

pH Electrodes and Buffer Solutions

For Laboratory and Portable Use

HAMILTON
the measure of excellence

HAMILTON - Your Trusted Supplier of Electrochemical Sensors for Laboratory and Portable Applications

To order products from this catalogue,
please contact the dealer in your country

Other products in HAMILTON's range:

- Electrochemical Sensors for Industrial Process Control
- Syringes
- SoftGrip™ Pipettes
- HPLC Columns
- Diluter/Dispensers
- OEM Standard Components
- Pipetting Robots
- Automated Analysers
- OEM Components for Automated Liquid Handling

Contents



What you can expect from HAMILTON Electrodes	Page 4
Applications	Page 5
Electrodes for General Laboratory Applications	Page 6
Electrodes for Special Laboratory Applications	Page 8
Electrodes for Portable Measurements	Page 10
Electrodes for Food Applications	Page 12
Accessories / Electrolytes / Conductivity Standards	Page 14
DURACAL pH and Redox Buffer Solutions	Page 15

What you can expect from HAMILTON

For over 50 years, the name of HAMILTON has been associated worldwide with uncompromised quality in precision fluid measuring and analytical products as well as in fully automated analytical processes. The same competence has led the Sensor Technology Group to design a line of high quality pH-, Redox- and oxygen electrodes for laboratory and process measurement. Laboratory electrodes are the "generalists" among electrochemical sensors. Used for many different applications, they must show highest accuracy, fast readings and have to endure long standby periods without any significant loss in performance. HAMILTON sensors meet these requirements. Our approved quality system in accordance with ISO 9001 and GMP (GLP) is the basis for total quality management and unvarying product quality.

For most laboratory or portable applications, you will find a suitable electrode among the range described in this brochure. To find the electrode you need, please consult the table on page 5 opposite. However should you have a special application problem, please contact your nearest HAMILTON dealer.

As a result of extensive work by our research and development department, HAMILTON and only HAMILTON is able to offer you revolutionary solutions in pH measurement:

The SINGLE PORE® concept:

Precise, reliable and fast readings

Since its introduction in 1991, the SINGLE PORE® concept has been increasingly successful. The advantage of this solution is clear. Instead of many minute pores in a ceramic diaphragm, only a single pore about 200 times larger (in the form of a capillary) is used. This SINGLE PORE® is practically impossible to clog. In combination with a special electrolyte, the flow rate into the pore is faster and leads to much better contact between the reference electrode and sample. This allows shorter response time and very accurate readings.

PTB (the German Federal Physical Technical Institute in Braunschweig) determined the SINGLE PORE® pH electrode to be the most accurate laboratory electrode. See also "Traceability of pH measurement" by Petra Spitzer; ISBN 3-89429-877-4 or SSN 0947-7063.

The Advanced POLILYTE:

Single Pore® also maintenance-free

The SINGLE PORE® electrode has a liquid electrolyte, which must be refilled from time to time.

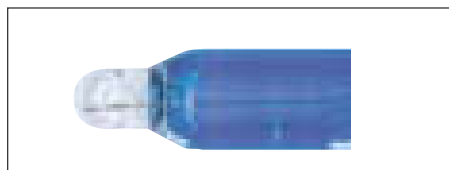
With the latest development of solid polymer electrolytes, HAMILTON now offers the advantages of the SINGLE PORE® system in a maintenance-free version. Thanks to this POLILYTE electrolyte, measurements are performed reliably, in almost every application, including very dirty, ion-weak or protein samples.

Previously, polymer electrolytes could not be used at low pH or organic solvents. However, with the newly developed Advanced POLILYTE polymer, measurements can now be performed at pH 0 and withstand organic solvents. Patent pending.

