



Electrode Handbook

• pH • ORP • ISE

SOLUTIONS FOR WATER ANALYSIS

EUTECH
INSTRUMENTS
Technology Made Easy ...



Corporate Profile

EUTECH
INSTRUMENTS

Technology Made Easy ...

| Over 15 Years of Product Excellence | Eutech Instruments is a leading ISO9001-certified company established in 1990. Dedicated to the design and manufacture of sensor-based instruments for water quality analysis, Eutech is a pioneer in the development of ASIC-based (Application Specific Integrated Circuit) instruments, and is internationally recognised for its achievements in sensor technology, software programming and product design. Eutech has an extensive product line, which includes the world's first Windows® CE-driven colour touchscreen research-grade bench meter, as well as instruments with proprietary patents and trademarks.

| Commitment to R&D | Eutech's competitiveness comes from our strong commitment to R&D. This is backed by a dedicated team of scientists and engineers who thrives on meeting new technological challenges to simplify laboratory and field analytical procedures. The Eutech team is constantly driven to explore the latest technologies and applying them in our design and manufacture of advanced instruments. The result is a unique line of products that are accurate, consistent, reliable and easy to use.

| Comprehensive Product Line | Eutech's constant drive for innovation is reason for our unique and expansive portfolio of microprocessor-based instruments and chemical sensor systems. We offer a comprehensive range of laboratory and field instruments for electrochemical and photometric water analysis. Eutech also manufactures continuous on-line process instruments for the monitoring and control of pH, Conductivity, Total Dissolved Solids (TDS), Redox Potential (ORP), Dissolved Oxygen (DO) and other water quality parameters.

Eutech products range from compact pocket testers and portable meters to research-grade benchtop meters and industrial process controllers. Each product carries the signature Eutech intuitive design and is packed with advanced user-friendly features.

| Customer Focus | Every Eutech innovation is conceptualised with the user in mind. This, coupled with our strategic location in the design and technology hub of Asia, has enabled the company to produce cutting edge instruments at competitive prices. Our consistent demonstration of insight into customer needs and product demands has earned the company consecutive Frost & Sullivan Market Engineering awards for Product Line Strategy.

Driven by a successful Total Customer Satisfaction Program incorporated in the ISO9001:2000 Quality System, all products undergo extensive testing and calibration by a qualified team of technical experts. Stringent quality control measures guarantee consistency, durability and performance. Eutech products are certified to comply with various global testing standards.

| Forging New Frontiers in Water Analysis | Underlying Eutech's objective to be a world leader in the field of water analysis instrumentation, the company adopts a proactive stand in anticipating the needs of the industry. With increasing global awareness and concern for water quality, the future provides new and exciting challenges and opportunities. To realize the potential of advanced water analytical technologies, Eutech will continue to forge close links and strategic alliances with research institutions, government agencies and private sector firms worldwide. These efforts support the Eutech mission – to make advanced technology easy to use.

| Global Reach | Eutech products are marketed in over seventy countries worldwide, through an extensive network of associate companies and distributors, with manufacturing facilities in Singapore and Malaysia. Eutech Instruments Singapore has a full-fledged value-chain operation which comprises R&D, manufacturing, marketing, customer service and logistics for worldwide support to customers.

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Introduction to pH Measurement

1.1 Basic Theory and Application of pH Measurement

pH refers to the power or exponent of hydrogen where 'p' stands for power and 'H' is the symbol of the element Hydrogen.

pH is defined as the negative logarithm of the molar concentration of the active hydrogen ions, $pH = -\log H^+$.

pH provides a convenient way to compare the relative acidity or alkalinity of a sample at a given temperature. For example, pure water has a neutral pH of 7, where the activities of hydrogen and hydroxide ions are equal. If the activity of hydrogen ion is greater than that of hydroxide ion the sample is described as acidic. In general, as the level of hydrogen ion activity increases, the pH decreases. A pH below 7 is known as acidic. On the contrary, as the level of hydrogen ion activity decreases, the pH increases. A pH above 7 is known as alkaline or basic.

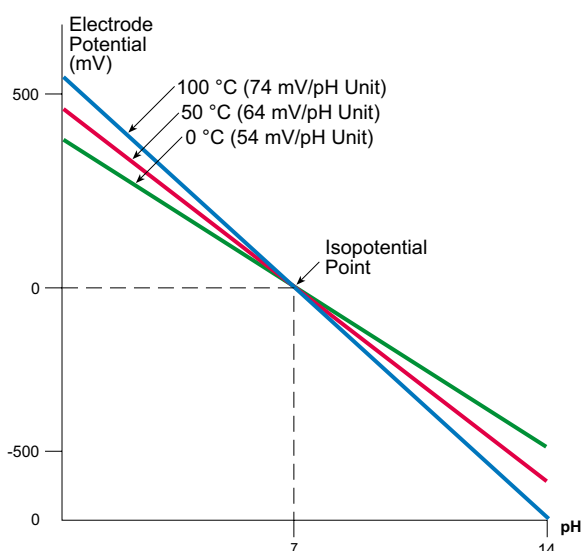
1.2 Use of Electrodes for pH Measurement

pH measurement is usually done with the use of a combination electrode. The combination electrode is an electrode system formed by a glass sensing half-cell and an internal reference half-cell. As the reference junction acts as the medium of conductor between the reference electrolyte and the sample to be measured, it must allow free movement of electrons through the junction and into the sample. A potential develops on the membrane surface when a pH electrode comes into contact with a sample and its value varies with the pH of the sample. This variation in potential is measured in mV by a meter and is converted to direct pH values.

1.3 Slope

The 'slope' is the voltage produced per pH. In theory, the value is 59.16mV per pH at 25°C. Practically, the value ranges between 50 and 58 mV.

1.4 Influence of Temperature on pH Measurement



Temperature variations can affect pH. However at a certain pH, usually 7, temperature will not have an effect on the potential of the system. This is known as the 'isopotential point'.

If automatic compensation is not practical, the following equation can be used to determine error:

Magnitude of error = $0.003 \text{ pH}/^{\circ}\text{C}/\text{pH unit from pH7}$

Note:

The temperature compensation here refers to electrode related temperature variation and not solution related variations.

pH Electrodes

2.1 Selection Criteria

Eutech combination electrodes offer the convenience of having the reference and measuring electrodes combined in a single housing. They are offered in a variety of configurations to suit most laboratory and field application needs.

Electrode Construction

 Glass Body	 Plastic Body
Glass withstands high temperature of 100°C or more. Resistant to corrosive materials and solvents. Brittle. Ideal for laboratory use and is easy to clean.	Not recommended for usage at temperature above 80°C. Moderate resistance to highly corrosive materials and solvents. Durable and withstands rough handling. Ideal for field use.

Single Vs Double Junction

 Single Junction	 Double Junction
Ideal for general purpose applications. Ag⁺ ions are in contact with junction and this can cause chemical interaction with sulphur. Not suitable for biological samples or tris buffers.	Prevents interference between the inner fill solution and sample. Electrolyte is free of Ag⁺ ions. Suitable for use with biological samples. Can be used in place of calomel reference electrodes.

