAB electrodes further extends the diffusion distance, considerably lengthening electrode life in aggressive media. These electrodes provide outstanding results in ion-weak and partially aqueous solutions.

HAMILTON pH membrane glass

Guarantee the accuracy of your measurements

The continuous improvement of our pH membrane glass offers many previously unavailable benefits. Most laboratory electrodes have a "V" type glass membrane. This unique glass possesses excellent mechanical stability and very low membrane resistance. This makes measurements possible in solutions with low conductivity.

"HF" glass is a development that guarantees the longest possible electrode life in processes containing hydrofluoric acid. In addition, this glass is well suited to the production of flat pH membranes. These are of great advantage, for example, with the Flatrode for readings of small volumes or on a flat surface areas.

HAMILTON "H" glass displays excellent characteristics and stable measurement values in media with low water content, for example in anhydrous or only partially aqueous solutions.

The low alkali error of "H" glass ensures accurate measurements even at high pH values.



Conductivity standards

Certified by an accredited laboratory

Fulfills all requirements of United States Pharmacopia USP Chapter 625

HAMILTON is the first vendor in the world of conductivity standards to offer 1.3 and 5 $\mu\text{S}/\text{cm}$ with a certified accuracy of $\pm 1\%$ and a lifetime of 1 and 3 years, respectively. The composition of these standards is patented. The measurement procedure for determining conductivity has been developed in collaboration with DFM¹⁾. A number of state metrological institutes that deal with measurement of electrolytic conductivity have started using these HAMILTON standards, since they lie in a low conductivity range and exhibit a previously unknown level of stability, confirmed by measurements performed by PTB²⁾.

For this reason, in an inter-laboratory test among prestigious European metrological institutes (PTB, DFM, DKD³⁾) it was HAMILTON standards that were used as the measurement solution.

See page 18 for details

¹⁾ DFM: Danish Institute of Fundamental Metrology, Denmark

²⁾ PTB: Physikalisch-Technische Bundesanstalt, Braunschweig

³⁾ DKD: Deutscher Kalibrierdienst



Duracal pH buffers

Certified by an accredited laboratory

Easy handling and 5-year stability

A complete range of patented stable pH buffer solutions from pH 1.09 to 12.00. HAMILTON guarantees DURACAL pH buffers to last for five years from the date of manufacture. The pH 9.21 and pH 10.1 buffers are even stable in air. High buffer capacities enable quick, stable calibrations.

Closed-loop traceability: In contrast with other manufacturers, who operate using only hierarchical (top-down) traceability, HAMILTON has developed a new approach featuring "closed-loop" traceability for the values 4.01, 7.00, 9.21 and 10.01. For users of DURACAL pH buffer solutions, this ensures a unique level of reliability.

Top-down traceability: With HAMILTON, the pH value of the DURACAL buffer is determined by a comparison with two secondary reference solutions.

Bottom-up traceability: From each batch manufactured, a representative quantity is measured at DKD. This ensures an external, independent verification by an accredited institute.

DKD issues an official calibration certificate for the corresponding DURACAL production batch.

See page 20 for details



Electrode Selection Table

Electrode	PN	Page	Acid, battery	Acid, hydrofluoric	Aqueous emulsions, suspensions	Aqueous solutions	Calcium oxide solution	Calcium sulphate solution	Copper bath	Cosmetics	Crème fraîche, milk, cream	Cyanide decontamination	Disinfectant	Earth	Emulsions	Fat	Fertilizer solutions	Field measurements	Fixing baths	Fruit & vegetables	Galvanic baths	Hydrogen peroxide (30%)	Infusion solutions	
Biotrode	238140	12																						
Double Pore	238400	13																						
Filltrode	242064	11																						
Flatrode	238401	12																						
Flushrode*	238060	11								P	P													
Foodtrode	238285	13																						
Gel-Glass	238025	11																						
Liq-Glass	238000	9																						
Liq-Glass BNC	238180	9																						
Liq-Glass DIN	238185	9																						
Liq-Glass ORP	238145	9																						
Liq-Glass Temp BNC	242056	9																						
Liq-Glass Temp DIN	238406	9																						
Liq-Glass Temp Lemo	242054	9																						
Minitrode	238100	12																						
Polilyte Lab	238403	10																						
Polilyte Lab Temp BNC	242060	10																						
Polilyte Lab Temp DIN	242058	10																						
Polilyte Lab Temp Lemo	242062	10																						
Polyplast	238380	14																						
Polyplast BNC	238381	14																						
Polyplast ORP	238385	14																						
Polyplast ORP BNC	238384	14																						
Polyplast Temp BNC	242050	14																						
Polyplast Temp DIN	238404	14																						
Polyplast Temp Lemo	242052	14																						
Single Pore Glass	238160	10																						
Slimtrode	238150	11																						
Spintrode	238197	12																						
Tiptrode	238080	13																						

* With samples containing protein (P), replace the electrolyte 3 M KCl with the separately available electrolyte PROTELYTE (see page 16).

GLP Laboratory electrodes

Design offers many advantages

- All electrodes are printed with an indelible serial number
- Individual test certificates with measured millivolt values
- Indelible marking ensures long-term readability
- Ergonomic electrode head
- Proven electrolyte sealing system
- High-quality seal between electrode head and cable (IP 68)
- Integrated, captive seal at the electrode refilling plug
- Blue inner buffer provides visual indication of contact with the pH membrane

Watering cap with screw lock

- Easy removal of the watering cap by means of the screw lock
- Secure sealing of the watering cap
- No spilling of electrolyte when removing the watering cap



Electrodes for general laboratory applications

LIQ-GLASS

PN 238000	Liq-Glass (without cable)
PN 238180	Liq-Glass BNC
PN 238185	Liq-Glass DIN

- Robust, combination pH electrode for daily laboratory use
- Universally applicable, in strong acids as well as in strong bases
- Ideally suited for acid/base titrations
- Serial number, certificate

Specifications:

pH: 0 to 14

Electrolyte: 3 M KCl (refillable)

Diaphragm: ceramic

Temperature sensor: no

T: -10 to 100°C

Shaft material: glass

Reference system: EVEREF

Sensor connection: S7 connector head, 1 m BNC or 1 m DIN



LIQ-GLASS TEMP

PN 242056	Liq-Glass Temp BNC
PN 238406	Liq-Glass Temp DIN
PN 242054	Liq-Glass Temp Lemo

- Robust, combination pH electrode for daily laboratory use
- Universally applicable, in strong acids as well as in strong bases
- Ideally suited for acid/base titrations
- Integrated temperature sensor (NTC 30 kOhm or Pt1000)
- Serial number, certificate

Specifications:

pH: 0 to 14

Electrolyte: 3 M KCl (refillable)

Diaphragm: ceramic

Temperature sensor: yes

Sensor connection:

T: -10 to 100°C

Shaft material: glass

Reference system: EVEREF

NTC 30 kOhm (PN 238406): Pt1000 (PN 242054: 242056)

PN 242056: 1 m BNC cable / 1 x 4 mm banana plug

PN 238406: 1 m DIN cable / 1 x 4 mm banana plug

PN 242054: 1 m LEMO cable / 2 x 2 mm banana plug
(2 adapters for 4 mm banana plug included)



LIQ-GLASS ORP

PN 238145	Liq-Glass ORP
-----------	---------------

- Robust, combination Redox electrode for all usual Redox measurements in the laboratory
- Universally applicable, in strong acids as well as in strong bases
- Long-term-stable EVEREF system
- Serial number, certificate

Specifications:

Redox: ± 2000 mV

Electrolyte: 3 M KCl (refillable)

