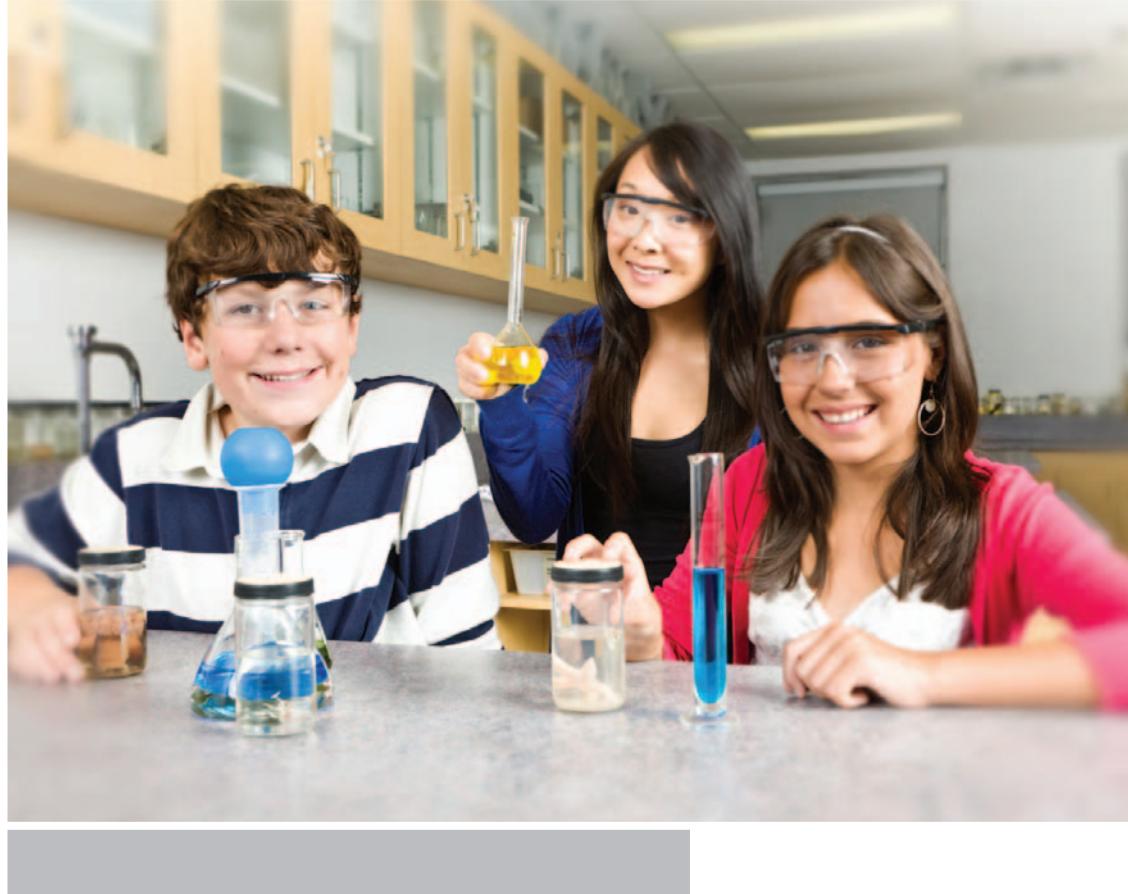


Electrode

A collector or emitter of electric charge as in a semi-conducting device; a form of transducer usually paired with an indicator to transform sensed values into information legible to the human eye.



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10. DO Electrodes
11. ATC Probes
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“My science experiments are fun and easy using Eutech’s meters.”



About pH Electrodes

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.

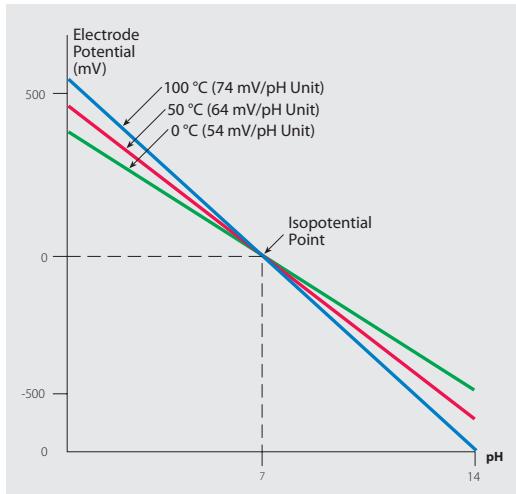
Use of Electrodes for pH Measurement

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.

Slope

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

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:

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

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

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

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.



Plastic Body

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

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.