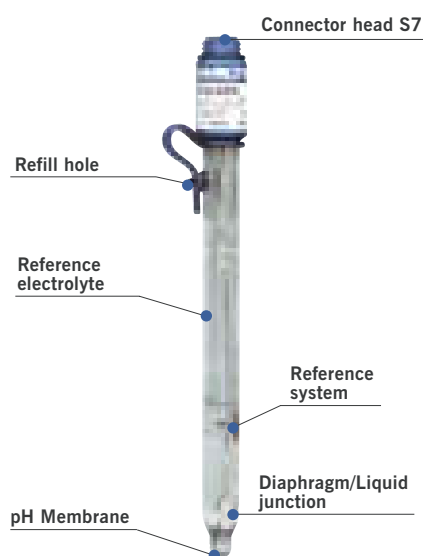
The EVEREF reference system:

Long electrode life thanks to stable reference potentials

The stability of the reference systems forms the basis for a long and reliable operating life of these electrodes. For this reason, many HAMILTON electrodes are equipped with reference systems from the EVEREF family. The silver chloride reservoir separated from the reference electrolyte by a diffusion barrier prevents the loss of silver chloride induced by temperature variations and allows the use of silver-free electrolytes. The EVEREF-B double liquid junction system used in the POLILYTE LAB electrodes further extends the diffusion barrier and this greatly increases electrode life in aggressive samples. It performs also well in liquids with low ion concentration or partly aqueous samples.



Practical Suggestions



Calibration and measurement:

- In the case of a liquid electrolyte you need to open the hole in order to refill the electrode.
- The electrode has to be immersed at the level of the diaphragm. The level of reference electrolyte must always be somewhat higher than the level of the sample solution. This prevents test liquid getting into the electrode.
- Wait until the temperature of the electrode is stabilized.
- Between one measurement and the next, rinse the electrode with deionized water. Then dry it with a wiping paper if

necessary. Do not rub the electrode as it will be charged electrostatically.

- Use DURACAL buffers for calibration to avoid handling problems.
If not using DURACAL buffers: never calibrate in the original bottle. Use only the necessary fresh quantity and close the bottle immediately afterwards. The used buffer needs to be thrown away.
- Carefully read the instructions for the pH meter prior to use.

Temperature influence:

The temperature will influence the pH value of the sample as well as the potential

Applications

	Gel Glass	Polylyte Lab	Liq Glass	Gel Plast	Polyplast	Single Pore Glass	Single Pore Plast	Single Pore Flat	Freezetrode	Foodtrode	Double Pore Slim	Double Pore	Cheesetrode	Tiptrode	Slimtrode	Minitrode	Spinetrode	Flushtrode	Double Flush
Bread, Dough									✓	✓									
Butter									✓			✓							
Cheese									✓		✓	✓		✓					
Colour, Varnish, Paint		✓	✓		✓	✓													✓
Cosmetics		✓	✓		✓	✓				✓									✓
Cream		✓																	✓
Deionized Water		✓				✓				✓									✓
Drinking Water	✓	✓	✓	✓	✓	✓	✓			✓									✓
Emulsions, Aqueous		✓	✓		✓	✓	✓			✓									✓
Emulsions, Partly Aqueous		✓			✓	✓													✓
Fruit Juice		✓	✓		✓					✓									✓
Fruits, Vegetables											✓	✓			✓				
Galvanic Waste		✓			✓	✓	✓												✓
Jam		✓								✓		✓							✓
Leather								✓											
Liquid Soap		✓	✓		✓	✓	✓												✓
Low Ionic Strength Solutions		✓				✓	✓												✓
Mayonnaise		✓								✓		✓							✓
Meat											✓	✓			✓				
Milk		✓			✓	✓	✓			✓	✓								
Protein Containing Samples		✓			✓	✓	✓			✓	✓		✓	✓	✓				
Samples in NMR tubes																		✓	
Small Sample Volumes								✓								✓	✓		
Soup, Detergents		✓	✓		✓	✓	✓			✓									✓
Surfaces								✓											
Suspensions, Aqueous		✓	✓		✓	✓	✓	✓											✓
Titration						✓				✓									✓
Titration, Nonaqueous																			✓
TRIS Buffer		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Varnish, Aqueous		✓				✓													✓
Viscous Samples		✓																	✓
Waste Water		✓			✓	✓	✓												✓
Wine			✓							✓									✓
Yoghurt		✓							✓	✓									

✓ Recommended electrode

generated by the electrode. The variation of pH because of a temperature change of the sample is generally unknown. It is therefore important to specify the measurement temperature. In order to compensate the variation of potential (Nernst) of the electrode, the use of automatic temperature compensation with a temperature sensor (e.g. Pt 1000 or NTC 30 kOhm) connected to the pH meter is recommended.