Diaphragm: 3 x ceramic

Temperature sensor: no

T: -10 to 100°C

Shaft material: glass

Reference system: EVEREF

Sensor connection: S7 connector head



Accessories on page 16

Electrodes for general laboratory applications



SINGLE PORE GLASS

PN 238160 SINGLE PORE Glass

- Highest accuracy and fast response time thanks to patented SINGLE PORE diaphragm
- Robust design for easy cleaning
- Wide applicability, use for emulsions, ion-weak media or general laboratory applications
- Reported by PTB to be the most accurate laboratory electrode tested
- Minimal alkali error
- Serial number, certificate

Specifications:

pH: 0 to 14	T: 0 to 100°C
Electrolyte: SKYLYTE-CL (refillable)	Shaft material: glass
Diaphragm: SINGLE PORE	Reference system: EVEREF
Temperature sensor: no	Sensor connection: S7 connector head



POLILYTE LAB

PN 238403 Polilyte Lab

- Maintenance-free, robust, combination easy-to-use pH electrode
- Universally applicable, well suited for measurements in emulsions and suspensions
- Thanks to the SINGLE PORE clogging of the diaphragm is practically impossible
- Serial number, certificate

Specifications:

pH: 0 to 14	T: -10 to 80°C
Electrolyte: POLISOLVE (maintenance-free)	Shaft material: glass
Diaphragm: SINGLE PORE	Reference system: EVEREF-B
Temperature sensor: no	Sensor connection: S7 connector head



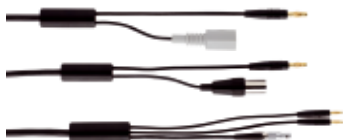
POLILYTE LAB TEMP

PN 242060 Polilyte Lab Temp BNC
PN 242058 Polilyte Lab Temp DIN
PN 242062 Polilyte Lab Temp Lemo

- Maintenance-free, robust, combination pH electrode for daily laboratory use
- Universally applicable, well suited for measurements in emulsions and suspensions
- Thanks to the SINGLE PORE, clogging of the diaphragm is practically impossible
- Integrated temperature sensor (NTC 30 kOhm or Pt1000)
- Serial number, certificate

Specifications:

pH: 0 to 14	T: -10 to 80°C
Electrolyte: POLISOLVE (maintenance-free)	Shaft material: glass
Diaphragm: SINGLE PORE	Reference system: EVEREF-B
Temperature sensor: yes	NTC 30 kOhm (PN 242058); Pt1000 (PN 242060, 242062)
Sensor connection:	PN 242060: 1 m BNC cable / 1 x 4 mm banana plug PN 242058: 1 m DIN cable / 1 x 4 mm banana plug PN 242062: 1 m LEMO cable / 2 x 2 mm banana plug (2 adapters for 4 mm banana plug included)



Accessories on page 16

Electrodes for general laboratory applications

FLUSHTRODE

PN 238060 Flushtrode

- Easy-to-clean, combination glass electrode with sleeve diaphragm
- Ideally suited for viscous samples, ion-weak media, or media containing protein (e.g. cosmetics)
- For samples containing protein, the electrode should be replaced with PROTELYTE (PN 238038)
- Serial number, certificate

Specifications: pH: 0 to 14
Electrolyte: 3 M KCl (refillable)
Diaphragm: sleeve diaphragm
Temperature sensor: no

T: -10 to 80°C
Shaft material: glass
Reference system: EVEREF
Sensor connection: S7 connector head



SLIMTRODE

PN 238150 Slimtrode

- pH electrode with 6 mm shaft diameter, for measurements in test tubes
- Universally applicable, even in strong acids as well as in normal laboratory use
- Long-term-stable EVEREF system
- Serial number, certificate

Specifications: pH: 0 to 14
Electrolyte: 3 M KCl (refillable)
Diaphragm: ceramic
Temperature sensor: no

T: 0 to 100°C
Shaft material: glass
Reference system: EVEREF
Sensor connection: S7 connector head



FILLTRODE

PN 242064 Filltrode

- Robust pH electrode with plastic shaft
- Multiple applications, thanks to its flat membrane: e.g. for viscous media
- Easy to clean
- The ring diaphragm prevents clogging
- Serial number, certificate

Specifications: pH: 0 to 14
Electrolyte: SKYLYTE-CL (refillable)
Diaphragm: ring diaphragm
Temperature sensor: no

T: 0 to 60°C
Shaft material: plastic
Reference system: EVEREF
Sensor connection: S7 connector head



GEL-GLASS

PN 238025 Gel-Glass

- Maintenance-free, excellent value, pH electrode for less rigorous applications
- Serial number, certificate

Specifications: pH: 0 to 14
Electrolyte: gel (maintenance-free)
Diaphragm: ceramic
Temperature sensor: no

T: -10 to 60°C
Shaft material: glass
Reference system: Ag/AgCl
Sensor connection: S7 connector head



Accessories on page 16

Electrodes for special laboratory applications



BIOTRODE

PN 238140

Biotrode

- Combination pH electrode for measurements in very small volumes, e.g. microtiter plates
- Ideally suited for solutions containing protein, as PROTELYTE prevents clogging of the diaphragm
- Long-term-stable EVEREF system
- Requires an immersion depth of only 7 mm
- Serial number, certificate

Specifications:

pH: 0 to 14

Electrolyte: Protelyte (refillable)

Diaphragm: ceramic

Temperature sensor: no

T: 0 to 100°C

Shaft material: glass

Reference system: EVEREF

Sensor connection: S7 connector head



MINITRODE

PN 238100

Minitrode

- Combination pH electrode for measurements in very small volumes, e.g. vials
- Long-term-stable EVEREF system
- Requires an immersion depth of only 7 mm
- Serial number, certificate

Specifications:

pH: 0 to 14

Electrolyte: 3 M KCl (refillable)

Diaphragm: ceramic

Temperature sensor: no

T: 0 to 100°C

Shaft material: glass

Reference system: EVEREF

Sensor connection: S7 connector head



SPINTRODE

PN 238197

Spintrode

- Combination pH electrode for measurements in very small volumes, e.g. NMR tubes
- Long-term-stable EVEREF system
- Requires an immersion depth of only 7 mm
- Serial number, certificate

Specifications:

pH: 0 to 14

Electrolyte: 3 M KCl (refillable)

Diaphragm: ceramic

Temperature sensor: no

T: 0 to 100°C

Shaft material: glass

Reference system: EVEREF

Sensor connection: S7 connector head



FLATRODE

PN 238401

Flatrode

- pH electrode with a true flat membrane for measurements of surfaces, e.g. paper, agar plates
- Robust plastic shaft and ring diaphragm
- Ring diaphragm guarantees quick response time because of enhanced contact between sample and reference
- Long-term-stable EVEREF system
- Serial number, certificate

Specifications:

pH: 0 to 14

Electrolyte: SKYLYTE-CL (refillable)

Diaphragm: ring diaphragm

Temperature sensor: no

T: 0 to 60°C

Shaft material: Plastic

Reference system: EVEREF

Sensor connection: S7 connector head

Accessories on page 16

Electrodes for foodstuff applications

FOODTRODE

PN 238285 Foodtrode

- Robust, combination pH electrode for measurements in media containing proteins
- 3 ceramic diaphragms guarantee quick and accurate measurements
- Easy to clean
- Long-term-stable, thanks to EVEREF system
- Serial number, certificate

Specifications:

pH: 0 to 14	T: -10 to 100°C
Electrolyte: PROTOLYTE (refillable)	Shaft material: glass
Diaphragm: 3 x ceramic	Reference system: EVEREF
Temperature sensor: no	Sensor connection: S7 connector head



DOUBLE PORE

PN 238400 Double Pore

- Maintenance-free, combination pH puncture electrode
- Especially for use with solid and semisolid samples
- Ideally suited for measurements in meat and cheese
- 2 SINGLE PORES makes clogging of the diaphragm practically impossible
- Serial number, certificate

