Starter Electrodes

Ingeniously Practical

Contents

About the Starter Series

Accurate and precise measurement has been our main focus since our inception in 1907. After more than a century of developing balances that have provided the reliable and repeatable weight determination that is essential to laboratory applications, OHAUS is proud to now offer our expertise in measurement in a line of electrochemistry products.

The Starter Series of electrodes includes pH, reference, oxidation-reduction potential (ORP), conductivity, dissolved oxygen (DO) and temperature electrodes that can be used in conjunction with our bench and portable meters. This catalog contains background information on each electrochemistry substance, information about our electrodes that measure these substances, as well as buffers and solutions.

pH Electrodes

Basic Theory of pH

pH is one of the most common parameters measured in a wide variety of industries such as water and wastewater treatment, food and beverage, agriculture, research and production, environmental monitoring, chemical and life sciences research, electronics production as well as other industrial applications.

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.

A pH electrode produces different mV in different solutions.

A perfect pH electrode, at 25˚C, produces a slope of 59.16mV per 1.00 pH unit and has a value that ranges between 50 and 58 mV.

Slope = mV /pH unit

Use of Electrodes for pH Measurement

Measurement is usually done with a combination electrode. The combination electrode is an electrode system formed by a glass electrode and a reference electrode.

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 through Nernst Equation.

E = E0 + (2.303RT/nF) logaH+

pH Electrode Structure

Shaft Body Material

	Characteristic	Advantage
Glass Shaft	Can withstand high temperatures and is resistant to corrosive materials and solvents.	Ideal for laboratory use and is easy to clean.
Plastic Shaft	Not recommended for usage at temperatures above 80 ˚C. Moderate resistance to highly corrosive materials and solvents.	Is durable and not easily broken.

Refillable vs. Gel

	Characteristic	Advantage
Refillable	Reference electroytes can be replenished when necessary.	Can be used many times over.
Gel	The reference electrolyte gel is not refillable and the electrode must be replaced when contaminated.	No maintenance is required.

Reference Junctions Types

	Characteristic	Advantage
Ceramic	This standard junction consists of a porous piece of ceramic which allows the electrolyte to slowly flow out of the electrode.	Stable and simple to use.
Annular Junction	Formulated with a special ceramic which encircles the glass bulb. Numerous pores in the ceramic provide lower resistance and more stable pH readings.	Not easily blocked and ideal for muddy samples.

pH Electrodes

Maintenance and Storage of pH Electrodes

pH electrodes are delicate measuring instruments that require proper care and maintenance to produce accurate and reliable results as well as to ensure a long useful life.

Always keep the pH electrode moist when not in use by using an electrode storage solution (3M KCl). DO NOT store the electrode in distilled or deionized water as this will cause ions to leak out of the glass bulb and reference electrolyte, causing a 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 in enough storage solution to cover the bulb. Replenish the bottle as needed.

					
Model	**ST320**	**ST310**	**STPURE**	**ST230**	**ST210**
pH Range	0 to 14 pH	0 to 14pH	0 to 13 pH	0 to 14 pH	0 to 14 pH
Temperature Range	0 to 80 °C	0 to 80 °C	0 to 100 °C	0 to 100 °C	0 to 80 °C
Shaft Material	Plastic	Plastic	Glass	Glass	Plastic
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Gel/Refillable	Non-refillable, Gel	Refillable	Refillable	Refillable	Refillable
Reference Junction Type	Fiber pin	Ceramic pin	Ground glass	Annular ceramic	Ceramic pin
Refilling Reference Electrolyte	3M KCl gel	3M KCl solution	3M KCl solution	3M KCl solution	3M KCl solution
Dimensions (Shaft)	120 x 12 mm	120 x 12 mm	120 x 12 mm	110 x 12 mm	120 x 12 mm
Cable Length	1 m	1 m	1 m	1 m	1 m
Temperature Sensor	Yes	Yes	NO	NO	NO
Connector	BNC	BNC Cinch	BNC	BNC Cinch	BNC
Description	General purpose 3-in1 plastic gel pH electrode suitable for normal samples	General purpose 3-in1 plastic refillable pH electrode suitable for normal samples	Glass-body refillable pH electrode for pure water (distilled water, rain water, tap water etc.)	General purpose glass-body refillable pH electrode suitable for muddy samples such as juice, milk etc.	General purpose 2-in1 plastic gel refillable pH electrode. Suitable for normal samples
Used With	OHAUS pH meters with BNC input connector and Cinch temperature connector	OHAUS pH meters with BNC input connector and Cinch temperature connector	All pH meters with BNC input connector	OHAUS pH meters with BNC input connector and Cinch temperature connector	All pH meters with BNC input connector

Reference Electrodes

Reference Electrodes have a stable and well defined electrochemical potential (at constant temperature) against which the applied or measured potentials in an electrochemical cell are referred. Therefore, a good reference electrode is non-polarizable, or will remain stable upon passage of a small current.