Storage of electrodes:

If an electrode is temporarily not in use, store it in the reference electrolyte or in HAMILTON storage solution. The refill hole

has to be closed. The electrode should not remain for a long time in deionized water.

Cleaning of electrodes:

The membrane as well as the diaphragm should be kept clean in order to avoid a slow response time of the electrode.

Clean the electrode of oil, grease or organic substances by using soap and tepid water. To clean off proteins immerse the electrode for at least one hour in a pepsin solution and HCl (hydrochloric acid). After every cleaning, recondition it for at least one hour in the reference electrolyte. Recalibrate it prior to any new measurement.

The lifetime of an electrode:

The lifetime of pH electrodes is generally limited. This can automatically be recognized through a gradual drift of the sensor characteristics. A longer response time and a shift of the mV reading in pH 7 will be the consequence. However, these alterations depend a lot on measuring conditions, maintenance and sample temperature. Generally speaking, the lifetime of an electrode can vary from one to three years for measurements at ambient temperature to just a few hours in some very critical applications.

Electrodes for General Laboratory Applications

NEW!



POLILYTE LAB

GEL GLASS

LIQ GLASS

LIQ GLASS DIN/BNC

SINGLE PORE GLASS

	Polilyte Lab	Gel Glass	Liq Glass	Liq Glass DIN/BNC	Single Pore Glass
Part No.	238 403	238 025	238 000	238 185/180	238 160
Measuring range	0...14	0...14	0...14	0...14	0...14
Temperature Range	0...80°C	0...80°C	0...80°C	0...80°C	0...80°C
Shaft material	Glass	Glass	Glass	Glass	Glass
Temperature sensor	No	No	No	No	No
Diaphragm	Open hole	Ceramic	Ceramic	Ceramic	Single Pore
Reference system	EVEREF - B	Ag/AgCl	EVEREF	EVEREF	EVEREF
Reference electrolyte	Polymer	Gel	3M KCl	3M KCl	Skylite®
Electrode head	S7	S7	S7	1.2m+ DIN or BNC	S7
Shaft length	120mm	130mm	120mm	120mm	160mm
Diameter	12mm	12mm	12mm	12mm	12mm
Shape of membrane	Cylindrical	Cylindrical	Cylindrical	Cylindrical	Cylindrical
Notes	No maintenance	No maintenance			