Specifications:

pH: 0 to 14	T: 0 to 60°C
Electrolyte: POLISOLVE (maintenance-free)	Shaft material: glass
Diaphragm: 2 x SINGLE PORES	Reference system: Ag/AgCl
Temperature sensor: no	Sensor connection: S7 connector head



TIPTRODE

PN 238080 Tiptrode

- Refillable, combination pH puncture electrode
- Especially for use with solid and semisolid samples
- Long-term-stable EVEREF system
- Serial number, certificate

Specifications:

pH: 0 to 14	T: 0 to 100°C
Electrolyte: PROTOLYTE (refillable)	Shaft material: glass
Diaphragm: ceramic	Reference system: EVEREF
Temperature sensor: no	Sensor connection: S7 connector head



Accessories on page 16

Electrodes for portable equipment applications



POLYPLAST

PN 238380 Polyplast
PN 238381 Polyplast BNC

- Robust, maintenance-free, combination pH electrode
- Shatter-proof plastic shaft
- Excellent for water and sewage
- Serial number, certificate

Specifications:

pH: 0 to 14
Electrolyte: POLISOLVE (maintenance-free)
Diaphragm: SINGLE PORE
Temperature sensor: no

T: 0 to 60°C
Shaft material: Plastic
Reference system: Ag/AgCl
Sensor connection: S7 connector head or 1 m BNC



POLYPLAST TEMP

PN 242050 Polyplast Temp BNC
PN 238404 Polyplast Temp DIN
PN 242052 Polyplast Temp Lemo

- Robust, maintenance-free, combination pH electrode
- Shatter-proof plastic shaft
- Excellent for water and sewage
- Integrated temperature sensor (NTC 30 kOhm or Pt1000)
- Serial number, certificate

Specifications:

pH: 0 to 14
Electrolyte: POLISOLVE (maintenance-free)
Diaphragm: SINGLE PORE
Temperature sensor: yes
Sensor connection:

T: 0 to 60°C
Shaft material: Plastic
Reference system: Ag/AgCl
NTC 30 kohm (PN 238404): Pt 1000 (PN 242050/242052)
PN 242050: 1 m BNC cable / 1 x 4 mm banana plug
PN 238404: 1 m DIN cable / 1 x 4 mm banana plug
PN 242052: 1 m LEMO cable / 2 x 2 mm banana plug
(2 adapters for 4 mm banana plug included)



POLYPLAST ORP

PN 238385 Polyplast ORP
PN 238384 Polyplast ORP BNC

- Robust, maintenance-free, combination Redox electrode
- Shatter-proof plastic shaft
- Excellent for water and sewage
- Serial number, certificate

Specifications:

Redox: ± 2000 mV
Electrolyte: POLISOLVE (maintenance-free)
Diaphragm: SINGLE PORE
Temperature sensor: no

T: 0 to 60°C
Shaft material: Plastic
Reference system: Ag/AgCl
Sensor connection: S7 connector head or 1 m BNC

Accessories on page 16

Electrodes for Portamess equipment

These electrodes are especially well suited for KNICK Portamess equipment
The electrode head creates a hermetic seal with the Portamess storage tube

LIQ-GLASS KNICK

PN 242068 Liq-Glass Knick Temp DIN

- Combination electrode for daily laboratory use, with glass shaft
- Universally applicable, even in strong acid as well as in normal use
- Serial number, certificate

Specifications:

pH: 0 to 14	T: -10 to 100°C
Electrolyte: 3 M KCl (refillable)	Shaft material: glass
Diaphragm: ceramic	Reference system: EVEREF
Temperature sensor: yes	Pt1000
Sensor connection:	1 m cable + DIN plug / 1 x 4 mm banana plug



POLYPLAST KNICK

PN 242070 Polyplast Knick Temp DIN

- Robust plastic shaft
- Ideally suited for field measurements
- Clog-free SINGLE PORE guarantees quick and reliable measurements
- Serial number, certificate

Specifications:

pH: 0 to 14	T: 0 to 60°C
Electrolyte: POLISOLVE (maintenance-free)	Shaft material: Plastic
Diaphragm: SINGLE PORE	Reference system: Ag/AgCl
Temperature sensor: yes	Pt1000
Sensor connection:	1 m cable + DIN plug / 1 x 4 mm banana plug



DOUBLE PORE KNICK

PN 242066 Double Pore Knick

- Robust PEEK shaft
- Smallest possible surface sample contact with glass
- Ideally suited for measurements of solid and semisolid samples (e.g. cheese, meat)
- 2 SINGLE PORES makes clogging of the diaphragm practically impossible
- Serial number, certificate

Specifications:

pH: 0 to 14	T: 0 to 60° C
Electrolyte: POLISOLVE (maintenance-free)	Shaft material: PEEK (high-performance plastic)
Diaphragm: 2 SINGLE PORES	Reference system: Ag/AgCl
Temperature sensor: no	Sensor connection: 1 m cable + DIN plug



Accessories on page 16

Accessories

Cables:

Cables are fitted with an S7 socket. The equipment-side plug must be chosen to fit the pH meter. The cables have a diameter of 3 mm and a standard length of 1 m, 3 m, and 5 m.

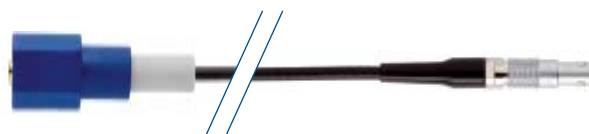
PN 355173: 1 m cable S7 / BNC *
PN 355176: 3 m cable S7 / BNC *
PN 355178: 5 m cable S7 / BNC *



PN 355174: 1 m cable S7 / DIN
PN 355177: 3 m cable S7 / DIN
PN 355179: 5 m cable S7 / DIN



PN 355175: 1 m cable S7 Lemo



* All BNC plugs have a moveable protective cover.

This helps ensure consistent results, as the plug is better protected from fluid splashes.

Electrolytes and solutions:

Electrolyte:

PN 238036: 3 M KCl, 100 ml
PN 238936: 3 M KCl, 500 ml
PN 242080: SKYLYTE-CL, 100 ml
PN 238038: PROTELYTE, 100 ml

Storage solution

For long life and faster electrode response times, it is best to store electrodes in our storage solution. This is an acid-buffered solution that in addition to providing optimized storage, also ensures regeneration of the electrode.

PN 238931: Storage solution, 500 ml



Cleaning solutions

Depending on the type of the application the pH glass or diaphragm can become contaminated. This is indicated by slow response of the electrode, or even incorrect readings. To overcome these problems, HAMILTON has developed a cleaning solution set.

The set comprises Cleaning Solution A, Cleaning Solution B, and a storage solution, each 500 ml in volume.

PN 238290: Cleaning solution set



pH simulators and temperature sensors

pH simulators

Applications for pH simulators:

- **Testing cables and measurement devices**
- **ISO 9000 test device monitoring with DKD certificate**

Testing cables and measurement devices:

Sometimes pH measurement problems are attributed to defective or poorly-chosen pH sensors. But often the cause is poor-quality, worn, or defective pH cables, which no longer fulfill the high demands of insulation resistance. Not to be forgotten are similar faults in measurement devices, that also make reliable pH measurement impossible. These problems can be detected with the pH simulator, eliminating costly and time-consuming trials of different electrodes.