STREF2 is a saturated calomel electrode (SCE)(Hg/Hg2Cl2 in saturated KCl) which traditionally was the most widely used electrode. The disadvantage is it cannot be used above 50 due to instability of the Hg2Cl2.

STREF1 is a Silver/Silver Chloride (Ag/AgCl in Saturated KCl) electrode which has become the most widely used reference electrode since the SCE became less popular.

Maintenance of the reference electrode can help avoid stability problems and keep it in good working order:

1. Make sure that the reference electrode compartments are filled with electrolyte solution.
2. Make sure the junction is not blocked.

Model	STREF2	STREF1
Description	Saturated Calomel (SCE)	Silver/Silver Chloride (Ag/AgCl)
E vs. SHE (Standard Hydrogen Electrode) (V)	0.241	0.198
Connector	2mm banana	2mm banana
Dimensions (Shaft)	120 x 12 mm	110 x 12 mm
Cable Length	1 m	1 m

ORP Electrodes

Oxidation-Reduction Potential (ORP) electrodes test for the overall availability of electrons in a medium, specifically the ratio of positive and negative ions in the solution. They are also sometimes referred to as Redox electrodes.

ORP is the only practical method used to electronically monitor sanitizer effectiveness and it is also commonly tested in water, such as swimming pools and aquariums, in order to help oxidize contaminants.

ORP is expressed in millivolts (mV). A range of -1000 mV to 1000mV is common with most ORP tests. The pH value influences the ORP value significantly.

Keeping the electrode clean is very important in order to keep the platinum band or disk from getting contaminated, which can result in slow response time or inaccurate measurement.

Model	STORP2	STORP1
Shaft Material	Glass	Plastic
Temperature Range	0-100 ˚C	0-80 ˚C
Internal Reference Type	Ag/AgCl	Ag/AgCl
Gel/Refillable	Refillable	Non-Refillable, Gel
Reference Junction Type	Annular ceramic	Ceramic pin
Refilling Reference Electrolyte	3M KCl gel	3M KCl gel
Dimensions (Shaft)	120 x 12 mm	120 x 12 mm
Cable Length	1 m	1 m
Temperature Sensor	NO	NO
Connector	BNC	BNC
Zero Potential Value	86mV±15mV	86mV±15mV
Grade Difference	≥ 165mV	≥ 165mV

Conductivity Electrode

Basic Theory of Conductivity

Conductivity is measured in a wide range of industries and gives a readout of total ionic concentration within the sample solution. It's a rapid and inexpensive way of determining the ionic strength of a solution.

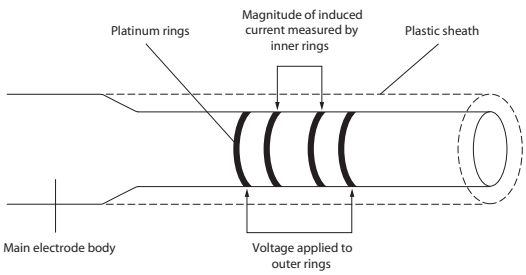
A basic conductivity cell consists of a pair of electrodes between which the sample is situated. The ratio of the distance between the electrodes (D) and their surface area (A) is known as the cell constant: K:

K= d/A [cm -1]

Every measuring cell has its own particular cell constant. It is recommended that you always determine the cell constant exactly by using a standard to calibrate.

In contrast to a pH electrode, the measuring cell does not change with time, at least if the sensor is used properly. The cell constant changes only if the surface of the electrode changes, for example through fingerprints, deposits, scratches or enclosed air bubbles.

The conductivity electrode should be stored dry.



The STCON3 utilizes the 4-Ring potentiometric method for measuring conductivity, which incorporates a series of four stainless steel rings formed into the probe shaft. This design completely eliminates polarization, which occurs with the 2-Plates amperometric method. Furthermore, without polarization the probe can measure a wider range of conductivity values because it does not suffer from electrolysis.