Double Junction

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

| 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

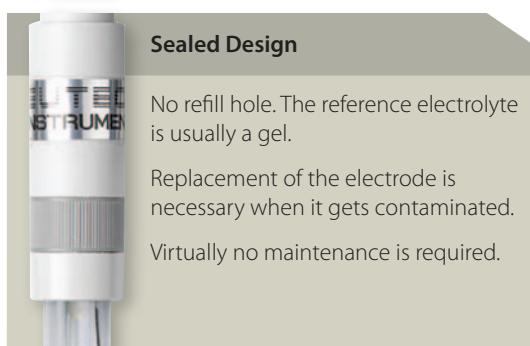


Refillable Design

Refill hole allows reference electrolyte replenishment.

Can be used many times over.

Needs refilling when fill solution is low.



Sealed Design

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.

| Unique Twist-Cap Design |

Unlike conventional designs which use rubber sleeves, Eutech's 620 series refillable electrodes feature a unique 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



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.

Electrodes

About pH Electrodes

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.

General Purpose Vs Specialty Applications

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



General Purpose Applications

Usually measures 120 mm (length) by 12 mm (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.

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.



Electrode Maintenance Guide

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.



Warranty

Eutech Instruments warrants its electrodes to be free from manufacturing defects for 6 months (unless otherwise specified).

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 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.

Electrodes

pH Electrodes (General Glass)
& (General Plastic)

Models	ECFG6350601B 93X218810	ECFG7350401B 93X218814	ECFG7370101B 93X218819	ECFG7351101B 93X218815	ECFG7451901B 93X218823	ECFG6351101B 93X218828
pH Electrodes (General Glass)						
Parameter	pH	pH	pH	pH	pH	pH
Range	0 to 13 pH	0 to 13 pH	0 to 13 pH	0 to 13 pH	0 to 14 pH	0 to 13 pH
Temp. Range	0 to 100 °C	0 to 100 °C	0 to 100 °C	0 to 100 °C	5 to 110 °C	0 to 100 °C
Liquid Junction Type	Annular ceramic	Annular ceramic	Annular ceramic	Sleeve	Annular ceramic	Annular ceramic
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Sealed/Refillable	Refillable	Refillable	Refillable	Refillable	Sealed	Sealed
Reference Junction	Single	Single	Double	Single	Single	Single
Refilling Reference Electrolyte	ECRE001	ECRE001	ECRE002	ECRE001	—	—
Dimensions (Shaft)	55 x 8 mm	130 x 12 mm	110 x 12 mm	110 x 12 mm	110 x 12 mm	55 x 8 mm
Cable Length	1 m	1 m	1 m	1 m	1 m	1 m
Connector	BNC	BNC	BNC	BNC	BNC	BNC
Description	General purpose glass-body pH electrode. Suitable for high viscosity samples where frequent cleaning of reference is required. Comes with 10 ml refilling electrolyte	General purpose glass-body pH electrode with protective sensor guard. Suitable for samples with low temperature measurements. Comes with 10 ml refilling electrolyte	Clog free double-junction glass pH electrode, ideal for samples containing TRIS buffers, sulfides and more. Easy to operate fill hole sleeve mechanism	General purpose glass-body pH electrode with sleeve design for faster response in high viscosity solutions, where frequent cleaning of reference is required	Rugged glass-body pH electrode for continuous, long-term use at high temperatures, particularly in strong alkaline solutions. Suitable for photographic chemicals	Glass-body pH electrode for solid or semi-solid samples
Used With	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector

pH Electrodes (General Plastic)

Models	ECFC7252101B 01X099412	ECFC72521R01B 01X099413	ECFC72522R01B 01X099414	ECFC7252201B / ECFC7252202B 01X099417 / 01X099419	ECFC7252205B / ECFC7252203B 01X099418 / 01X417010
pH Electrodes (General Plastic)					
Parameter	pH	pH	pH	pH	pH
Range	1 to 13 pH	1 to 13 pH			
Temp. Range	0 to 80 °C	0 to 80 °C			
Liquid Junction Type	Porous HDPE pin	Porous HDPE pin	Porous HDPE pin	Porous HDPE pin	Porous HDPE pin
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Sealed/Refillable	Sealed	Refillable	Refillable	Sealed	Sealed
Reference Junction	Single	Single	Double	Double	Double
Refilling Reference Electrolyte	—	ECRE001	ECRE002	—	—
Dimensions (Shaft)	90 x 12 mm	90 x 12 mm			
Cable Length	1 m	1 m	1 m	1 m / 2 m	5 m / 3 m
Connector	BNC	BNC	BNC	BNC	BNC
Description	General purpose plastic-body pH electrode. Comes with 10 ml refilling electrolyte	General purpose plastic-body pH electrode. Comes with 10 ml refilling electrolyte	General purpose plastic-body pH electrode. Comes with 10 ml refilling electrolyte	General purpose plastic-body pH electrode. Available with 2 m cable (ECFC7252202B)	General purpose plastic-body pH electrode. Available with 3 m cable (ECFC7252203B)
Used With	All pH meters with BNC input connector	All pH meters with BNC input connector			

Models	EC620130 01X218972	EC620131 01X218973	EC620132 01X218974	EC620133 01X218975
pH Electrodes (Specialty Open Pore)				
Parameter	pH	pH	pH	pH
Range	0 to 14 pH	0 to 14 pH	0 to 14 pH	2 to 11 pH
Temp. Range	0 to 80 °C	0 to 80 °C	0 to 60 °C	0 to 50 °C
Liquid Junction Type	Open pore	Open pore	Open pore	Open pore
Internal Reference Type	Ag/AgCl	Polymer-gel	Polymer-gel	Polymer-gel
Sealed/Refillable	Refillable	Sealed	Sealed	Sealed
Reference Junction	Double	Double	Double	Double
Refilling Reference Electrolyte	EC636430	—	—	—
Dimensions (Shaft)	140 x 12 mm	120 x 12 mm	105 x 12 mm	80 x 6 mm
Cable Length	1 m	1 m	1 m	1 m
Connector	BNC	BNC	BNC	BNC
Description	Open pore glass-body pH combination electrode for general pH measurements. Comes with 10 ml refilling electrolyte	Open pore glass-body pH electrode for general testing and high viscosity solutions where frequent cleaning of reference is required	Open pore plastic-body pH electrode for general pH measurements.	Open pore glass-body spear tip electrode. Suitable for semi-solid samples.
Used With	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector

Models	EC620185 93X218946	ECD A9350603B 93X218879	ECCOMBI03M 01X234601
pH Electrodes (Specialty)			 
Parameter	pH	pH	pH/Conductivity/Temperature
Range	0 to 14 pH	1 to 14 pH	1 to 13 pH / 0 to 20 mS/cm
Temp. Range	-5 to 100 °C	0 to 50 °C	0 to 80 °C
Liquid Junction Type	Annular ceramic	Annular ceramic	Porous HDPE pin
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl
Sealed/Refillable	Refillable	Sealed	Refillable
Reference Junction	Double	Single	Single
Refilling Reference Electrolyte	ECRE002	—	—
Dimensions (Shaft)	106 x 10 mm	151 x 26 mm	155 x 55 mm
Cable Length	1 m	3 m	3 m
Connector	BNC	BNC	6-pin
Description	Fast-responding glass-body electrode with extra rugged bulb design. Suitable for applications where frequent breakage of glass bulbs is a problem, but unsuitable for epoxy electrodes. Comes with 10 ml electrolyte	Submersible ABS-body gel-filled electrode	Combined pH electrode and 2-pin stainless steel conductivity electrode with 15 cm ABS guard
Used With	All pH meters with BNC input connector	All pH meters with BNC input connector	PC 10

Electrodes

pH Electrodes (3-in-1)
& ORP Electrodes

Models	ECFC7352901B 01X218964	ECFC7352901W 01X218995	ECFE7372801W 93X218990	ECFE7352801B 93X218835	ECFC7352901J 01X417004
pH/ATC Electrodes (3-in-1)					
Parameter	pH/Temperature	pH/Temperature	pH/Temperature	pH/Temperature	pH/Temperature
Range	1 to 13 pH	1 to 13 pH	1 to 13 pH	1 to 13 pH	1 to 13 pH
Temp. Range	0 to 80 °C	0 to 80 °C	0 to 80 °C	0 to 80 °C	0 to 80 °C
Liquid Junction Type	Porous HDPE pin	Porous HDPE pin	Porous HDPE pin	Porous HDPE pin	Porous HDPE pin
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Sealed/Refillable	Sealed	Sealed	Sealed	Sealed	Sealed
Reference Junction	Single	Single	Double	Single	Single
Refilling Reference Electrolyte	—	—	—	—	—
Dimensions (Shaft)	90 x 12 mm	90 x 12 mm	115 x 12 mm	115 x 12 mm	115 x 12 mm
Cable Length	1 m	1 m	1 m	1 m	1 m
Connector	BNC & 2.5 mm phono	BNC & 6-pin	BNC & 6-pin	BNC & phono plug	BNC & 8-pin
Description	General purpose plastic-body "3-in-1" pH/Temperature combination electrode	General purpose plastic-body "3-in-1" pH/Temperature combination electrode	General purpose plastic-body "3-in-1" pH/Temperature combination electrode	General purpose plastic-body "3-in-1" pH/Temperature combination electrode	General purpose plastic-body "3-in-1" pH/Temperature combination electrode
Used With	pH 5 / pH 6 / pH 5+/pH 6+ / pH 11 / pH 110 / pH 510 / pH 700 / pH 1100 / pH 2100 / pH 2700 / Ion 6 / Ion 6+ / Ion 510 / Ion 700 / Ion 2700 / PC 2700	PC 510 / PC 300 / pH 310 / pH 300	PC 510 / PC 300 / pH 310 / pH 300	Discontinued CyberScan models – pH 10 / pH 100 / pH 200 / pH 500 / pH 1000 / pH 2000	pH 600 / pH 610 / pH 620 / PC 650 / PD 650 / PCD 650

Models	ECFC7960101B 01X256612	ECFC7960201B 01X256613	ECFC79601R01B 01X254014	ECFC79602R01B 01X256621	ECFG7960101B 93X219103
Oxidation Reduction Potential (ORP) Electrodes					
Parameter	Oxidation Reduction Potential (ORP)	Oxidation Reduction Potential (ORP)	Oxidation Reduction Potential (ORP)	Oxidation Reduction Potential (ORP)	Oxidation Reduction Potential (ORP)
Range	-1000 to 1000 mV	-1000 to 1000 mV	-1000 to 1000 mV	-1000 to 1000 mV	-1000 to 1000 mV
Temp. Range	0 to 80 °C	0 to 80 °C	0 to 80 °C	0 to 80 °C	0 to 100 °C
Sensor Type	Platinum pin	Platinum pin	Platinum pin	Platinum pin	Platinum band
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Sealed/Refillable	Sealed	Sealed	Refillable	Refillable	Refillable
Reference Junction	Single	Double	Single	Double	Single
Refilling Reference Electrolyte	—	—	—	—	ECRE001
Dimensions (Shaft)	90 x 12 mm	90 x 12 mm	90 x 12 mm	90 x 12 mm	100 x 12 mm
Cable Length	1 m	1 m	1 m	1 m	1 m
Connector	BNC	BNC	BNC	BNC	BNC
Description	General purpose plastic-body ORP electrode	General purpose plastic-body ORP electrode.	General purpose plastic-body ORP electrode. Comes with 10 ml refilling electrolyte	General purpose plastic-body ORP electrode. Comes with 10 ml refilling electrolyte	General purpose glass-body ORP electrode. Comes with 10 ml refilling electrolyte
Used With	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector	All pH meters with BNC input connector	All ORP meters with BNC input connector

Models	CONSEN91B 01X244701	CONSEN91J 01X244721	CONSEN9103J 01X244725	EC620165 93X219046	CONSEN91W 01X244702	CONSEN9501D 01X466602	93X546101 93X546101	93X546102 93X546102	CONSEN9203J 01X244723	CONSEN9201D 01X244730	ECCONSEN72W 93X244303
Conductivity Electrodes											

* Max. constant temp of 75 °C; intermittent measurements up to 100 °C

Models	DO6HANDY 01X233913	ECDO6HANDY3M 01X233916	ECDOHANDY8M 01X239606	EC620SSP 01X295704	ECDOHANDYNEW 01X239601
Dissolved Oxygen (DO) Electrodes					

Electrodes

ATC Probes &

Temperature Probes

Models

Models	PH5TEM01P 01X021804	PH5TEMB01P 01X210303	ECPHWPTEM01J 01X021818	PHWPTEM01W 01X021807	EC62019 01X306504	PHWPTEM03J 01X021820
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ATC Probes

Parameter

Temperature

Temp. Range 0 to 100 °C

Material Stainless steel 304

Dimensions (Shaft) 84 x 3 mm

Dimensions (Handle) 85 x 12 mm

Cable Length 1 m

Connector 2.5 mm phono plug

Used With pH 110 / pH 11 / Ion 6+ / pH 6+ / pH 5+

pH 110 / pH 11 / Ion 6+ / pH 6+ / pH 5+	pH 2700 / Ion 2700 / pH2100/pH1100/Ion510/ pH 510 / pH 700/Ion 700	pH 620 / pH 610 / pH 600	pH 310 / pH 300 / PC 300 / PC 510	pH 6500 / pH 6000 / pH 1500 / CON 1500 / PC 6000/PC6500/PCD6500	pH 610 / pH 620
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Models

Models	TEM5TEM01P 01X021811	TEM6TEM01R 01X021814	ECTPGLPJ01M 01X220001	ECTPGLPK01M 01X220101	ECTPPENJ01M 01X220002	ECTPPENK01M 01X220102
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Temperature Probes

Parameter

Temperature

Range 0 to 125 °C

Meter Thermistor

Dimensions (Shaft) 117 x 3 mm

Cable Length 1 m

Connector 1/4 inch phono plug

Description 100 K thermistor

Temperature probe, ungrounded, SS304 (max. temp. 150 °C)

Used With EcoScan Temp 5

EcoScan Temp 5	EcoScan Temp 6	EcoScan Temp JKT	EcoScan Temp JKT	EcoScan Temp JKT	EcoScan Temp JKT
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