ISO 9000 test device monitoring:

To adapt the simulator for ISO 9000-compliant test device monitoring on the shop floor, the device must be certified by DKD, the German calibration service, which is accredited by PTB (Physikalisch-Technische Bundesanstalt, Braunschweig) for the measurements involved. The DKD certificate contains the measured mV values, which must be displayed by the measurement device being tested within the given tolerances.

pH SIMULATOR LAB

Simulates pH and Redox sensors

For testing cables and measurement devices

16 test values, including NIST pH buffer values

Testing of pH input resistance (Hi Z)

Adapter cable for BNC, standard S7 plug

- Easy and safe operation, using high-quality touch-buttons
- Simple, one-hand operation
- Large, easy-to-read illuminated display
- Testing of high-ohm measurement device input resistance and the often poor resistance of pH cables
- Battery level display ensures correct operation and eliminates unnecessary battery changes
- Waterproof front
- DKD certificate with measured mV values available as an option

pH SIMULATOR LAB



pH SIMULATOR PRO

Same as pH SIMULATOR LAB, but also includes:

- Protective rubber cover with folding support
- Service case with place for 2 x 250 mL pH buffer
- With SIMULATOR PRO, the rubber cover protects against minor knocks, mechanical damage, and also contains a leg to prop up the simulator for ease of reading
- The SIMULATOR PRO is equipped with extra adapter cables for VP cable tests, including Pt100 or Pt1000 simulations
- DKD certificate with measured mV values available as an option

pH SIMULATOR PRO



Specifications	
pH simulation values	pH 1.00, 1.68, 4.01, 6.86, 7.00, 9.18, 10.01, 12.45
pH simulation accuracy	±0.02 pH
mV simulation values	-1800, -900, -390, +390, +900, +1800 mV
mV simulation accuracy	±1 mV
pH input resistance test (Hi Z)	1 GOhm at pH 4.01 and 10.01
Display	LEDs, values separated for ease of operation
Output	BNC plugs, various adapter cables
Battery state display	LED
Power source	4 x AAA batteries
Operating temperature	0 to 40°C
Permissible air humidity	80% up to 30°C, linear decrease up to 50% at 40°C
Measurements	Approximately 140 x 170 x 35 mm

Label	PN
pH SIMULATOR LAB	237556
pH SIMULATOR LAB with certificate	237560
pH SIMULATOR PRO	237550
pH SIMULATOR PRO with certificate	237566
Replacement parts:	
Rubber protective cover	237552
Accessories:	
DURACAL pH buffer pH 4.01, 250 mL	238317
DURACAL pH buffer pH 7.00, 250 mL	238318
DURACAL pH buffer pH 9.21, 250 mL	238319
DURACAL pH buffer pH 10.01, 250 mL	238321

Conductivity standards

HAMILTON conductivity standards – leading in long-term stability and accuracy

Although seemingly a minor matter, calibration and verification of conductivity sensors is far from simple. This is particularly the case with measurements in the low conductivity range, for which stable and reliable calibration standards have been completely lacking up to now. Since a conductivity standard is not a buffer solution, the lower the value of the conductivity standard, then the greater the effect of entry of CO₂ or contamination.

HAMILTON is the first manufacturer to offer conductivity standards of 1.3 and 5 µS/cm with a certified accuracy of ±1%, and a lifetime of 1 and 3 years respectively. The composition of these standards is patented; the procedure for determining conductivity was developed in collaboration with DFM¹⁾. Many state metrological institutes that deal with measurement of electrolytic conductivity use HAMILTON standards, since they lie in a low conductivity range and exhibit the type of stability that has never been achieved before (see illustration "Stability over 3 years" on page 19, with test measurements by PTB²⁾). During an interlaboratory test among prestigious European metrological institutes (PTB, DFM, DKD³⁾) HAMILTON standards were used as the measurement solution.

HAMILTON is different:

HAMILTON offers conductivity standards with various conductivity values, whose stability of ±1% is guaranteed over a lifetime of up to 3 years. These standards can be used repeatedly, on condition that the bottle is not left open (without its lid) for more than 1 hour in total.

In order to ensure the accuracy of the conductivity standards a representative number of bottles from each batch are measured by DFM. The DFM value is recorded on the calibration certificate and on each bottle. DFM enjoys the highest prestige in Europe in the area of electrolytic conductivity and is equipped with an absolute measurement cell that was developed in collaboration with NIST, and is accredited by the Danish accreditation agency DANAK to a conductivity of 0.9 µS/cm. DFM and NIST⁴⁾ have made comparisons of their measurement uncertainty and have confirmed in a series of scientific publications that the measurement accuracy is in each case the same. Because no primary standards exist in the low conductivity range, we depend on absolute measurement cells which trace electrical conductivity back to the SI units: meter and Volt. Testing of HAMILTON standards is thus carried out on the most precise measurement apparatus in the world, and certified accordingly.

¹⁾ DFM: Danish Institute of Fundamental Metrology, Denmark

²⁾ PTB: Physikalisch-Technische Bundesanstalt, Braunschweig

³⁾ DKD: Deutscher Kalibrierdienst

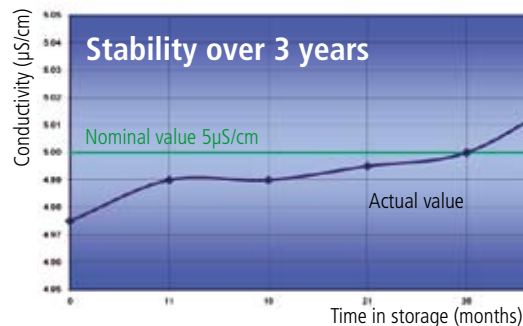
⁴⁾ NIST: National Institute of Standards and Technology, Gaithersburg MD, USA




Conductivity standards


Unique advantages:

- Remains stable for a minimum of 1 year for 1.3 µS/cm, and up to 3 years for all other values
- Certificate with calibration document from DFM (available at www.hamiltoncompany.com/cert)
- Expiration date shown on every bottle
- Bottles are permitted to stay open for a total of 60 minutes





Danish Fundamental Metrology
Møntetårnet 307
DK-2800 Kgs. Lyngby
Phone: +45 45 93 11 44



DANAK
CAL. Reg. nr. 255

Certificate nr. C0614
Page 1 of 2

Part Nr.: 238973/01
PO Nr.: 238973/01
PPL Nr.: 238973/01
Dat.: 2006-03-10

Calibration certificate

Electrolytic conductivity

Client	Hamilton Bonaduz AG
Address	Via Crusch 8, CH-7402 Bonaduz, Switzerland
Telephone/Fax	+41 81 660 6060
Contact person	Dr. Philipp Arquint
Date received	2006-02-23

Identification	Hamilton 1,3 µS/cm Standard
Batch	P/N 238973, WO 1278874
Date of calibration	2006-03-06

Result: Hamilton 1,3 µS/cm Standard, P/N 238973, WO 1278874, sample 1

Laboratory environmental conditions: $T = 23,0 \pm 0,5 \text{ }^\circ\text{C}$, $RH = 45 \pm 5 \%$, $\rho(\text{CO}_2)/p_0 = 380 \pm 70 \text{ ppm}$

T_0 (°C)	$k(T_0)$ (µS/cm)	$U(k)$ (µS/cm)
25,00	1,2897	0,0025

The reported measurement uncertainty U is given as the standard uncertainty multiplied with a coverage factor of $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty has been calculated in accordance with EA-04/2.

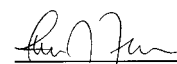
Method and details of the measurement is given on page 2.

The calibration is traceable to recognised national and international standards.

The calibration has been performed under DANAK accreditation no. 255.

Parts of the calibration certificate can only be reproduced with the written consent of DFM.

DANAK is one of the signatories to the EA Multilateral Agreement for the mutual recognition of calibration certificates.


 Hans D. Jensen
 Ph.D.