Internal Reference Types

| Calomel Reference (Hg/Hg₂Cl₂) |

Calomel reference electrodes can give potentials accurate to within 0.01 millivolt. The repeatability and potential stability of such electrodes are superior to those of the Ag/AgCl electrode, although only at a constant and relatively low temperature. Calomel is subject to a constant and relatively low temperature fluctuation with a temperature limitation of 80°C. Calomel is recommended for clinical measurement; for samples containing protein, tris buffers; and for high purity water applications.

| Silver/Silver Chloride Reference (Ag/AgCl) |

Ag/AgCl reference electrodes are largely hysteresis-free and can be used at a higher temperature with lower temperature coefficients. Ag/AgCl is the best general purpose reference with a wide temperature range (-5 to 110°C).

| Double Junction |

A double junction reference is constructed with an Ag/AgCl inner chamber and a chemically compatible reference solution in the outer chamber. It is recommended for samples containing organic compounds, proteins, heavy metals; and other compounds that interact with silver, such as bromides, iodides, cyanides and sulfides.

Refillable Vs Sealed Design

 Refillable Design	 Sealed Design
Refill hole allows reference electrolyte replenishment. Can be used many times over. Needs refilling when fill solution is low.	No refill hole. The reference electrolyte is usually a gel. Replacement of the electrode is necessary when it gets contaminated. Virtually no maintenance is required.

Reference Construction

| Refillable Reference Cell |

Selected for high accuracy, stability, and longer electrode life. Refillable types sacrifice convenience and ease of maintenance.

Patented Twist-Cap Design

Unlike conventional designs which use rubber sleeves, Eutech's 620 series refillable electrodes feature a patented refill-hole with twist-cap design – easy-to-use and leak-proof. Refilling of reference electrolyte is hassle-free and quick with no wastage.



Twist-open the cap to expose the refilling hole.



Pour in reference electrolyte with the refilling bottle (that is supplied with all electrodes)



Twist-close the cap.

| Sealed Reference Cell |

Sealed gel-filled reference electrodes are designed for convenience where minimal maintenance is required. Slightly lower accuracy and shorter life must be taken into account.

Types of Reference Junctions

 Annular Junction Fast electrode response.	 Porous HDPE Junction Low electrolyte flow, hence more durable.	 Flushable Junction Cleanses by pumping out electrolyte to remove residue, thus eliminates clogging problems in viscous samples.	 Open pore Junction About 200 times larger than ceramic junctions, ensures increased electrolyte flow for stable junction potential.
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Reference Junctions

Some glass combination electrodes feature an anti-fouling annular ceramic junction. The annular junction is formulated with a special ceramic which encircles the glass bulb. Numerous pores in the ceramic provide lower resistance and more stable pH readings. The plastic body combination electrodes come standard with a porous HDPE pin junction. Sleeve junction provides the highest flow rate for difficult samples.

General Purpose Vs Specialty Applications

Most electrodes come in different stem lengths and diameters for specific applications.

 General Purpose Applications Usually measures 120mm (length) by 12mm (diameter) and can be used for general applications.	 Specialty Applications Effective for specific applications. For instance the spear tip sensor can be used for the direct pH testing of semi-solids and soft materials. Sleeve type electrode ensures high electrolyte flow so it is ideal for low ionic strength and viscous sample measurements. On the other hand, a flat surface tip electrode is used for flat samples like paper or cloth. Micro-stem electrode fits into thin stem NMR tubes or small vessels. For harsh use, a durable tough bulb electrode that is resistant to breakage is recommended.
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2.2 Electrodes - Selection Guide

Glass Body Combination pH Electrodes

Code No.	Glass Type	Application Code	pH Range	Temperature Range (°C)	Length x Dia. (mm)	Internal Reference Element
ECFG73504	X-2	A, F	0 - 13	0 to 100	110 x 12	Ag/AgCl Refillable
ECFG73905	X-2	B, C, G	0 - 13	-5 to 80	110 x 12	Calomel Refillable
ECFG73792	X-2	H, O	0 - 13	0 to 110	110 x 12	Ag/AgCl Double Junction Sealed
ECFG73593	X-2	H	0 - 13	0 to 100	110 x 12	Ag/AgCl Sealed
ECFG73701	X-2	E, O	0 - 13	0 to 100	110 x 12	Ag/AgCl Double Junction Refillable
ECFG74519	X-3	H, T	0 - 14	5 to 110	110 x 12	Ag/AgCl Sealed
ECFG63506	X-2	A, D	0 - 13	0 to 100	55 x 8	Ag/AgCl Refillable
ECFG43902	X-2	B, C, M	0 - 13	-5 to 80	180 x 4	Calomel Refillable
ECFG43904	X-2	B, C, M	0 - 13	-5 to 80	55 x 4	Calomel Refillable
ECFG73521	X-2	Q	0 - 13	0 to 100	110 x 12	Ag/AgCl Refillable
ECFG63511	X-2	J	0 - 13	0 to 100	25 x 8	Ag/AgCl Sealed
ECFG53912	X-2	B, J	0 - 13	-5 to 80	25 x 6	Calomel Refillable
ECFG52910	X-1	B, S	0 - 12	-5 to 80	55 x 6	Calomel Refillable
ECFG72520	X-1	I	0 - 12	0 to 100	110 x 12	Ag/AgCl Refillable
ECFG73711	X-2	D, O	0 - 13	0 to 100	110 x 12	Ag/AgCl Double Junction Refillable
ECFG73511	X-2	D	0 - 13	0 to 100	110 x 12	Ag/AgCl Refillable
ECFG72710LI	X-2	E	0 - 13	0 to 100	110 x 12	LiCl Double Junction Refillable
EC620130	X-2	A, B, C, G, L, O, Q, R	0 - 14	0 to 80	160 x 12	Ag/AgCl Double Junction Refillable
EC620131	X-2	A, B, C, D, L, O, Q, R	0 - 14	0 to 80	130 x 12	Ag/AgCl Double Junction Sealed
EC620133	X-2	A, B, I, O, Q	2 - 14	0 to 50	25 x 6	Ag/AgCl Double Junction Sealed
EC620185	X-2	A, B, K, L, O	0 - 14	-5 to 100	102 x 10	Ag/AgCl Double Junction Refillable
EC620181	X-2	A, K	0 - 14	0 to 80	102 x 10	Ag/AgCl Refillable
EC620183	X-2	A, B, K	0 - 14	0 to 80	102 x 10	Ag/AgCl Double Junction Refillable
EC620286	X-2	A, B, G	0 - 14	-5 to 80	106 x 10	Calomel Refillable
EC620293	X-2	B, N, P	0 - 14	-5 to 80	150 x 6	Calomel Refillable
EC620095	X-2	B, N, P	0 - 14	0 to 80	254 x 3	Calomel Refillable
EC620096	X-2	B, N, P	0 - 14	0 to 80	127 x 3	Calomel Refillable
EC620297	X-2	B, N, P	0 - 14	-5 to 100	165 x 5	Ag/AgCl Refillable

Membrane Glass Types

- X-1** is especially suited for low temperature, nonaqueous solutions and pH measurements under pH 12.
- X-2** is best suited for most pH measurements where minimal or no Na⁺ is present. It is a low-resistant glass with a very fast and stable response and is designed for pH ranges of 0 to 13 and temperatures of 0 °C to 135 °C.
- X-3** is especially formulated for continuous, long-term use at high temperatures, particularly in strong alkaline solutions above pH 11. It experiences negligible Na⁺ ion error above 13 pH. The impedance of the glass is much higher than other glasses, and a slower response will be experienced at room temperature and below. Response time increases as the temperature is elevated.