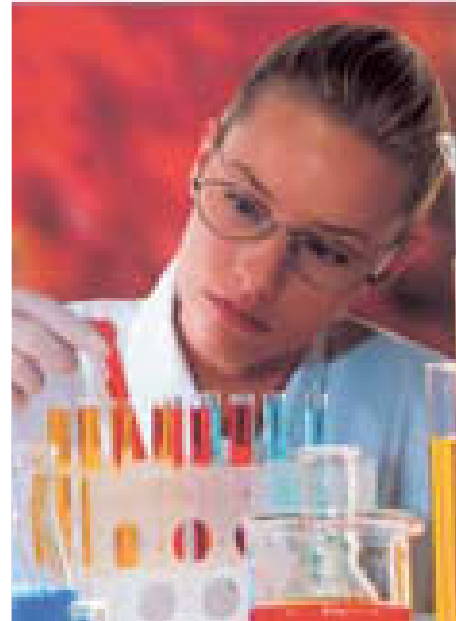
SINGLE PORE FLAT

SLIMTRODE

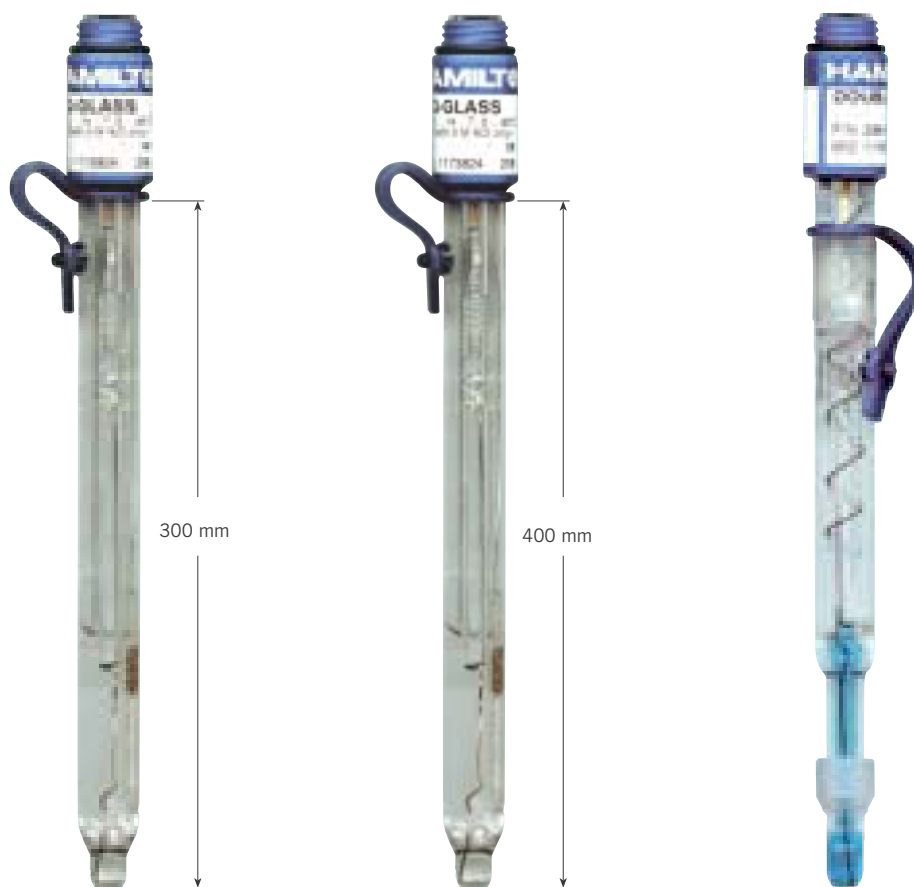
FLUSHTRODE

LIQ GLASS ORP

Single Pore Flat	Slimtrode	Flushtrode	Liq Glass ORP
238120	238150	238060	238145
0...14	0...14	0...14	± 2000mV
0...60°C	0...80°C	10...50°C	0...80°C
Epoxy	Glass	Glass	Glass
No	No	No	No
Single Pore	Ceramic	Sleeve type	Ceramic
EVEREF	EVEREF	EVEREF	EVEREF
Skylite®	3M KCl	3M KCl	3M KCl
S7	S7	S7	S7
110mm	100mm	120mm	120mm
12mm	6mm	12mm	12mm
Flat	Cylindrical	Cylindrical	Platinum ring
Measurement on surface	Micro tube		Redox measurement



Electrodes for Special Laboratory Applications

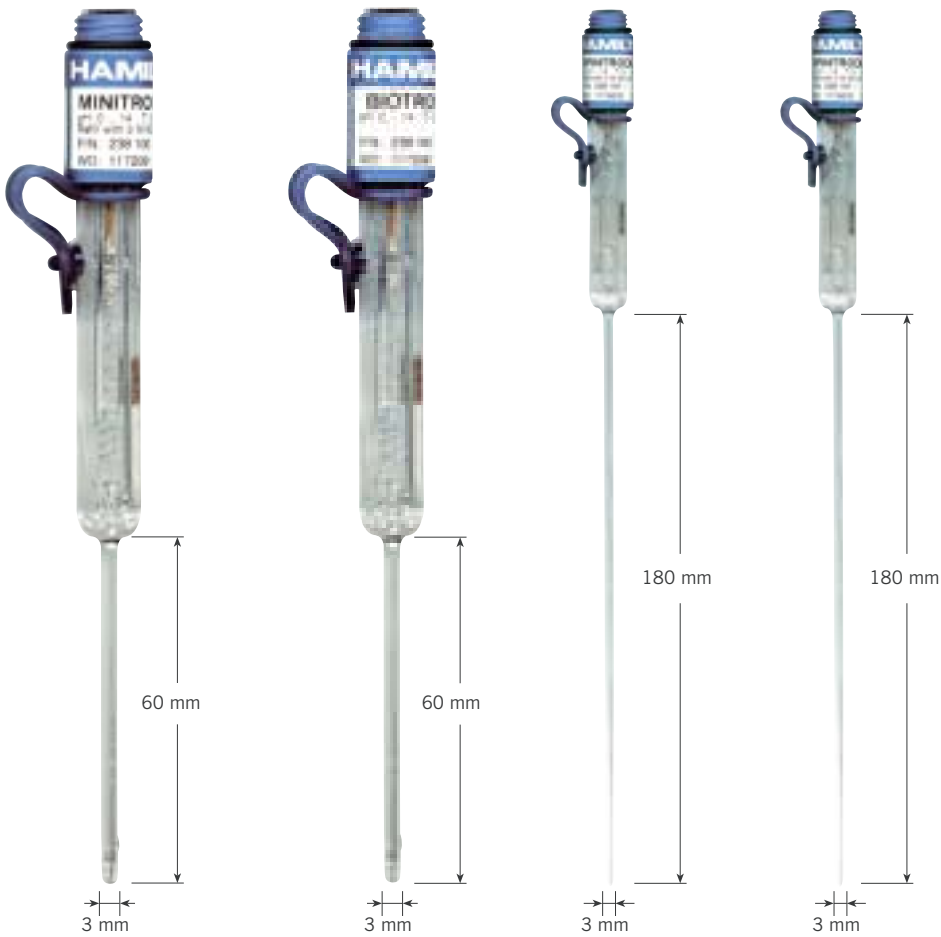


LIQ GLASS 300

LIQ GLASS 400

DOUBLE FLUSH

	Liq Glass 300	Liq Glass 400	Double Flush
Part No.	238182	238183	238190
Measuring range	0...14	0...14	0...14
Temperature Range	0...80°C	0...80°C	10...50°C
Shaft material	Glass	Glass	Glass
Temperature sensor	No	No	No
Diaphragm	Ceramic	Ceramic	Sleeve type
Reference system	EVEREF	EVEREF	EVEREF
Reference electrolyte	3M KCl	3M KCl	0.1M KCl
Electrode head	S7	S7	S7
Shaft length	300mm	400mm	120mm
Diameter	12mm	12mm	12mm
Shape of membrane	Cylindrical	Cylindrical	Cylindrical
Notes			



MINITRODE

BIOTRODE

SPINTRODE

SPINTRODE P

Minitrode	Biotrode	Spintrode	Spintrode P
238100	238140	238197	238198
0...14	2...11	0...14	2...11
0...80°C	0...60°C	0...80°C	0...60°C
Glass	Glass	Glass	Glass
No	No	No	No
Ceramic	Ceramic	Ceramic	Ceramic
EVEREF	EVEREF	EVEREF	EVEREF
3M KCl	Protelyte	3M KCl	Protelyte
S7	S7	S7	S7
60mm	60mm	180mm	180mm
3mm	3mm	3mm	3mm
Cylindrical	Cylindrical	Cylindrical	Cylindrical
Microsamples	Microsamples with proteins	Measurement in NMR tubes	Measurement in NMR tubes with proteins



Electrodes for Portable Measurements

NEW!



POLYPLAST

NEW!



DIN

BNC



POLYPLAST DIN/BNC

NEW!



POLYPLAST TEMP/DIN

	Polyplast	Polyplast DIN/BNC	Polyplast Temp/DIN
Part No.	238380	238382/381	238404
Measuring range	0...14	0...14	0...14
Temperature Range	0...60°C	0...60°C	0...60°C
Shaft material	Epoxy	Epoxy	Epoxy
Temperature sensor	No	No	NTC 30 KOhm
Diaphragm	Single Pore	Single Pore	Single Pore
Reference system	Ag/AgCl	Ag/AgCl	Ag/AgCl
Reference electrolyte	Polymer	Polymer	Polymer
Electrode head	S7	1.2m +DIN or BNC	1.2m +DIN+Banana 4mm
Shaft length	130mm	130mm	130mm
Diameter	12mm	12mm	12mm
Shape of membrane	Cylindrical	Cylindrical	Cylindrical
Notes	No maintenance	No maintenance	For Knick and WTW pH meters



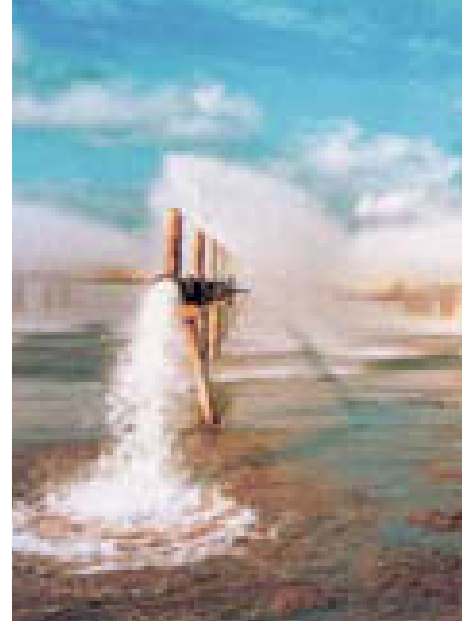
LIQ PLAST

SINGLE PORE PLAST

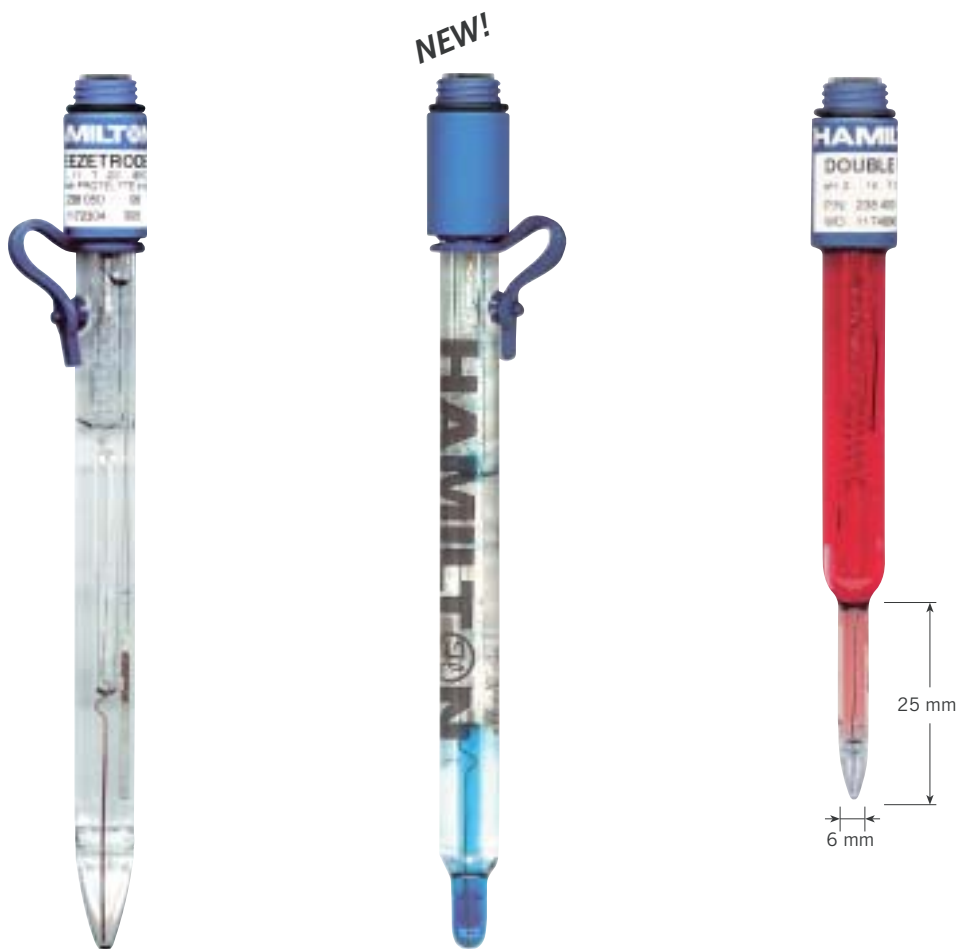
SINGLE PORE FLAT

LIQ GLASS ORP

Liq Plast	Single Pore Plast	Single Pore Flat	Liq Glass ORP
238010	238130	238120	238145
0...14	0...14	0...14	±2000mV
0...60°C	0...60°C	0...60°C	0...80°C
Epoxy	Epoxy	Epoxy	Glass
No	No	No	No
Ceramic	Single Pore	Single Pore	Ceramic
EVEREF	EVEREF	EVEREF	EVEREF
3M KCl	Skylite®	Skylite®	3M KCl
S7	S7	S7	S7
130mm	110mm	110mm	120mm
12mm	12mm	12mm	12mm
Cylindrical	Cylindrical	Flat	Platinum ring
		Measurement on surface	Redox measurement



Electrodes for Food Applications



FREEZETRODE

FOODTRODE

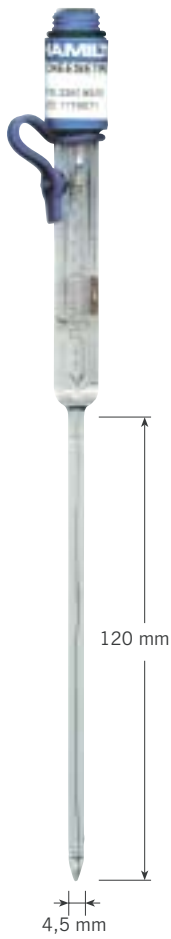
DOUBLE PORE

	Freezetrode	Foodtrode	Double Pore
Part No.	238050	238285	238400
Measuring range	2...11	2...14	2...14
Temperature Range	-20...80°C	-10...80°C	0...50°C
Shaft material	Glass	Glass	Glass
Temperature sensor	No	No	No
Diaphragm	Ceramic	3 x Ceramic	2 x Open hole
Reference system	EVEREF	EVEREF	Ag/AgCl
Reference electrolyte	Protelyte	Protelyte	Polymer
Electrode head	S7	S7	S7
Shaft length	120mm	120mm	25mm
Diameter	12mm	12mm	6mm
Shape of membrane	Conical	Cylindrical	Spear tip
Notes			

NEW!



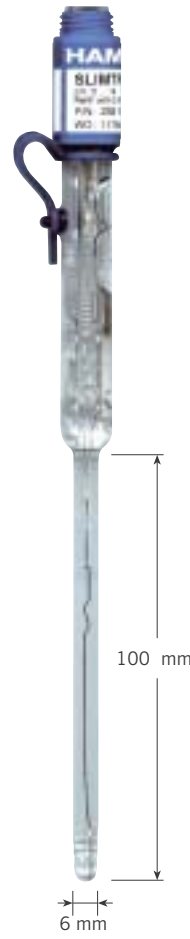
DOUBLE PORE SLIM



CHEESE TRODE



TIP TRODE



SLIM TRODE



Double Pore Slim	Cheesetrode	Tiptrode	Slimtrode
238418	238195	238080	238150
2...14	2...11	2...11	0...14
0...50°C	0...60°C	0...80°C	0...80°C
Glass	Glass	Glass	Glass
No	No	No	No
Open hole	Ceramic	Ceramic	Ceramic
Ag/AgCl	EVEREF	EVEREF	EVEREF
Polymer	Protelyte	Protelyte	3M KCl
S7	S7	S7	S7
25mm	120mm	25mm	100mm
4.5mm	4.5mm	6mm	6mm
Spear tip	Spear tip	Spear tip	Cylindrical

Accessories

Cables

The cables are equipped with an S7 electrode connector. The plug is to be chosen according to the pH meter used. Cable diameter 3 mm, length 1m. Ask for other lengths.

Part No. 355 045 DIN plug



Part No. 355 043 BNC plug



Part No. 355 046 RADIOMETER plug



Part No. 355 060 METROHM (LEMO) plug



Part No. 355 044 Standard US plug



Electrolytes

Solutions ready for use to maintain the electrolyte refill level

- Part No. 238 931 Storage Solution (bottle of 500 ml)
- Part No. 238 036 3M KCl (bottle of 100 ml)
- Part No. 238 936 3M KCl (bottle of 500 ml)
- Part No. 238 079 0.1M KCl (bottle of 100 ml)
- Part No. 238 037 Skylite for Single Pore (bottle of 100 ml)
- Part No. 238 038 Protelyte (bottle of 100 ml)
- Part No. 281 057 1M KNO₃ (bottle of 100 ml)

Conductivity standards with certified 2-year accuracy

- Traceable to N.I.S.T.
- Certificate including actual value and expiry date
- Actual value and expiration date on bottle
- Includes temperature table for accurate calibration
- High quality 300 ml laboratory glass bottle
- 6 conductivity values available from stock
- USP 24 conforming 15 μ S/cm standard with 2% accuracy over 12 months