Date: 2006-03-10

DANAK accreditation no. 255
Danish Fundamental Metrology
Møntetårnet 307, DK-2800 Kgs. Lyngby

Certificate nr. C0614
Page 2 of 2
Date: 2006-03-10

Method

The solution was supplied by the client. Solution samples were provided in glass bottles containing 300 ml. The bottles were closed with a screw cap and seal.

The conductivity has been derived from a measurement of the impedance of the solution in the frequency range from 1 kHz to 3 kHz and from the calibrated cell constant of the cell used. The cell was temperature controlled by submersion in an oil bath with stability better than 2 mK. The value for the conductivity has been referred to the given temperature(s) using a correction based on the measurement of the temperature coefficient of the solution. At 25 °C the average temperature deviation was 13 mK and the temperature coefficient was determined to 6,8 %/°C (procedure Q2KAL801).

The conductivity cell was last calibrated 2005-07-01 (DFM certificate C10503).
The impedance bridge was last calibrated 2005-04-01 (DFM certificate C1R0501).
The thermometer used was last calibrated 2006-01-10 (DANAK 98 certificate 15692).

No uncertainty contribution for CO₂ sensitivity of the solution has been taken into account. The average CO₂ partial pressure was measured near the measurement position and is given with the result.

DFM has participated in international comparisons of conductivity measurements, including CCQM P22 and CCQM P47. In the comparisons, DFM results show agreement with the international consensus within the reported measurement uncertainties.

DANAK (Danish Accreditation)

DANAK was established in 1991 in pursuance of the Danish Act No. 394 of 13 June 1990 on the promotion of Trade and Industry.

The requirements to be met by accredited laboratories are laid down in the "Danish Agency for Trade and Industry's" ("Erhvervsfremme Styrelsen's") Statutory Order on accreditation of laboratories to perform testing etc. and GLP-inspection. The statutory order refers to other documents where the criteria for accreditation are specified further.

The standards ISO/IEC 17025 "General requirements for the competence of testing and calibration laboratories" and ISO/IEC 45002 "General criteria for the assessment of testing laboratories" describes fundamental criteria for accreditation. DANAK uses guidance documents to clarify the requirements in the standards, where this is considered to be necessary. These will mainly be drawn up by the "European co-operation for Accreditation (EA)" or the "International Laboratory Accreditation Co-operation (ILAC)" with a view to obtaining uniform criteria for accreditation worldwide. In addition, DANAK draws up Technical Regulations with specific requirements for accreditation that are not contained in the standards.

In order for a laboratory to be accredited it is, among other things, required:

- that the laboratory and its personnel are not subject to any commercial, financial or other pressures, which might influence their technical judgement,
- that the laboratory operates a documented quality system,
- that the laboratory has at its disposal all items of equipment, facilities and premises required for correct performance of the service that it is accredited to perform,
- that the laboratory management and personnel have technical competence and practical experience in performing the service that they are accredited to perform,
- that the laboratory has procedures for traceability and uncertainty calculations,
- that accredited testing or calibration is performed in accordance with fully validated and documented methods,
- that the laboratory keeps records which contain sufficient information to permit repetition of the accredited test or calibration,
- that the laboratory is subject to surveillance by DANAK on a regular basis, - that the laboratory shall take out an insurance, which covers liability in connection with the performance of accredited services.

Reports carrying DANAK's logo are used when reporting accredited services and show that these have been performed in accordance with the rules for accreditation.

Value at 25°C	Accuracy	Stability (in months)	Certificate from	Packaging unit	PN
1.3 µS/cm	±1%	12	DFM	Glass bottle 300 mL	238973
5 µS/cm	±1%	36	DFM	Glass bottle 300 mL	238926
15 µS/cm	±1%	36	DFM	Glass bottle 300 mL	238927
84 µS/cm	±1%	18	DFM	1 Calpack bottle 500 mL	238984
100 µS/cm	±1%	36	DFM	Glass bottle 300 mL	238934
147 µS/cm	±1%	18	DFM	1 Calpack bottle 500 mL	238985
1413 µS/cm	±1%	36	DFM	Glass bottle 300 mL	238928
1413 µS/cm	±1%	18	DFM	1 Calpack bottle 500 mL	238986
100 mS/cm	±1%	24	HAMILTON	Glass bottle 300 mL	238935
12288 µS/cm	±1%	18	DFM	1 Calpack bottle 500 mL	238988

DURACAL pH buffers

Can you trust your buffer solution?

GMP, GLP, ISO 9001, EN 45000, calibration, verification, traceability, certification from an accredited organization: key expressions that are increasingly important. The calibration of pH and Redox electrodes has never been easy. All calibration procedures assume that the labeled values of the calibration buffers are correct. But buffer values can change over time and so can your results.

A complete range of patented buffer solutions provides pH stability never before achieved. HAMILTON guarantees DURACAL pH buffers for 5 years after the date of manufacture. The pH 9.21 and pH 10.01 buffers are even stable in air. High buffering capacity provides rapid, stable calibration. The growth of fungus and micro-organisms is prevented.

Traceability

An important issue for the production of Certified Reference Material is to ensure traceability through an unbroken chain of comparisons to reference material of the highest metrological quality (Primary Reference Material) from NIST¹⁾ and PTB²⁾.

Unlike other manufacturers, where only top-down traceability is applied, HAMILTON works with circular or closed-loop traceability. This closed-loop traceability ensures users of the unique reliability of HAMILTON DURACAL buffers.

Top-down traceability: At HAMILTON, the pH value of DURACAL buffers is determined by comparison against two secondary reference buffer solutions. These are purchased from accredited suppliers of secondary reference materials. The solutions themselves are compared against primary reference solutions from PTB¹⁾ or NIST²⁾. The measurement uncertainties from each measurement comparison are known and documented.

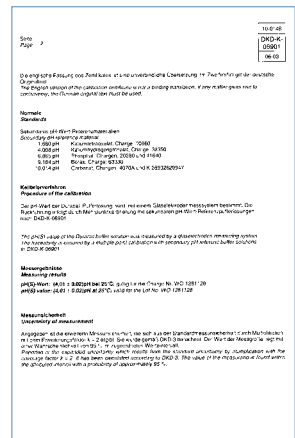
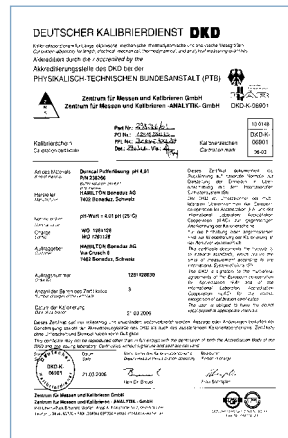
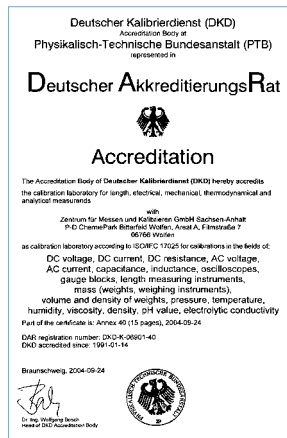
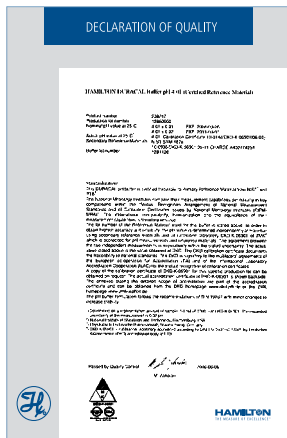
Bottom-up traceability: To ensure the highest possible accuracy and full reliability of the pH value, a representative number of samples from every single production lot is sent to a German DKD³⁾ laboratory (DKD-K-06901) for external, independent and impartial verification. In this laboratory, the DURACAL samples are compared against secondary reference solutions from DKD-K-06901. These secondary reference solutions are compared to a primary reference solution from PTB or NIST. At this stage, the loop is closed: the primary reference solutions are the start- and end-points of the circular traceability loop. DKD provides HAMILTON with a calibration certificate for every DURACAL production batch.