Plastic Body Combination pH Electrodes

Code No.	Glass Type	Application Code	pH Range	Temperature Range (°C)	Length x Dia. (mm)	Internal Reference Element
ECFE74526	X-3	T	0 - 14	-5 to 80	115 x 12	Ag/AgCl Sealed
ECFE72511	X-1	I	0 - 12	0 to 100	115 x 12	Ag/AgCl Sealed
ECFE53901	X-2	B, N, P	0 - 13	-5 to 80	155 x 6	Calomel Sealed
ECFC72521	X-1	A, L, R	1 - 13	0 to 80	110 x 12	Ag/AgCl Sealed
ECFC72521R	X-1	A, L, R	1 - 13	0 to 80	110 x 12	Ag/AgCl Refillable
ECFC72522	X-1	A, L, O, R	1 - 13	0 to 80	110 x 12	Ag/AgCl Double Junction Sealed
ECFC72522R	X-1	A, L, O, R	1 - 13	0 to 80	110 x 12	Ag/AgCl Double Junction Refillable
EC620132	X-2	A, B, G, L, O, Q	0 - 14	0 to 60	120 x 12	Ag/AgCl Double Junction Sealed
EC620109	X-2	B, D, G, L, Q	0 - 14	0 to 100	175 x 12	Ag/AgCl Double Junction Refillable
EC620116	X-2	A, B, D, G, L, Q	0 - 14	0 to 100	175 x 12	Ag/AgCl Double Junction Refillable
EC620300	X-2	A, B, L	0 - 14	-5 to 80	106 x 10	Calomel Refillable

Plastic Body Combination ORP Electrodes

Code No.	Sensor Type	Application Code	Temperature Range (°C)	Length x Dia. (mm)	Internal Reference Element
ECFC79602	Platinum Band	U, V	0 to 80	110 x 12	Ag/AgCl Sealed
ECFE77689	Antimony	Y	0 to 80	110 x 12	Ag/AgCl Sealed
ECFE78602	Gold Disc	W	0 to 80	110 x 12	Ag/AgCl Sealed
ECFC79601	Platinum Pin	U	0 to 80	110 x 12	Ag/AgCl Sealed
ECFC79601R	Platinum Pin	U	0 to 80	110 x 12	Ag/AgCl Refillable
ECFC79602	Platinum Pin	U, X	0 to 80	110 x 12	Ag/AgCl Double Junction Sealed
ECFE79602R	Platinum Pin	U, X	0 to 80	110 x 12	Ag/AgCl Double Junction Refillable

* All electrodes are supplied with standard cable length of 1m and with BNC connectors. Refer to our price list for electrodes with longer cable length.

Application Codes & Descriptions

A	General purpose, aqueous pH measurements. Quality control, general laboratory and aquarium water.	L	Portable pH meter; field and school use.
B	Tris buffers, clinical, and biological media containing proteins, creams, fats and cosmetics.	M	Micro sample, such as semi-micro cuvettes and NMR tube.
C	Research measurements, fruit juices, beer, milk and yogurt.	N	Test tube measurements.
D	High viscosity solutions such as emulsions, suspensions, paints and varnishes where frequent cleaning of the reference is necessary.	O	Reference contamination problems which require a double junction reference, such as media containing sulfides, bromides, iodides, and cyanides.
E	Non aqueous solutions. Must be used with special reference electrolyte ECRE015.	P	Measurements in long, narrow vessels.
F	Low temperature measurements.	Q	Soil pH measurements.
G	Low ionic strength solutions, such as high purity water.	R	Swimming pool, pH control under continuous flow conditions.
H	High temperature measurements.	S	Isoelectric focusing gels and other surface measurements that require a small diameter flat tip.
I	Surface measurements such as paper, skin, textile, leather and agar plates.	T	Photographic chemical; high pH sample (12 to 14 pH).
J	Solid or semi-solid samples such as cheese, meats, fruits, bread, or other similar sample.	U	ORP measurements for general purpose.
K	Rugged use; ruggedized electrode tip. Aqueous media in general.	V	Swimming pool ORP measurement.
		W	ORP measurement for cyanide use.
		X	ORP measurement requiring a double junction reference.
		Y	Hydrofluoric acid and abrasive solution measurements.
		Z	Potentiometric measurements of chlorides and other halides.

3.0

pH Electrodes for Precise Measurement



3.1 Open Pore pH Electrodes

Catering to the discerning laboratory professional, this series of open-pore electrodes makes use of single pore capillary reference junctions, which are about 200 times larger than typical ceramic junctions. As a result, the electrodes are almost impossible to clog, even in difficult samples. If used in combination with specially formulated electrolyte, the flow rate into the pore is faster and leads to better contact between the reference electrode and sample. This, in turn, generates a shorter response time and more accurate measurements.



Unique Fluid-Gel Electrolyte and Open-Pore Junction Design

Provides a faster flow rate and improved contact for quick, stable and highly accurate readings.



Refillable Double Liquid Junction

Suitable for high ion concentration samples; also performs well in low ion concentration and partly aqueous samples.



Solid Polymer-Gel Electrolyte

Besides being pressure resistant and maintenance-free, the polymer gel provides a more stable matrix as compared to other gelled electrode reference systems. This enhances the ability of the electrode to produce reliable results in dirty, ion-weak or protein samples; low pH samples; and in the presence of organic solvents. The rugged spear tip electrode is one that uses polymer gel electrolyte to provide reliable performance needed for difficult samples and is ideal for soft foods.



EC620130



Model	EC620130
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Open Pore
Reference Junction	Double Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	160 mm
Diameter	12 mm



Model	EC620131
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Open Pore
Reference Junction	Double Junction
Reference Type	Polymer Sealed
Shape of Membrane	Cylindrical
Shaft Length	130 mm
Diameter	12 mm



EC620131



Model	EC620132
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 60 °C
Shaft Material	Epoxy
Liquid Junction Type	Open Pore
Reference Junction	Double Junction
Reference Type	Polymer Sealed
Shape of Membrane	Cylindrical
Shaft Length	120 mm
Diameter	12 mm



Model	EC620133
Measuring pH Range	2 to 14 pH
Temperature Range	0 to 50 °C
Shaft Material	Glass
Liquid Junction Type	Open Pore
Reference Junction	Double Junction
Reference Type	Polymer Sealed
Shape of Membrane	Spear Tip
Shaft Length	25 mm
Diameter	6 mm



EC620132

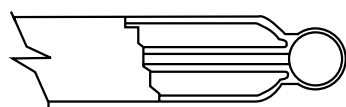


EC620133

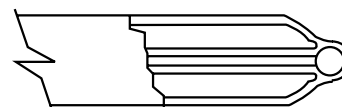
3.2 Specialty pH Electrodes

Rugged Bulb - Five Times Thicker than Regular Bulbs

The tough tip electrode features a rugged bulb that is 1.0mm thick as compared to 0.2mm in a standard bulb. Yet the rugged bulb electrode is able to produce fast, accurate and consistent measurements.

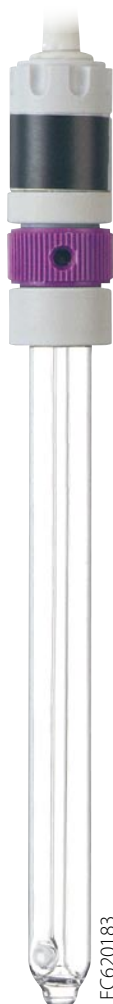


0.2mm Standard Bulb Electrode



1.0mm Standard Bulb Electrode

Up to 40 times more durable than conventional glass pH electrodes, the rugged bulb electrode does not sacrifice response times. It is the perfect answer in applications where frequent breakage of glass bulb electrodes is a problem, and where plastic body electrodes are not a practical option. This rugged tough tip combination electrode can weather much punishment - making it an excellent choice for demanding applications in the plant, field and classroom. This double-junction electrode comes with Ag/AgCl internal element, porous ceramic outer junction and KCl electrolyte that does not interfere with tris buffers.