The STCON3 conductivity electrode has a built-in temperature sensor which is 30K. When using STCON3, please consider the following:

1. Make sure the plastic shield is in place when measuring.
2. Be sure the solution has reached the line on the plastic shield and below the vent hole when measuring.
3. To prevent carry over from high to low conductivity solutions, rinse with distilled water between and after measurements.
4. Make sure the cell chamber is bubble-free when measuring.
5. Allow sufficient time for the sensor to stabilize when measuring samples at different temperatures. Manual end-pointing is advised.

Model	STCON3
Connection	Mini-Din
Cable Length	1.0 m
Shaft Length	130mm
Shaft Diameter	14mm
Temperature Range	0-50 ˚C
Measurement Range	70 µs/cm - 200ms/cm (0.5% accuracy)

DO Electrode

Basic principle of DO

There are 3 types of commonly used oxygen sensors: polarographic, galvanic and optical (luminescence) sensors.

STDO11 is a galvanic DO electrode and the the simplest sensor among the 3 sensors. It produces its own electric current.

The cathode is silver and the anode is zinc. Oxygen passes through the membrane and is reduced at the cathode to increase the electrical signal (current) read by the electrode. As oxygen increases, the signal increases. The reaction is:

$O2 + H2O + Zn = Zn(OH)2$

Galvanic sensors are active at all times and will degrade in storage as well as during use. The galvanic electrode does not need to polarize (warm up) before calibration or measurement while polarographic electrodes take 15 minutes to several hours to warm up.

Model	STDO11
Connection	BNC
Cable Length	1.1m
Shaft Length	120mm
Shaft Diameter	12mm
Shaft Material	Plastic
Temperature Range	0-50 ˚C
Measurement Range	0-200%
Storage Solution	10% NaCl

Carefully remove the protective bottle from the tip of the electrode by unscrewing the lid and removing the bottle. Remove the shorting plug from the connector and store in a safe place. Be careful because the protective bottle lid is tightly fit on the electrode.

STDO11 should be stored in a moist environment to keep the membrane from drying out, but do not store directly in water.

Calibration and Measurement

When calibrating out of a liquid substance, remove water droplets from the membrane by shaking the sensor. When measuring, stir the sample to ensure accurate and stable readings.

Temperature Electrode & Solutions

Temperature Compensation

Temperature variations can affect pH measurements. However at pH level 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 pH/˚C/pH unit from pH 7

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

STTEMP30 is a standalone sensor that can be used in conjunction with Starter 3100, 2100, 300 and 300D meters to check for temperature variations.

Model	STTEMP30
Shaft Material	Stainless steel
Shaft Length	120mm
Temperature Range	0-100 ˚C
Cable Length	1 m
Connection	Cinch

pH Buffer Solutions
250 ml pH buffer solutions are available in values of pH 4.01, 7.00, 9.21, 10.01. Select solutions come in color coded bottles with dispenser tops and help with instant recognition. These are available in 250 ml bottles.

Conductivity standards
250 ml Conductivity standard solutions are available in values of 84µs/cm, 1413µs/cm and 12.88 ms/cm.

Reference Refilling Electrolyte
3M KCl saturated (with AgCl) reference fill solutions for Ag/AgCl single junction electrodes is available.

Electrode Storage Solutions
After cleaning or when the electrode is not in use, always keep pH electrodes in some storage solution to ensure proper working condition.

Description	Item Number
pH Buffer Powder Sachet (4.01; 7.00; 10.1)	83033971
Buffer pH4.01 250ml*6	30065083
Buffer pH7.00 250ml*6	30065084
Buffer pH9.21 250ml*6	30065085
Buffer pH10.00 250ml*6	30065086
pH electrode Reference Electrolyte (30ml)	30059255
pH electrode Storage Solution(125ml)	30059256
pH sensor Protect Bottle (10 in bag)	30064800
Standard Conduct 84µS/cm 250ml*6	30065087
Standard Conduct 1413µS/cm 250ml*6	30065088
Standard Conduct 12.88mS/cm 250ml*6	30065089


OHAUS

About OHAUS Starter Series

After more than a century of perfecting the art of measurement through our durable weighing products, OHAUS precision is now available in a line of benchtop, portable and pen pH, conductivity, dissolved oxygen, salinity, total dissolved solids (TDS), oxidation reduction potential (ORP) meters and electrodes. The Starter Series includes a wide breadth of products from basic level meters that offer high performance at a great value to high performance products that have extended and advanced functionality, as well as a variety of electrodes that can be used in combination with our bench and portable meters.

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