Due to the complete traceability of the measurement procedure and the assignment of uncertainties to the particular testing steps, the DURACAL buffers can be classified as "Certified Reference Material" (CRM-certified reference material).

Features:

- Convenient 250 mL or 500 mL bottle with built-in calibration compartment
- Economical, only about 15 mL of buffer is used per calibration
- Certified pH value from a DKD laboratory accredited for pH measurement
- First class certificate with traceability to international standards
- Certificates available at <http://www.hamiltoncompany.com/cert>
- Expiration date on the bottle
- Immune to micro-organisms

- 1) NIST
National Institute of Standards and Technology,
Gaithersburg MD, USA
- 2) PTB
Physikalisch Technische Bundesanstalt,
Braunschweig, Germany
- 3) DKD
Deutscher Kalibrierdienst DKD-K-06901,
Zentrum für Messen und Kalibrieren GmbH,
Wolfen, Germany



Simple handling for professional results:



Step 1: Open bottle



Step 2: Fill calibration compartment



Step 3: Calibrate electrode



Step 4: Empty calibration compartment

pH buffers

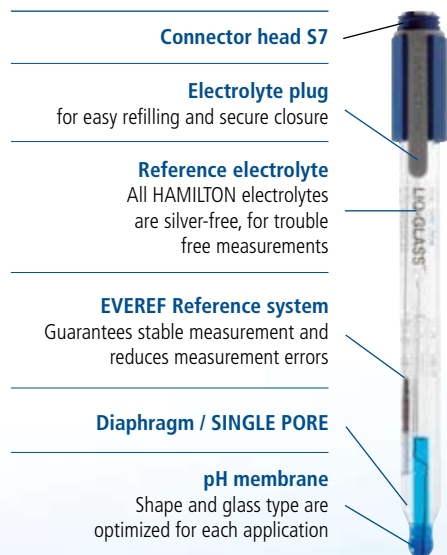
pH Value	Accuracy	Stability (in months)	Certified by	Packaging unit	PN
1.09	±0.02	60	HAMILTON	500 mL	238271
1.68	±0.02	60	HAMILTON	500 mL	238272
2.00	±0.02	60	HAMILTON	500 mL	238273
3.06	±0.02	60	HAMILTON	500 mL	238274
4.01	±0.01 / ±0.02	24 / 60	DKD	250 mL	238317
4.01	±0.01 / ±0.02	24 / 60	DKD	500 mL	238217
4.01	±0.01 / ±0.02	24 / 60	DKD	3 x 500 mL	238917
4.01	±0.01 / ±0.02	24 / 60	DKD	5 L	238332
4.01	±0.01 / ±0.02	24 / 60	DKD	10 L	238194
4.01	±0.01 / ±0.02	24 / 60	DKD	1000 L	238895
5.00	±0.02	60	HAMILTON	500 mL	238275
6.00	±0.02	60	HAMILTON	500 mL	238276
7.00	±0.01 / ±0.02	24 / 60	DKD	250 mL	238318
7.00	±0.01 / ±0.02	24 / 60	DKD	500 mL	238218
7.00	±0.01 / ±0.02	24 / 60	DKD	3 x 500 mL	238918
7.00	±0.01 / ±0.02	24 / 60	DKD	5 L	238333
7.00	±0.01 / ±0.02	24 / 60	DKD	10 L	238188
7.00	±0.01 / ±0.02	24 / 60	DKD	1000 L	238896
8.00	±0.02	60	HAMILTON	500 mL	238277
9.21	±0.02	60	DKD	250 mL	238319
9.21	±0.02	60	DKD	500 mL	238219
9.21	±0.02	60	DKD	3 x 500 mL	238919
9.21	±0.02	60	DKD	10 L	238216
9.21	±0.02	60	DKD	1000 L	238897
10.01	±0.02	60	DKD	250 mL	238321
10.01	±0.02	60	DKD	500 mL	238223
10.01	±0.02	60	DKD	3 x 500 mL	238923
10.01	±0.02	60	DKD	10 L	238187
10.01	±0.02	60	DKD	1000 L	238898
11.00	±0.02	24	HAMILTON	500 mL	238278
12.00	±0.02	24	HAMILTON	500 mL	238279
4.01/7.00/9.21	±0.01 / ±0.02	24 / 60	DKD	500 mL, mixed	238922
4.01/7.00/10.01	±0.01 / ±0.02	24 / 60	DKD	500 mL, mixed	238924

Redox buffers

Redox value	Accuracy	Stability (monthly)	Certified by	Packing unit	PN
271 mV	±5 mV	24	None	500 mL	238228
475 mV	±5 mV	24	None	250 mL	238322
475 mV	±5 mV	24	None	500 mL	238227

Practical advice for pH and Redox electrodes

Construction of a pH or Redox sensor

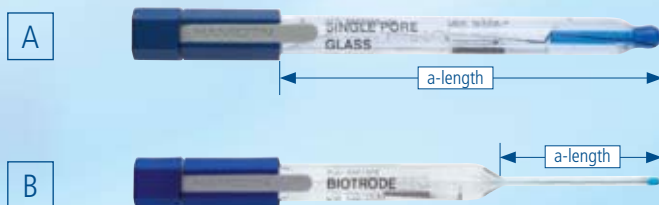


Length of the electrode

What is the a-length, and where does it start?

The a-length depends on the construction of the electrode. With electrodes that have a 12 mm shaft passing all the way through the body (see picture A) the a-length is measured from the connector head to the end of the electrode.

With electrodes that have a shaft diameter of less than 12 mm, the a-length begins at the smaller diameter (see picture B).



Calibration and measurement

- For quick and accurate results, the electrolyte plug should be open during measurements (Note: polymer electrolytes do not have an electrolyte plug).
- The electrode should be immersed far enough to cover the diaphragm. The height to which the electrolyte is filled must always be above that of the sample. This prevents the sample solution from entering into the electrode.
- Always wait for the electrode to reach the same temperature as the sample.
- Between measurements, the electrode should be rinsed with deionized water. If necessary, dab it dry with a paper towel. Never rub the electrode dry with a paper towel, as it will become electrostatically charged and a slow response will result.
- To prevent problems, calibrate with DURACAL® buffer (see page 20/21). If you do not use DURACAL® buffer, never calibrate in the original bottle. Always use fresh buffer solution for calibration. Close the bottle after use.
- Dispose of used buffer responsibly.
- Read the operating instructions of the pH measurement device.

Practical advice for pH and Redox electrodes

Temperature influences

Both the pH/Redox value of the sample and the characteristics of the electrode are temperature dependent. Usually, the temperature dependency of the sample is unknown. Therefore, it is important to always record the measurement temperature together with the measured value. The automatic temperature compensation of measurement devices can only compensate for the temperature dependence of the electrode's characteristics curve (Nernst-Gleichung). For this purpose, temperature sensors (for example, Pt1000 or NTC 30kOhm) are used. In order to obtain the most accurate measurement, the sensor should always be calibrated at the same temperature at which measurements will later take place.

For measurements that will serve as a comparison between laboratory and process values, make sure that the laboratory measurement takes place at the same temperature as the process measurement.

Storage

For storage, place the electrode (with closed electrolyte plug) in the reference electrolyte, or better, in the HAMILTON storage solution (PN 238931). The storage solution helps to clean both the diaphragm and the pH glass. Electrodes must never be stored in deionized water.