EC620183



Model	EC620183
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Ceramic
Reference Junction	Double Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	102 mm
Diameter	10 mm

Model	EC620185
Measuring pH Range	0 to 14 pH
Temperature Range	-5 to 100 °C
Shaft Material	Glass
Liquid Junction Type	Ceramic
Reference Junction	Double Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	102 mm
Diameter	10 mm

Long Thin Stem

Long thin-stem electrodes with diameter up to 8mm are ideal for small sample testing in NMR tubes, centrifuge, test tubes or small vessels.



Model	EC620096
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Calomel Refillable
Shape of Membrane	Cylindrical
Shaft Length	127 mm
Diameter	3 mm



Model	EC620293
Measuring pH Range	0 to 14 pH
Temperature Range	-5 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Calomel Refillable
Shape of Membrane	Cylindrical
Shaft Length	150 mm
Diameter	6 mm



Flushable Junction

The flushable annular junction allows instantaneous refreshing of junction by pressing the electrode cap. This action cleans clogs effortlessly. This versatile electrode is ideal for testing dirty water, low ionic strength solutions and solutions with heavy metals or organics.



Model	EC620109
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 100 °C
Shaft Material	Epoxy
Liquid Junction Type	Flushable
Reference Junction	Double Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	175 mm
Diameter	12 mm

Model	EC620116
Measuring pH Range	0 to 14 pH
Temperature Range	0 to 100 °C
Shaft Material	Epoxy
Liquid Junction Type	Flushable
Reference Junction	Double Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	175 mm
Diameter	12 mm

pH Electrodes for Routine Measurement



4.1 General Purpose pH Electrodes

Plastic Body Combination Electrodes

Eutech's plastic body combination electrodes are suitable for a wide range of general purpose laboratory and field applications. The electrode housing is made of specialty engineering plastic that has high impact resistance and withstands the rigours of rugged use up to 3 bar pressure and temperatures up to 80°C.

Choose from two models: single- or double-junction, sealed (gel-filled) or refillable. Standard-size sealed models are filled with polymerised reference electrolyte. The rugged plastic body improves electrode durability. The Glass pH bulb is recessed for protection. Use refillable electrodes (with open refill hole) for fast, stable response.



ECFC72521



Model	ECFC72521	ECFC72521R
Measuring pH Range	1 to 13 pH	1 to 13 pH
Temperature Range	0 to 80 °C	0 to 80 °C
Shaft Material	Plastic	Plastic
Liquid Junction Type	Porous HDPE Pin	Porous HDPE Pin
Reference Junction	Single Junction	Single Junction
Reference Type	Ag/AgCl Sealed	Ag/AgCl Refillable
Shape of Membrane	Sphere	Sphere
Shaft Length	110 mm	110 mm
Diameter	12 mm	12 mm



Model	ECFC72522	ECFC72522R
Measuring pH Range	1 to 13 pH	1 to 13 pH
Temperature Range	0 to 80 °C	0 to 80 °C
Shaft Material	Plastic	Plastic
Liquid Junction Type	Porous HDPE Pin	Porous HDPE Pin
Reference Junction	Double Junction	Double Junction
Reference Type	Ag/AgCl Sealed	Ag/AgCl Refillable
Shape of Membrane	Sphere	Sphere
Shaft Length	110 mm	110 mm
Diameter	12 mm	12 mm



ECFC72522



Model	ECFC7352901B	ECFC7352901W	ECFC7352901J
Measuring pH Range	0 to 13 pH	0 to 13 pH	0 to 13 pH
Temperature Range	0 to 80 °C	0 to 80 °C	0 to 80 °C
Shaft Material	Plastic	Plastic	Plastic
Liquid Junction Type	Porous HDPE Pin	Porous HDPE Pin	Porous HDPE Pin
Reference Junction	Single Junction	Single Junction	Single Junction
Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl
Connector Type	BNC & 2.5mm Phono	BNC & 6 Pin Connector	BNC & 8 Pin Connector
Shape of Membrane	Cylindrical	Cylindrical	Cylindrical
Shaft Length	110 mm	110 mm	110 mm
Diameter	12 mm	12 mm	12 mm

Note:

Plastic body 3-in-1 pH/Temp combination electrode
 (ECFC7352901B for pH 5/6, Ion 6, pH 11/110, pH 510, Ion 510 and pH 2100/1100)
 (ECFC7352901W for pH 300/310, PC 300 and PC 510)
 (ECFC7352901J for pH 600/610/620)



ECFC73529

Glass-Body Combination Electrodes

This laboratory grade glass body electrode has a refillable Ag/AgCl reference. The annular junction delivers fast, stable response and is ideal for general purpose applications in laboratory and field environments.



Model	ECFG73504
Measuring pH Range	0 to 13 pH
Temperature Range	0 to 100 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	110 mm
Diameter	12 mm



ECFG73504

4.2 Specialty pH Electrodes

Long Thin Stem

Long thin-stem electrodes below 8mm diameter are available for small sample testing in NMR tubes, centrifuge, test tubes or small vessels.



ECFG53901



Model	ECFE53901
Measuring pH Range	0 to 13 pH
Temperature Range	-5 to 80 °C
Shaft Material	Epoxy
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Calomel Sealed
Shape of Membrane	Cylindrical
Shaft Length	155 mm
Diameter	6 mm



ECFG43904



Model	ECFG43904
Measuring pH Range	0 to 13 pH
Temperature Range	-5 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Calomel Refillable
Shape of Membrane	Cylindrical
Shaft Length	55 mm
Diameter	4 mm



Model	ECFG63506
Measuring pH Range	0 to 13 pH
Temperature Range	0 to 100 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Sphere
Shaft Length	55 mm
Diameter	8 mm



ECFG63506

Sleeve Design

The sleeve design provides high electrolyte flow rate, suitable for improved response time in emulsions, slurries, suspensions and solutions of low ionic strength. The unique reference design and fill solution minimize drift and give excellent performance at high temperatures. The sleeve can be loosened or removed for easy cleaning.



Model	ECFG73711	ECFG73511
Measuring pH Range	0 to 13 pH	0 to 13 pH
Temperature Range	0 to 100 °C	-5 to 80 °C
Shaft Material	Glass	Glass
Liquid Junction Type	Sleeve	Sleeve
Reference Junction	Double Junction	Single Junction
Reference Type	Ag/AgCl Refillable	Calomel Refillable
Shape of Membrane	Sphere	Sphere
Shaft Length	110 mm	110 mm
Diameter	12 mm	12 mm



ECFG73511

Organic Sample Measurement

The calomel reference electrode is ideal for biotechnology applications with organics, proteins, tris buffers or metals. It can withstand solutions that react with silver.



Model	ECFG73905
Measuring pH Range	0 to 13 pH
Temperature Range	-5 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Calomel Refillable
Shape of Membrane	Sphere
Shaft Length	110 mm
Diameter	12 mm



ECFG73905

Spear Tip Design

The rugged spear tip electrode is ideal for testing semi-solids and soft foods. Featuring an annular junction for fast response, this refillable electrode has an Ag/AgCl reference. The single junction electrode is suitable for lab gels, plant materials and other general purpose applications.