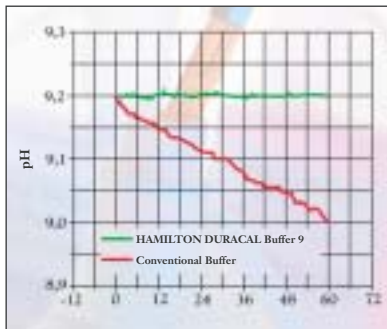
Product	Value	Accuracy	Stability Months	Certificate	Bottle	P/N
Conductivity Standard	5 μ S/cm	\pm 5%	24	✓	300 ml	238 926
Conductivity Standard	15 μ S/cm	\pm 5%	24	✓	300 ml	238 927
Conductivity Standard	15 μ S/cm	\pm 2%	12	✓	300 ml	238 938
Conductivity Standard	100 μ S/cm	\pm 3%	24	✓	300 ml	238 934
Conductivity Standard	706 μ S/cm	\pm 2%	24	✓	300 ml	238 929
Conductivity Standard	1413 μ S/cm	\pm 1%	24	✓	300 ml	238 928
Conductivity Standard	100 mS/cm	\pm 1%	24	✓	300 ml	238 935

DURACAL pH and Redox Buffer Solutions



5 year guarantee of accuracy

- Certificate including the actual value and expiry date
- Certified traceable to primary SRM from NIST/PTB
- Immune to micro-organisms
- Convenient 500 ml plastic bottle with built-in calibration compartment
- Economical, since less buffer is used per calibration
- Fast calibration through built-in potassium chloride (KCl) in pH 7 buffer to exclude memory effects



Product	pH	Accuracy	Stability Months	Certificate	Bottle	P/N
DURACAL pH Buffer	1.09	±0.02	60	✓	3 x 500 ml	238 962
DURACAL pH Buffer	1.68	±0.02	60	✓	3 x 500 ml	238 963
DURACAL pH Buffer	2.00	±0.02	60	✓	3 x 500 ml	238 964
DURACAL pH Buffer	3.06	±0.02	60	✓	3 x 500 ml	238 932
DURACAL pH Buffer	4.01	±0.01	60	✓	3 x 500 ml	238 917
DURACAL pH Buffer	5.00	±0.02	60	✓	3 x 500 ml	238 965
DURACAL pH Buffer	6.00	±0.02	60	✓	3 x 500 ml	238 966
DURACAL pH Buffer	7.00	±0.01	60	✓	3 x 500 ml	238 918
DURACAL pH Buffer	8.00	±0.02	60	✓	3 x 500 ml	238 967
DURACAL pH Buffer	9.21	±0.02	60	✓	3 x 500 ml	238 919
DURACAL pH Buffer	10.01	±0.02	60	✓	3 x 500 ml	238 923
HAMILTON pH Buffer	11.00	±0.05	24	✓	3 x 500 ml	238 968
HAMILTON pH Buffer	12.00	±0.05	24	✓	3 x 500 ml	238 969
DURACAL pH Buffer	4.01	±0.01	60	-	10 l	238 194
DURACAL pH Buffer	7.00	±0.01	60	-	10 l	238 188
DURACAL pH Buffer	9.21	±0.02	60	-	10 l	238 216
DURACAL pH Buffer	10.01	±0.02	60	-	10 l	238 187
DURACAL pH Buffer	4.01 / 7.00 / 9.21	±0.02	60	✓	3 x 500 ml	238 922
DURACAL pH Buffer	4.01 / 7.00 / 10.21	±0.02	60	✓	3 x 500 ml	238 924
REDOX Buffer	271 mV	± 5 mV	24	-	500 ml	238 228
REDOX Buffer	475 mV	± 5 mV	24	-	500 ml	238 227

Your HAMILTON representative:

HAMILTON
the measure of excellence



HAMILTON Bonaduz AG
Via Crusch 8
CH-7402 Bonaduz
Switzerland
Tel. +41 81 660 60 60
Fax +41 81 660 60 70
marketing@hamilton.ch

HAMILTON Company
4970 Energy Way, Reno
Nevada 89502, USA
Toll Free 800 648 5950
Tel. +1 775 858 3000
Fax +1 775 856 7259
sales@hamiltoncompany.com

A worldwide network of over 300 distributors are available to serve your needs.

www.hamiltoncompany.com

E/690 101/03 09/01