Cleaning

Contamination of the diaphragm is the most frequent cause of measurement problems. Only infrequently do problems with the glass membrane occur. The diaphragm and the pH membrane should therefore be kept clean in order to avoid measurement errors and long response times. Use soap and water to remove oil, fat, and organic substances. In the event of contamination of the electrode by proteins, submerge the electrode in a fresh solution of 0.4% HCl, and 5 g/l pepsin. After every cleaning, the electrode should be conditioned in HAMILTON storage solution for at least 2 hours. After cleaning always perform a new calibration before carrying out measurements.

To simplify cleaning, HAMILTON has developed a special cleaning set (PN 238290) which easily remove most types of contamination from electrode diaphragm and pH glass.

Most frequent causes of calibration problems

The following three problems occur most often during calibration:

- Zero calibration error
- Electrode slope too low
- Slow response, for example, longer than 3 minutes

There are a variety of causes for the problems named above. The most frequent are:

- a) The buffer solutions used are either contaminated or out-of-date. It could also be that one of the buffer solutions used is no longer the value labeled on the bottle – for this reason, never store buffer solutions in unmarked or dirty containers.
- b) The reference electrolyte and / or the diaphragm are contaminated.
- c) An old or defective electrode is used.
- d) An electrode is used that has not been hydrated long enough (after dry storage or after cleaning with strong acid solution).
- e) The pH membrane of the electrode is mechanically damaged, and has cracks.
- f) The electrode is electrostatically charged (through rubbing of the electrode shaft with a cloth instead of careful dabbing with soft paper).
- g) The temperature difference between electrode and buffer solution is more than 10°C.
- i) The connection between electrode and measurement device can also cause problems: for instance, a break in the cable, or a short-circuit caused by moisture in the cable or electrode plug.

Specifications

pH or Redox Sensor	Nominal measurement range	Temperature range	Reference electrolyte	Reference system	Shaft material	Shaft diameter (mm)	Shaft diameter below (mm)
BIOTRODE	0 to 14	0 to 100°C	PROTELYTE	EVEREF	Glass	12	3
DOUBLE PORE	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Glass	12	6
DOUBLE PORE KNICK	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	PEEK	12	6
FILLTRODE	0 to 14	0 to 60°C	SKYLYTE-CL	EVEREF	Plastic	12	12
FLATRODE	0 to 14	0 to 60°C	SKYLYTE-CL	EVEREF	Plastic	12	12
FLUSHTRODE*	0 to 14	-10 to 80°C	3 M KCL	EVEREF	Glass	12	12
FOODTRODE	0 to 14	-10 to 100°C	PROTELYTE	EVEREF	Glass	12	12
GEL-GLASS	0 to 14	-10 to 60°C	GEL	Ag/AgCl	Glass	12	12
LIQ-GLASS	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS BNC	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS DIN	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS ORP	± 2000 mV	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS Temp BNC	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS Temp DIN	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS Temp Lemo	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
LIQ-GLASS KNICK	0 to 14	-10 to 100°C	3 M KCL	EVEREF	Glass	12	12
MINITRODE	0 to 14	0 to 100°C	3 M KCL	EVEREF	Glass	12	3
POLILYTE LAB	0 to 14	-10 to 80°C	POLISOLVE	EVEREF-B	Glass	12	12
POLILYTE LAB Temp BNC	0 to 14	-10 to 80°C	POLISOLVE	EVEREF-B	Glass	12	12
POLILYTE LAB Temp DIN	0 to 14	-10 to 80°C	POLISOLVE	EVEREF-B	Glass	12	12
POLILYTE LAB Temp Lemo	0 to 14	-10 to 80°C	POLISOLVE	EVEREF-B	Glass	12	12
POLYPLAST	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST BNC	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST ORP	± 2000 mV	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST ORP BNC	± 2000 mV	0 to 60 °C	POLYSOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST Temp BNC	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST Temp DIN	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST Temp Lemo	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
POLYPLAST KNICK	0 to 14	0 to 60°C	POLISOLVE	Ag/AgCl	Plastic	12	12
SINGLE PORE GLASS	0 to 14	0 to 100°C	SKYLYTE-CL	EVEREF	Glass	12	12
SLIMTRODE	0 to 14	0 to 100°C	3 M KCL	EVEREF	Glass	12	6
SPINTRODE	0 to 14	0 to 100°C	3 M KCL	EVEREF	Glass	12	3
TIPTRODE	0 to 14	0 to 100°C	PROTELYTE	EVEREF	Glass	12	6

* For samples containing protein, replace the 3 M KCl with the separately obtainable PROTELYTE electrolyte (see page 16).

** Adapter for 4 mm banana plug included.

Specifications

Shaft length (a)	Membrane glass	Membrane shape	Diaphragm	Number of diaphragms	Minimum immersion depth (mm)	Electrode head	Temperature sensor
60 mm	V glass	Cylindrical	Ceramic	1	7	S7	No
35 mm	V glass	Spear	SINGLE PORE	2	15	S7	No
35 mm	V glass	Spear	SINGLE PORE	2	15	Fixed cable with DIN plug	No
120 mm	HF glass	Flat	Ring	1	4	S7	No
120 mm	HF glass	Flat	Ring	1	1	S7	No
120 mm	V glass	Cylindrical	Ground sleeve	1	30	S7	No
120 mm	V glass	Cylindrical	Ceramic	3	20	S7	No
120 mm	V glass	Cylindrical	Ceramic	1	15	S7	No
120 mm	V glass	Cylindrical	Ceramic	1	15	S7	No
120 mm	V glass	Cylindrical	Ceramic	1	15	Fixed cable with BNC plug	No
120 mm	V glass	Cylindrical	Ceramic	1	15	Fixed cable with DIN plug	No
120 mm	Platin	Cylindrical	Ceramic	3	15	S7	No
120 mm	V glass	Cylindrical	Ceramic	1	15	Fixed cable with BNC plug / 1 x 4 mm banana plug	Pt1000
120 mm	V glass	Cylindrical	Ceramic	1	15	Fixed cable with DIN plug / 1 x 4 mm banana plug	NTC 30 kOhm
120 mm	V glass	Cylindrical	Ceramic	1	15	Fixed cable with Lemo plug / 2 x 2 mm banana plug**	Pt1000
110 mm	V glass	Cylindrical	Ceramic	1	15	Fixed cable with DIN plug / 1 x 4 mm banana plug	Pt1000
60 mm	V glass	Cylindrical	Ceramic	1	7	S7	No
120 mm	V glass	Cylindrical	SINGLE PORE	1	15	S7	No
120 mm	V glass	Cylindrical	SINGLE PORE	1	15	Fixed cable with BNC plug / 1 x 4 mm banana plug	Pt1000
120 mm	V glass	Cylindrical	SINGLE PORE	1	15	Fixed cable with DIN plug / 1 x 4 mm banana plug	NTC 30 kOhm
120 mm	V glass	Cylindrical	SINGLE PORE	1	15	Fixed cable with Lemo plug / 2 x 2 mm banana plug**	Pt1000
120 mm	V glass	Cylindrical	SINGLE PORE	1	10	S7	No
120 mm	V glass	Cylindrical	SINGLE PORE	1	10	Fixed cable with BNC plug	No
120 mm	Platin	Cylindrical	SINGLE PORE	1	10	S7	No
120 mm	Platin	Cylindrical	SINGLE PORE	1	10	Fixed cable with BNC plug	No
120 mm	V glass	Cylindrical	SINGLE PORE	1	10	Fixed cable with BNC plug / 1 x 4 mm banana plug	Pt1000
120 mm	V glass	Cylindrical	SINGLE PORE	1	10	Fixed cable with DIN plug / 1 x 4 mm banana plug	NTC 30 kOhm
120 mm	V glass	Cylindrical	SINGLE PORE	1	10	Fixed cable with Lemo plug / 2 x 2 mm banana plug**	Pt1000
110 mm	V glass	Cylindrical	SINGLE PORE	1	10	Fixed cable with DIN plug / 1 x 4 mm banana plug	Pt1000
120 mm	H glass	Cylindrical	SINGLE PORE	1	15	S7	No
100 mm	V glass	Cylindrical	Ceramic	1	15	S7	No
180 mm	V glass	Cylindrical	Ceramic	1	7	S7	No
25 mm	V glass	Spear	Ceramic	1	17	S7	No