Model	ECFG53912
Measuring pH Range	0 to 13 pH
Temperature Range	-5 to 80 °C
Shaft Material	Glass
Liquid Junction Type	Annular
Reference Junction	Single Junction
Reference Type	Calomel Refillable
Shape of Membrane	Spear
Shaft Length	25 mm
Diameter	6 mm



ECFG53912



4.3 Other Specialty pH Electrodes

Model	Description	Measuring pH Range	Temperature Range (°C)	Shaft Length	Shaft Diameter (mm)
EC620052	Glass Body, Prefilled, Calomel Reference Half Cell Electrodes (Require Separate Indicating Half-Cell)	0 - 14	-5 to 80	105	10
EC620095	MicroProbe Glass Body Combination, Micro-Tip, 152.4 mm Stem Length, Ag/AgCl Reference	0 - 14	0 to 80	254	3
EC620181	Tough Rugged Bulb Glass Body Combination with Single Junction, Ag/AgCl Reference	0 - 14	0 to 100	102	10
EC620284	Glass Body, Universal Glass pH Indicating Half Cell (Requires Separate Reference Half Cell)	0 - 14	-5 to 110	102	10
EC620286	Glass Body Combination, Single Junction, Calomel Reference	0 - 14	-5 to 80	106	10
EC620297	MicroProbe Glass Body Combination	0 - 14	-5 to 100	165	5
EC620300	Plastic Body Liquid-Filled Combination, Calomel Reference	0 - 14	-5 to 80	106	10
ECFC7352901B	Plastic Body "3-in-1" pH/Temp (30Kohm) Combination with Ag/AgCl Reference, Sealed	0 - 13	0 to 80	110	12
ECFE539010B	Epoxy Body Combination with Calomel Reference, Sealed	0 - 13	-5 to 80	155	6
ECFE7251101B	Epoxy Body Combination with Ag/AgCl Reference, Sealed	0 - 12	0 to 80	115	12
ECFE7352801B	Epoxy Body "3-in-1" pH/Temp (1Kohm) Combination with Ag/AgCl Reference, Sealed	0 - 13	0 to 80	110	12
ECFE7452601B	Epoxy Body Combination with Ag/AgCl Reference, Sealed	0 - 14	5 to 80	115	12
ECFE7768901B	Epoxy Body Combination Antimony with Ag/AgCl Reference, Sealed	2 - 11	0 to 100	110	12
ECFG4390201B	Glass Body Combination with Calomel Reference, Refillable	0 - 13	-5 to 80	180	4
ECFG72710LI01B	Glass Body Combination with Double Junction, Refillable	0 - 13	0 to 100	110	12
ECFG7352101B	Glass Body Combination with Ag/AgCl Reference, Refillable	0 - 13	0 to 100	110	12
ECFG7359301B	Glass Body Combination with Ag/AgCl Reference, Sealed	0 - 13	0 to 110	110	12
ECFG7370101B	Glass Body Combination with Double Junction, Refillable	0 - 13	0 to 100	110	12
ECFG7379201B	Glass Body Combination with Double Junction, Sealed	0 - 13	0 to 110	110	12
ECFG7451901B	Glass Body Combination with Ag/AgCl Reference, Sealed	0 - 14	5 to 110	110	12
35815-00	Flexiphet Solid-State (Non-glass) Epoxy Body pH Electrode, Flat Tip, Non Flow Gel with PTFE Diaphragm	0 - 14	-5 to 105	105	10
35815-10	Flexiphet Solid-State (Non-glass) Epoxy Body pH Electrode, Cone Tip, Non Flow Gel with PTFE Diaphragm	0 - 14	-5 to 105	105	10
35815-12	Flexiphet Solid-State (Non-Glass) Epoxy Body pH Electrode, Cone Tip, Refillable Flow with PTFE Diaphragm	0 - 14	-5 to 105	105	10
35815-15	Flexiphet Solid-State (Non-Glass) Epoxy Body pH Electrode, Piercing Sharp Tip, Non Flow Gel with PTFE Diaphragm	0 - 14	-5 to 105	50	10

Other Electrodes

5.1 ORP Electrodes

Choose single junction electrodes for field, clean water, and other general purpose applications or double junction electrodes for samples containing heavy metals and organics. Platinum sensors are suitable for most general uses, while gold sensors are ideal for cyanide/chromate and ozone applications.

Model	ECFC79601	ECFC79601R
Measuring ORP Range	-1000 to 1000 mV	-1000 to 1000 mV
Temperature Range	0 to 80 °C	0 to 80 °C
Shaft Material	Plastic	Plastic
Sensor Type	Platinum Pin	Platinum Pin
Reference Junction	Single Junction	Single Junction
Reference Type	Ag/AgCl Sealed	Ag/AgCl Refillable
Shape of Membrane	Cylindrical	Cylindrical
Shaft Length	115 mm	115 mm
Diameter	12 mm	12 mm



Model	ECFC79602
Measuring ORP Range	-1000 to 1000 mV
Temperature Range	0 to 80 °C
Shaft Material	Plastic
Sensor Type	Platinum Pin
Reference Junction	Double Junction
Reference Type	Ag/AgCl Sealed
Shape of Membrane	Cylindrical
Shaft Length	115 mm
Diameter	12 mm



Model	ECFC79602R
Measuring ORP Range	-1000 to 1000 mV
Temperature Range	0 to 80 °C
Shaft Material	Plastic
Sensor Type	Platinum Pin
Reference Junction	Double Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	115 mm
Diameter	12 mm





ECFG7986101B

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Model	ECFG7960101B
Measuring ORP Range	-1000 to 1000 mV
Temperature Range	0 to 100 °C
Shaft Material	Glass
Sensor Type	Platinum Band
Reference Junction	Single Junction
Reference Type	Ag/AgCl Refillable
Shape of Membrane	Cylindrical
Shaft Length	110 mm
Diameter	12 mm

Model	ECFG7986101B
Measuring ORP Range	-1000 to 1000 mV
Temperature Range	0 to 110 °C
Shaft Material	Glass
Sensor Type	Platinum Band
Reference Junction	Double Junction
Reference Type	Polymer Sealed
Shape of Membrane	Cylindrical
Shaft Length	110 mm
Diameter	12 mm

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Model	ECFE79601
Measuring ORP Range	-1000 to 1000 mV
Temperature Range	0 to 80 °C
Shaft Material	Epoxy
Sensor Type	Platinum Band
Reference Junction	Single Junction
Reference Type	Ag/AgCl Sealed
Shape of Membrane	Cylindrical
Shaft Length	115 mm
Diameter	12 mm



ECFE79601

5.2 Ion Selective Electrodes (ISE)

Eutech offers a large selection of Ion Selective Electrodes (ISE) to suit a wide variety of applications. Each electrode has a typical response time of 20 to 30 seconds which varies with solution concentration. Gas sensing electrodes also include replacement membranes. Eutech offers three electrode types: Membrane/Solid State, Gas Sensing, or Glass bulb.

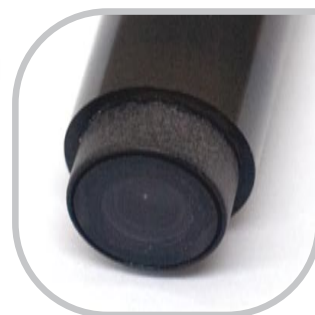
Choose from single junction or double junction electrodes. Single junction electrodes are ideal for clean water applications. Use double junction electrodes for testing dirty water and solutions with heavy metals or organics. All electrodes are refillable and include 15ml of electrolyte, filling pipette and instructions. Solid state electrodes also include polishing strips.

5.3 ISE General Application Guide

ISE Applications	Concentration Range	Temperature / pH Range
Ammonia NH_3 - High Purity Power Station Water, Fish Tanks, Sea Water, Waste Water, Plating Baths, Air/Stack Gases and Biological Samples Type: Gas Sensing	(17,000 to 0.001 ppm) $1.0 \text{ to } 5 \times 10^{-6} \text{ M}$	0 to 50 °C / Above pH 11
Ammonium NH_4 - Boiler Feed Water, Natural Water and Fertilizers Type: Polymer Membrane	(18,000 to 0.01 ppm) $1.0 \text{ to } 5 \times 10^{-6} \text{ M}$	0 to 50 °C / pH 4 to pH 10
Bromide Br^- - Water, Wine, Soil, Plant Tissue, Blood and Clinical Analysis Type: Solid State	(79,000 to 0.4 ppm) $1.0 \text{ to } 5 \times 10^{-6} \text{ M}$	0 to 50 °C / pH 2 to pH 14
Cadmium Cd^{+2} - Plating Baths Type: Solid State	(11,200 to 0.01 ppm) $0.1 \text{ to } 1 \times 10^{-7} \text{ M}$	0 to 80 °C / pH 2 to pH 12
Calcium Ca^{+2} - Water Softening Systems, Boiler Feed Water, Drinking/ Mineral Water, Clinical Analysis and Food Applications Type: Polymer Membrane	(40,000 to 0.2 ppm) $1.0 \text{ to } 5 \times 10^{-6} \text{ M}$	0 to 50 °C / pH 3 to pH 10
Carbon Dioxide CO_2 and Carbonate CO_3^{-2} - Soft Drinks/Carbonated Beverages, Wine, Beer, Fermentation Processes, Bacterial Cultures Type: Gas Sensing	(440 to 0.4 ppm) $1 \times 10^{-2} \text{ to } 1 \times 10^{-4} \text{ M}$	0 to 50 °C / pH 4.8 to pH 5.2
Chloride Cl^- - River/Tap Water, Plant Tissue, Soils, Boiler Feed Water, Clinical Analysis, Sweat, Urine, Cement, Plating Baths and Food Samples Type: Solid State	(35,500 to 1.8 ppm) $1.0 \text{ to } 5 \times 10^{-5} \text{ M}$	0 to 80 °C / pH 2 to pH 12
Copper Cu^{+2} - Plating Baths and Water Type: Solid State	(6350 to 6.4×10^{-4} ppm) $0.1 \text{ to } 1 \times 10^{-8} \text{ M}$	0 to 80 °C / pH 2 to pH 12
Cyanide CN^- - Plating Baths, Waste Water and Plant Tissue Type: Solid State	(260 to 0.13 ppm) $5 \times 10^{-6} \text{ to } 10^{-2} \text{ M}$	0 to 80 °C / pH 11 to pH 13
Fluoride F^- - Drinking/Natural Water, Waste Water, Air/Stack Gases, Acids, Sea Water Minerals, Soils, Food, Biological Fluids, Toothpaste/Mouth Wash, Coal, Carbonated Beverages and Bone Type: Solid State	0.02 ppm to Saturated (10^{-6} to Saturated)	0 to 80 °C / pH 5 to pH 8
Iodide I^- - Milk, Feeds, Plants and Pharmaceuticals Type: Solid State	(127,000 to 6×10^{-3} ppm) $5 \times 10^{-8} \text{ to } 1.0 \text{ M}$	0 to 80 °C / pH 0 to pH 14
Lead Pb^{+2} - Plating Baths and Organic Compounds Type: Solid State	(20,7000 to 0.2 ppm) $10^{-6} \text{ to } 10^{-1} \text{ M}$	0 to 80 °C / pH 3 to pH 8
Nitrate NO_3^- - Surface/Drinking Water, Sewage Effluent, Soil Extracts, Fertilizers, Plant Tissue, Meat, Potatoes, Spinach, Beets, Baby Food Type: Polymer Membrane	(62,000 to 0.5 ppm) $7 \times 10^{-6} \text{ to } 1.0 \text{ M}$	0 to 50 °C / pH 2.5 to pH 11
Potassium K^+ - Waste Water, River/Tap Water, Clinical Analysis, Saliva, Serum, Fertilizers, Soils and Wines Type: Polymer Membrane	(39,000 to 0.04 ppm) $10^{-6} \text{ to } 1.0 \text{ M}$	0 to 50 °C / pH 2 to pH 12
Silver/Sulfide $\text{Ag}^+/\text{S}^{-2}$ - Sewage Effluent, Soils, Sediments, Plating Baths and Photographic Fixing Solution Type: Solid State	(107,900 to 0.01 ppm) $10^{-7} \text{ to } 1.0 \text{ M (Ag}^+, \text{S}^{-2})$	0 to 80 °C / pH 2 to pH 12
Sodium Na^+ - Steam Condensates in Power Plants, Clinical Analysis, Serum, Foods, Wine, Glass, Sea Water, Swimming Pools, Fish Farms and Aquariums Type: Glass Bulb	(23,000 to 0.2 ppm) $10^{-6} \text{ M to Saturated}$	0 to 80 °C / pH 5 to pH 12



Ion Selective Electrode



	Interferences	Electrode	Standard 0.1M	Standard 100 ppm	Standard 1000 ppm	Ion Strength Adjuster
	Volatile Amines	ECNH30101B	ECSCSAA1BT	ECSCSAA2BT	ECSCSAA3BT	ECISAAA1BT
	K ⁺	ECNH40301B	ECSCSAM1BT	ECSCSAM2BT	ECSCSAM3BT	ECISAAM1BT
	S ²⁻ , I ⁻ , CN ⁻ , High Cl ⁻ and NH ₃ Levels	ECBRO0301B	ECSCSBR1BT	ECSCSBR2BT	-	ECISABR1BT
	Ag ⁺ , Hg ²⁺ , Cu ²⁺ , High Pb ²⁺ and Fe ²⁺ Levels	ECCD0301B	ECSCSCD1BT	ECSCSCD2BT	-	ECISACD1BT
	Pb ²⁺ , Hg ²⁺ , Cu ²⁺ , Ni ²⁺ , Fe ²⁺ , Mg ²⁺ , Zn ²⁺ , Ba ²⁺ , K ⁺ , Na ⁺	ECCAL0201B	ECSCSCA1BT	ECSCSCA2BT	ECSCSCA3BT	ECISACA1BT
	Volatile Weak Acids	ECCO20101B	ECSCSCO1BT	ECSCSCO2BT	ECSCSCO3BT	ECISACO1BT
	S ²⁻ , I ⁻ , CN ⁻ , Br ⁻ , OH ⁻ , NH ₃ , S ₂ O ₃ ²⁻	ECCL00301B	ECSCSCL1BT	ECSCSCL2BT	ECSCSCL3BT	ECISACL1BT
	Ag ⁺ , Hg ²⁺ , High Cl ⁻ , Br ⁻ , Fe ²⁺ and Cd ²⁺ Levels	ECCU0301B	ECSCSCU1BT	ECSCSCU2BT	-	ECISACU1BT
	S ²⁻ , I ⁻ , Br ⁻ , Cl ⁻	ECCN0301B	-	-	-	-
	OH ⁻	ECFO0301B	ECSCSFL1BT	ECSCSFL2BT	ECSCSFL3BT	ECISAF1BT
	S ²⁻ , CN ⁻ , Br ⁻ , Cl ⁻ , NH ₃ , S ₂ O ₃ ²⁻	ECIO0301B	ECSCSIO1BT	ECSCSIO2BT	-	ECISAIO1BT
	Ag ²⁺ , Hg ²⁺ , Cu ²⁺ , High Cd ²⁺ and Fe ²⁺ Levels	ECPB0301B	ECSCSPB1BT	ECSCSPB2BT	-	ECISAPB1BT
	ClO ₄ ⁻ , I ⁻ , CN ⁻ , BF ₄ ⁻	ECNO0301B	ECSCSNT1BT	ECSCSNT2BT	ECSCSNT3BT	ECISANT1BT
	Cs ⁺ , NH ₄ ⁺ , Tl ⁺ , H ⁺ , Ag ⁺ , Li ⁺ , Na ⁺ , Tris 1 ⁺	ECK0301B	ECSCSKO1BT	ECSCSKO2BT	-	ECISAKO1BT
	Hg ²⁺	ECAGS0301B	ECSCSSS1BT	ECSCSSS2BT	-	ECISASS1BT
	H ⁺ , K ⁺ , Li ⁺ , Ag ⁺ , NH ₄ ⁺ , Rb ⁺ , Cs ⁺ , Tl ⁺	ECNA0201B	ECSCSLNA1BT	ECSCSLNA2BT	ECSCSLNA3BT	ECISALNA1BT

6.0 Accessories



pH Buffer Solutions



pH Buffer Sachets



Flexible Electrode Holder

pH Buffer Solutions

pH buffer solutions, available in 480 ml and 1 l leak-proof bottles. Buffer values include pH 1.68, 4.01, 7.00, 9.00, 10.01 and 12.45. Coloured coded buffers with dispenser tops are available in selected models for instant recognition: pH 4 - red, pH 7 - yellow and pH 10 - blue. These are available in 480 ml and 1 l bottles. Certificate of Analysis can be downloaded from our website <http://www.eutechinst.com>.

pH Buffer Sachets

Single use buffer sachets are vacuum-sealed and air-tight with ± 0.01 pH accuracy at 25 °C. These NIST-traceable buffers are shipped in a box of 20 sachets. The available values are pH 4, 7, 10 and deionised water for rinsing. Simply insert the electrode into a buffer sachet, calibrate, rinse and discard used solutions properly when done. No wastage and contamination-free; convenient for laboratory and outdoor use.

Reference Refilling Electrolyte

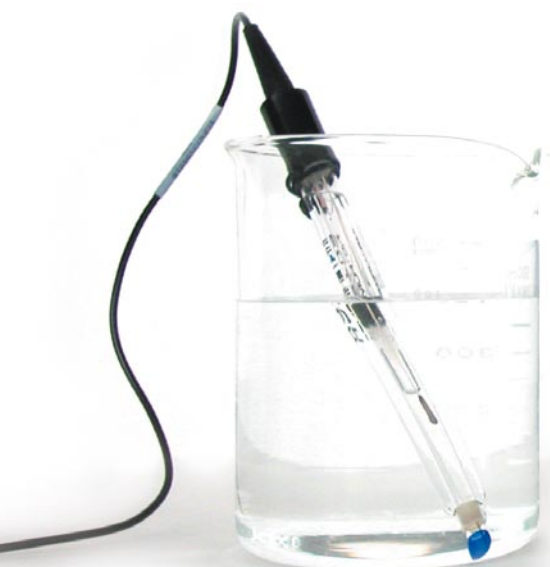
Several types of reference fill solutions are available: 4M KCl saturated (with AgCl) for Ag/AgCl single junction electrodes; 4M KCl saturated for Ag/AgCl double junction electrodes or 4M KCl for Calomel ($\text{Hg}/\text{Hg}_2\text{Cl}_2$) electrodes and other specialty electrodes.

Electrode Cleaning & Storage Solutions

Remove protein or grease and oil deposits from electrodes with cleaning solution which contains pepsin. After cleaning or when the electrode is not in use, always keep pH electrodes in some storage solution to ensure proper working condition.

Flexible Electrode Holder

The electrode holder clasps up to four standard electrodes (14mm dia. max) and one ATC probe with a swivel arm that can be rotated 360°. It also allows any positioning of electrodes at a constant vertical angle - either moving side-to-side or up-and-down for added convenience.



Maintenance and Technical Tips

7.1 Measurement System and Calibration

pH Meter

The pH meter functions as a specialized voltmeter capable of accurately measuring small voltage changes at extremely high impedance of pH electrode and adjusts to pH and voltage characteristics of the electrode system.

Most modern pH meters incorporate automatic or/and manual temperature compensation to correct for variation in pH value of a given solution with sample temperature. Newer microprocessor-based meters are programmed to solve the Nernst equation, taking into account electrode voltage, efficiency and temperature. Most meters provide automatic buffer recognition for calibration, error messages and diagnostic circuitry to simplify operation and reduce operator error.

Calibration Buffers

These standard solutions of known pH value are used to adjust the pH meter/electrode system to display precise measurements. Buffers are available as ready-to-use solutions, in sachets and capsules. All buffers have the special characteristic of resisting pH change upon dilution or acid/base contamination to a certain extent. Some solutions are standardized against NIST-certified pH references for calibrating meters with resolution up to 0.001 pH.

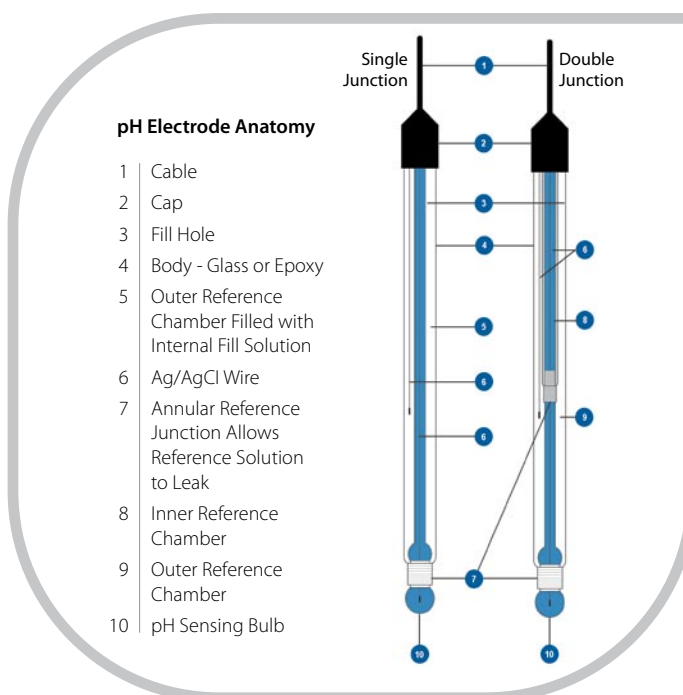
Electrode System

The electrode system consists of two half cells: a pH indicating electrode, which develops a potential dependent on the pH of a solution, and a reference electrode which provides a constant potential and completes the electrical circuit. Nowadays combination electrodes - both half cells joined coaxially - are frequently used for the convenience and compactness they offer.

Calibration

The electrode must be calibrated regularly to ensure accurate, repeatable measurements with a variety of commercial pH calibration buffer solutions.

For optimal accuracy, calibration or standardization should be performed with fresh buffer of pH value close to that of the sample to be tested. When the sample pH is unknown, a two-point calibration is performed: first with pH 7 (close to the electrode's zero-potential point), followed by an acid or base buffer whose value brackets the expected pH value of the sample. Although one-point calibration suffices for fairly reliable measurement, three-point or even five-point calibrations yield the most accurate results across the entire measurement range. Make sure the pH meter caters for a choice of pH calibration buffer set, namely the USA, NIST or DIN reference buffer standards.





7.2 Testing of pH Meter and Electrode

pH Meter with mV (Millivolt) Readout

Attach a shorted BNC cap to the meter's BNC input and change the pH to mV measurement mode. The mV reading should read about 0.0 mV. If the measured reading exceeds ± 0.2 mV, the meter should be electronically calibrated.

Electrode

Connect pH electrode to pH/mV meter and toggle to mV measurement mode. Immerse electrode and calibrate using a fresh pH 7 buffer first, then rinse with deionised water, followed by either pH 4 or pH 10 calibration. When done, check the slope/offset display of the meter for diagnosis of electrode characteristics. Alternatively if the meter does not offer slope/offset display function, determine the percentage of electrode's slope. For example, if pH 7 yields -5.0 mV, and at pH 4 the mV reading is 165 mV, the net change is 170 mV. Divide this value by 177.5, and multiply it by 100 to determine the % of electrode's slope (i.e. 95.7%). For new electrodes, their slope should be between 95% and 102%. If the slope falls below 92%, clean the electrode.

7.3 Use and Care of Electrodes

Maintenance and Storage of pH Electrodes

Electrodes are delicate measuring instruments that require proper care and maintenance to produce accurate and reliable results, and to prolong useful life.

Always keep the pH electrode moist when not in use for a period of time, by using an electrode storage solution or a pH 7 buffer as storage media to soak the electrode. DO NOT store the electrode in distilled or deionised water as this will cause ions to leach out of the glass bulb and reference electrolyte, causing slow and sluggish response.

Electrodes may be shipped with either protective caps or in electrode soaking bottles to prevent cracking or scratching, and to keep the glass bulbs moist. Remove the electrode gently from the storage bottle and rinse it with distilled water before use. For long-term storage, always keep the electrode in the bottle, filled with sufficient storage solution to cover the bulb. Replenish the bottle as needed.

Handling

The electrode should be rinsed thoroughly between sample measurements and calibrations with distilled or deionised water. Blot the electrode dry to gently dislodge excess water. Use a lint-free wiping paper as rubbing causes the electrode to be charged electrostatically. Never use polymer or plastic body electrodes in samples containing organic solvents.

Refillable Electrodes

The filling solution in refillable electrodes should be filled up to, but not past, the refill hole. Make sure that the refill hole is open when measuring to ensure that the fill solution flows properly through the reference junction.

7.4 Rejuvenation and Reconditioning of Electrodes

As electrodes age, their efficiency is reduced. Symptoms include sluggish or erratic readings. This aging is usually caused either by contamination of the glass membrane, or by blockage of the liquid junction reference. Below are a few remedial procedures to improve the performance of such electrodes.

Unblocking Reference Junction

A blocked or clogged reference junction attributes to about 80% of all pH measurement difficulties; resulting in extremely slow response, off-scale readings and electrically noisy measurements. Procedures for unblocking the junction depend on the type of reference junction electrode in use:

- **Gel-Filled Electrodes**

Soak the electrode in warm water (about 60 °C) for 5 to 10 minutes to re-establish contact. Or place the electrode in warm saturated KCl solution (60 °C) and allow both electrode and solution to cool down to room temperature.

- **Liquid-Filled Electrodes**

| Sleeve and Annular Junction |

Drain the electrode, rinse the cavity with distilled water and refill it with fresh electrolyte. For sleeve-type electrodes, rotate the sleeve to re-establish flow if necessary.

- **Ceramic Junction**

| For Calomel Types Only |

Soak the electrode in warm water for about 10 minutes, and check for electrolyte flow. Alternatively, soak the electrode tip in concentrated HCl for 5 to 10 minutes (use adequate ventilation and precautionary measures when performing this task). Rinse the electrode, then check for electrolyte flow again.

| For Silver/Silver Chloride Types Only |

Soak the electrode in warm saturated KCl solution (60 °C) for about 10 minutes, and check for electrolyte flow. Alternatively, soak the electrode tip in concentrated ammonium hydroxide for 5 to 10 minutes (use adequate ventilation and precautionary measures when performing this task). Rinse the electrode, then check for electrolyte flow.

| For Ceramic Junctions Only |

If the junction remains clogged, gently sand the junction area (be careful not to touch the glass bulb), and check for electrolyte flow.

Cleaning Glass pH Membrane

Dirty glass membranes are usually indicated by beads of water forming on the bulb when rinsing with distilled water. The bulb can be cleaned as follows:-

- **For Protein**
Soak in fresh protein removal solution ECDPCBT for 30 minutes, rinse thoroughly before use.
- **For Inorganic Deposits**
Wash with EDTA, ammonia or acids
- **For Grease and Similar Films**
Wash with acetone, methanol, etc.

Reconditioning Glass pH Membrane

Prolonged use, excessive alkaline immersion, or high temperature operation will cause surface leaching of the membrane glass; resulting in erratic or sluggish response which cannot be remedied by clearing the electrode. Immerse the electrode tip into 0.1N HCl for less than 5 minutes, and rinse with water. Then immerse the electrode tip into 0.1N KOH for 5 minutes, and rinse thoroughly with water. Check for electrode's performance. If the problem persists, repeat the steps but note that frequent HCl/KOH treatment can shorten the electrode life.

Solutions

Ordering Information

Order No.	Stock Code	Item
ECBU1BT	01X211211	Colourless pH 1.68 Buffer Solution (480 ml)
ECBU4BT	01X211201	Colourless pH 4.01 Buffer Solution (480 ml)
ECBU7BT	01X211202	Colourless pH 7.00 Buffer Solution (480 ml)
ECBU9BT	01X211222	Colourless pH 9.00 Buffer Solution (480 ml)
ECBU10BT	01X211203	Colourless pH 10.01 Buffer Solution (480 ml)
ECBU12BT	01X211212	Colourless pH 12.45 Buffer Solution (480 ml)
ECBU4BTC	01X211204	Red Colour Coded pH 4.01 Buffer Solution (480 ml)
ECBU7BTC	01X211213	Yellow Colour Coded pH 7.00 Buffer Solution (480 ml)
ECBU10BTC	01X211205	Blue Colour Coded pH 10.01 Buffer Solution (480 ml)
ECBU4BTC1LIT	01X211233	Red Colour Coded pH 4.01 Buffer Solution (1 Litre)
ECBU7BTC1LIT	01X211234	Yellow Colour Coded pH 7.00 Buffer Solution (1 Litre)
ECBU10BTC1LIT	01X211235	Blue Colour Coded pH 10.01 Buffer Solution (1 Litre)
ECBU4BS	01X223102	NIST-Traceable pH 4.01 Buffer Sachets (Pack of 20 Pcs x 20 ml)
ECBU7BS	01X223101	NIST-Traceable pH 7.00 Buffer Sachets (Pack of 20 Pcs x 20 ml)
ECBU10BS	01X223103	NIST-Traceable pH 10.01 Buffer Sachets (Pack of 20 Pcs x 20 ml)
ECRINWT	01X223201	NIST-Traceable Deionised Rinse Water Sachets (Pack of 20 Pcs x 20 ml)
ECORPQUIN	01X062700	ORP Quinhydrone 255 mV (480 ml)
ECORPQUIN086	01X211215	ORP Quinhydrone 86 mV (480 ml)
ECORPPRE	01X081500	ORP Pre-Treatment 475 mV (480 ml)
ECRE001	01X211208	Refilling Electrolyte for Single Junction Ag/AgCl Electrodes (480 ml)
ECRE002	01X211218	Refilling Electrolyte for Double Junction Ag/AgCl Electrodes (480 ml)
ECRE005	01X211206	Electrode Storage Solution (480 ml)
ECRE006	01X370502	Electrode Storage Solution For Eutech 620 Series
ECDPCBT	01X211216	Protein Removal Solution (480 ml)
ECPHELSTDC	01X081600	Flexible Electrode Holder with Swivel Arm



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