pH meter cross reference

Manufacturer	Model	Connection	Biotrode 238140	Double Pore 238400	Filltrode 242064	Flatrode 238401	Flushrode 238060	Foodtrode 238285	Gel-Glass 238025	Liq-Glass 238000	Liq-Glass BNC 238180	Liq-Glass DIN 238185	Liq-Glass ORP 238145	Liq-Glass Temp BNC 242056	Liq-Glass Temp DIN 238406	Liq-Glass Temp Lemo 242054	Minitrode 238100	Polylyte Lab 238403	Polylyte Lab Temp BNC 242060	Polylyte Lab Temp DIN 242058	Polylyte Lab Temp Lemo 242062	Polyplast 238380	Polyplast BNC 238381	Polyplast ORP 238385	Polyplast ORP BNC 238384	Polyplast Temp BNC 242050	Polyplast Temp DIN 238404	Polyplast Temp Lemo 242052	SINGLE PORE Glass 238160	Slimtrode 238150	Spintrode 238197	Tiptrode 238080			
Crison	PH 25	BNC																																	
	Basic 20	BNC																																	
	GLP 21	BNC																																	
	GLP 22	BNC																																	
Eutech	EcoScan pH 5	BNC																																	
	EcoScan pH 6	BNC																																	
	CyberScan pH 11	BNC																																	
	CyberScan pH 110	BNC																																	
	CyberScan pH 300	BNC																																	
	CyberScan pH 310	BNC																																	
	CyberScan pH 510	BNC																																	
	CyberScan pH 1100	BNC																																	
	CyberScan pH 2100	BNC																																	
	CyberScan pH 1500	BNC																																	
	CyberScan pH 6000	BNC																																	
	CyberScan pH 6500	BNC																																	
	Hanna	HI 901	BNC																																
HI 902		BNC																																	
HI 9813-6		BNC																																	
HI 9813-5		BNC																																	
HI 9813-0		BNC																																	
HI 8010		BNC																																	
HI 4212		BNC																																	
HI 4211	BNC																																		
Metrohm	pH Meter 780	Lemo																																	
	pH/Ion Meter 781	Lemo																																	
	pH Mobile 826	Lemo																																	
	pH 691	Lemo																																	
	pH Lab 827	Lemo																																	
Mettler-Toledo	Seven Easy S20	BNC																																	
	Seven Multi S40	BNC																																	
	Seven Multi S47	BNC																																	
	pH Meter 1120 (-X)	DIN																																	
	pH Meter 1140 (-X)	DIN																																	
Seven Go pH SG2	BNC																																		
Schott	CG 842	DIN																																	
	CG 843	DIN																																	
	CG 843 P	DIN																																	
	Handylab pH 11	DIN																																	
	Handylab pH 12	DIN																																	
Handylab pH/LF 12	DIN																																		
Testo	Testo 230	BNC																																	
WTW	InoLab pH Level 1	DIN																																	
	InoLab pH Level 2	DIN																																	
	InoLab pH Level 3	DIN																																	
	PH 540 GLP	DIN																																	
	InoLab 720	DIN																																	
	InoLab 730	DIN																																	
	InoLab 740 / 750	DIN																																	
	ProfiLine 197i	DIN																																	
	Portable Meter 315	DIN																																	
	Portable Meter 330	DIN																																	
Portable Meter 340	DIN																																		
Portable Meter 350	DIN																																		

Blue squares indicate compatible electrodes and meters.

For connections to meters not listed above, please contact your HAMILTON laboratory electrode supplier.

Alphabetical index

A		
a-length	22	
Accessories	16	
Applications list	6, 7	
B		
Biotrode	12, 24	
BNC plug	16	
Buffer pH and Redox	5, 20, 21	
C		
Cable	16	
Calibration	22	
Calibration, problem causes	23	
Cleaning	23	
Cleaning solutions	16	
Conductivity standards	5, 18, 19	
D		
DIN plug	16	
DOUBLE PORE	13, 24	
DOUBLE PORE Knick	15, 24	
DURACAL pH buffer	5, 20, 21	
E		
Electrode construction	22	
Electrolyte	16	
Equipment list	26	
Errors	23	
EVEREF reference system	4, 22, 24	
F		
Filltrode	11, 24	
Flatrode	12, 24	
Flushtrode	11, 24	
Foodtrode	13, 24	
G		
Gel glass	11	
L		
Length-a	22	
Lemo plug	16	
Liq-Glass Temp BNC	9, 24	
Liq-Glass	9, 24	
Liq-Glass BNC	9, 24	
Liq-Glass DIN	9, 24	
Liq-Glass Knick Temp DIN	15, 24	
Liq-Glass ORP	9, 24	
Liq-Glass Temp DIN	9, 24	
Liq-Glass Temp Lemo	9, 24	
M		
Membrane glass	5	
Measurement	22	
Minitrode	12, 24	
N		
NIST	18, 20	
P		
pH membrane glass	5	
pH simulator	17	
Polilyte Lab	10, 24	
Polilyte Lab Temp BNC	10, 24	
Polilyte Lab Temp DIN	10, 24	
Polilyte Lab Temp Lemo	10, 24	
POLISOLVE	4, 24	
Polyplast	14, 24	
Polyplast BNC	14, 24	
Polyplast KNICK	15, 24	
Polyplast ORP	14, 24	
Polyplast Temp BNC	14, 24	
Polyplast Temp DIN	14, 24	
Polyplast Temp Lemo	14, 24	
PROTELYTE	16	
R		
Redox electrodes	9, 14	
Reference system EVEREF	4, 22	
S		
Simulator pH	17	
SINGLE PORE	4, 25	
SKYLYTE CL	16, 24	
Slimtrode	11, 24	
Specifications	24	
Spintrode	12, 24	
Standards, pH, Redox, conductivity	5, 18, 19, 20	
Storage	23	
Storage solution	16, 23	
T		
Temperature influence	23	
Tiptrode	13, 24	
W		
Watering cap	8	



HAMILTON
THE MEASURE OF EXCELLENCE™

HAMILTON Bonaduz AG

Via Crusch 8
CH-7402 Bonaduz, Schweiz
Toll-free: 00800-660-660-60
Telephone: +41-81-660-60-60
Fax: +41-81-660-60-70
sensors@hamilton.ch

HAMILTON Company

4970 Energy Way
Reno, Nevada 89520 USA
Toll-free: 800-648-5950
Telephone: +1-775-858-3000
Fax: +1-775-856-7259
sales@hamiltoncompany.com

HAMILTON quality products:

Process sensors
DURACAL™ pH buffer solutions
Conductivity sensors
Conductivity standards
Oxygen sensors
Retro-fit armatures for sensors
MICROLITER™ syringes
GASTIGHT® syringes
Instrument syringes
SoftGrip™ pipettes
SoftTouch™ pipettes
SoftAide™ pipettes
SoftTop™ dispenser
GC liner
HPLC columns
Precix GC columns

Laboratory automation for:

Drug discovery
Genomics
Proteomics
Forensics
In-vitro diagnostics

<http://www.hamiltoncompany.com>

sensors@hamilton.ch

Your HAMILTON representative: