STARTER™ Electrodes

High Performance Water Analysis Instruments

Ingeniously Practical

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STARTER™ *Electrodes Selector Guide*

		pH Electrodes												
		ST350	ST320	ST320 IP67	ST310	ST272	ST270	ST260	ST230	ST210	STMICRO8	STMICRO5	STPURE	STSURF
pH measurements of environmental and laboratory samples	Standard Aqueous samples, general purpose (e.g. pH buffers)	●	●	●	●	◐	◐	◐	●	●	●	●	●	◐
	Waste water	●	◐	◐	◐				●	◐				
	River/lake water	●	●	●	●				●	●			●	
	Swimming pool	●	◐	◐	◐				●	◐			●	
	Tap water/drink water	●	◐	◐	◐				●	◐			●	
	Pharmaceutical industry water	●	◐	◐	◐				●	◐			●	
	Distilled water/pure water	◐							◐				●	
	Education purpose samples	◐	◐	◐	●				◐	●	◐		◐	
	Strong Acid(not HF)or strong Base	◐							◐					
	Harsh Environmental solution, e.g high temperature or corrosive	◐							◐					
	Drug formulations	◐							◐					
	Tris-buffer solutions							●						
	Suspensions(e.g. ink, soil in water)	◐							◐					
	Cell culture media					◐	◐							◐
	Small container/Tube samples										●	◐		
	Microtube samples										◐	●		
pH measurements of Food and Beverages etc.. (various liquid or semi-solid samples)	Jam/Yoghurt	◐				●	●		◐					◐
	Vegetable and fruit	◐				●	●		◐					
	Honey	◐							◐					
	Cream	◐							◐					
	Fish/Meat/Poutry					●	●							
	Cheese					●	●							
	Milk	●	◐	◐	◐				●	◐				
	Soy sauce	●	◐	◐	◐				●	◐				
	Beer	●	◐	◐	◐				●	◐				
	Wine	◐							◐					
	Tea and coffee	●	◐	◐	◐				●	◐				

● fit for this application

◐ partially fit for this application

not fit for this application

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Exemplary daily use chemical products pH measurements	Pesticidea solution	◐							◐					
	Paint/latex paint	◐							◐					
	Water paint	◐							◐					
	Cosmetics/emulsion	●	◐	◐	◐				●	◐				
	Shampoo/ Shower creams/ liquid soups	●	◐	◐	◐				●	◐				
pH measurement on surface	Meat/Cheese													●
	Paper													◐
	Skin													●
	Agar													◐

		Redox(ORP) Electrodes		Conductivity Probes		
		STORP1	STORP2	STCON3	STCON3 IP67	STCON7
pH measurements of environmental and laboratory samples	Standard Aqueous samples, general purpose (e.g. pH buffers)	●	●	◐	◐	◐
	Waste water	◐	●	◐	◐	
	River/lake water	●	●	●	●	
	Swimming pool					
	Tap water/drink water	◐	◐	●	●	
	Pharmaceutical industry water			◐	◐	●
	Distilled water/pure water					◐
	Education purpose samples					
	Strong Acid(not HF)or strong Base					
	Harsh Environmental solution, e.g high temperature or corrosive					
	Drug formulations					
	Tris-buffer solutions					
	Suspensions(e.g. ink, soil in water)					
	Cell culture media					
	Small container/Tube samples					
	Microtube samples					

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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 precise 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 includes pH, reference, oxidation-reduction potential (ORP) electrodes, as well as conductivity, dissolved oxygen (DO) and temperature probes that can be used in conjunction with our bench and portable meters. This catalog contains essential information regarding OHAUS' portfolio of Starter sensors, including product specifications and sample types they were designed to measure. In addition to the sensors, information regarding accessories such as conductivity and pH solutions used for calibration, are included.

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pH Electrodes

Basic Theory of pH

pH is a one of the most commonly measured parameters in chemical and life sciences research, as well as is many different industries, including water and wastewater treatment, food technology, environmental protection, production and agriculture.

pH is defined as the negative logarithm of the hydrogen ions concentration in the sample:

$pH = -\log [H^+]$

pH provides a convenient way to compare the relative acidity or alkalinity of a sample at a given temperature.

pH electrodes produce different mV values in solutions with different pH. Ideally, at 25°C, a pH electrode should produce a slope of 59.16mV per 1 pH unit.

Electrodes for pH Measurement

pH measurement is usually conducted using a combination electrode that consists of a pH-sensitive glass electrode that is sensitive to hydrogen ions present in the sample as well as a reference electrode that has a constant potential value.

A potential is developed on the membrane surface when a pH electrode comes into contact with a sample.

pH meters measure variations in the potential and convert it directly to a corrsponding pH value, according to the Nernst equation:

$E = E_0 + (2.303RT/nF)\log[H^+]$

pH measurement is sensitive to temperature changes. However, at a pH of 7, temperature will not have an effect on the potential of the system.This is known as the isopotential point. OHAUS' 3-in-1 electrodes are convenient tools that contain a built-in temperature probe that can be used together with a meter to compensate temperature changes without application of any extrernal temperature probe.

pH Electrode Structure

Shaft Body Material

	Characteristic	Advantage
Glass Shaft	Can withstand high temperatures and is resistant to corrosive materials and organic solvents.	Ideal for laboratory use, easy to clean.
Plastic Shaft	Not recommended for usage at temperatures above 80˚C. Moderate resistance to highly corrosive materials and organic solvents.	Durable and sturdy

Refillable vs. Non-refillable

	Characteristic	Advantage
Refillable	Reference electrolytes can be replenished when necessary.	Reusable
Non-refillable	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, 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 usable life.

If an electrode is not in use always keep it moist by placing the electrode's glass bulb in the 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, which can cause a slow response and damage the electrode.

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. Gently remove the electrode 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	ST320 IP67 3M	ST310	STPURE	ST230	ST210
Item Number	83033967	30468960	83033965	83033969	83033968	83033966
pH Range	0 to 13pH	0 to 13pH	0 to 14 pH	0 to 13 pH	0 to 14pH	0 to 14 pH
Temp. Range	0 to 80 °C	0 to 80 °C	0 to 80 °C	0 to 100 °C	0 to 100 °C	0 to 80 °C
Shaft material	Plastic	Plastic	Plastic	Glass	Glass	Plastic
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Refillable/Non-refillable	Non-refillable, Gel	Non-refillable, Gel	Refillable	Refillable	Refillable	Refillable
Reference Junction Type	Fiber pin	Fiber pin	Ceramic pin	Ground glass	Annular ceramic	Ceramic pin
Refilling Reference Electrolyte	3M KCl gel	3M KCl gel	3M KCl solution	3M KCl solution	3M KCl solution	3M KCl solution
Dimensions (Shaft)	120 × 12 mm	120 × 12 mm	120 × 12 mm	120 × 12 mm	110 × 12 mm	120 × 12 mm
Cable Length	1 m	3 m	1 m	1 m	1 m	1 m
Temperature Sensor	Yes	Yes	Yes	No	No	No
Connector	BNC Cinch	IP67 BNC IP67 Cinch	BNC Cinch	BNC	BNC	BNC
Application	3-in-1 non-refillable pH electrode with integrated temprature probe. Suitable for standard or muddy samples.	3-in-1 non-refillable pH electrode with IP67 connectors and 3m cable. Compatible with ST400/400M IP67 waterproof portable meter.	3-in-1 plastic refillable pH electrode, suitable for normal samples.	Glass-body refillable pH electrode for pure water (distilled water, rain water, tap water etc.).	Glass-body refillable pH electrode. Suitable for muddy samples such as juice, milk etc..	2-in-1 plastic refillable pH electrode. Suitable for normal samples.

pH Electrodes

The newest addition to the OHAUS Starter Series of electrochemistry instruments includes electrodes that support advanced pH measurements.

OHAUS offers several pH electrodes, including a glass shaft 3-in-1 electrode (ST350), micro-sample pH electrodes (STMICRO5 and STMICRO8), double-salt bridge pH electrode (ST260) that is suitable for pH measurement of tris-buffer solutions, or a flat surface pH electrode (STSURF).

Model	ST350	ST272	ST270	STMICRO5	STMICRO8	ST260	STSURF
Item Number	30129354	30393265	30240974	30087566	30087569	30129357	30129470
pH Range	0 to 14pH	2 to 12pH	0 to 14pH	0 to 14pH	0 to 14pH	0 to 14pH	2 to 12pH
Temp. Range	0 to 100 °C	0 to 50 °C	0 to 100 °C	0 to 100 °C	0 to 100 °C	0 to 100 °C	0 to 80 °C
Shaft material	Glass	Plastic	Glass	Glass	Glass	Glass	Plastic
Internal Reference Type	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Refillable/Non-Refillable	Refillable	Non-refillable, Gel	Non-refillable, Gel	Refillable	Refillable	Refillable	Refillable
Reference Junction Type	Annular ceramic	Annular fiber	Annular ceramic	Annular ceramic	Annular ceramic	Ceramic pin	Ground glass
Refilling Reference Electrolyte	3M KCl solution	3M KCl gel	3M KCl gel	3M KCl solution	3M KCl solution	Double salt-bridge 3M KCl(AgCl) Pure KCl solution	3M KCl solution
Dimensions (Shaft)	120 × 12 mm	120 × 15 mm	120 × 12 mm	80 × 5 mm	150 × 8 mm	120 × 12 mm	120 × 12 mm
Cable Length	1 m	1 m	1 m	1 m	1 m	1 m	1 m
Temperature Sensor	Yes	No	No	No	No	No	No
Connector	BNC Cinch	BNC	BNC	BNC	BNC	BNC	BNC
Application	3-in-1 refillable pH electrode, with integrated temperature probe. Suitable for normal samples.	2-in-1 plastic shaft puncture pH electrode for semi-solid samples such meat, fruits or cheese, the steel head ensure the structure stronger and durable, not eay to break..	Puncture electrode suitable for semi-solid samples such as fruits, meat or cheese.	2-in-1 80mm length and 5mm diameter refillable pH electrode. Suitable for small samples, tubes, and narrow containers.	2-in-1 150mm length and 8mm diameter refillable pH electrode. Suitable for small samples, tubes, and narrow containers.	2-in-1 double salt-bridge pH electrode. Suitable for samples which may react with Ag ions, such as tris-buffer solution.	2-in-1 refillable pH electrode. Suitable for flat surface applications, such as skin, paper etc..

Reference Electrodes

Basic Principle of Reference Electrodes

Reference eletrodes have a stable and well defined electrochemical potential. A measured potential in an electrochemical cell is determined against a defined potential value of a reference electrode.

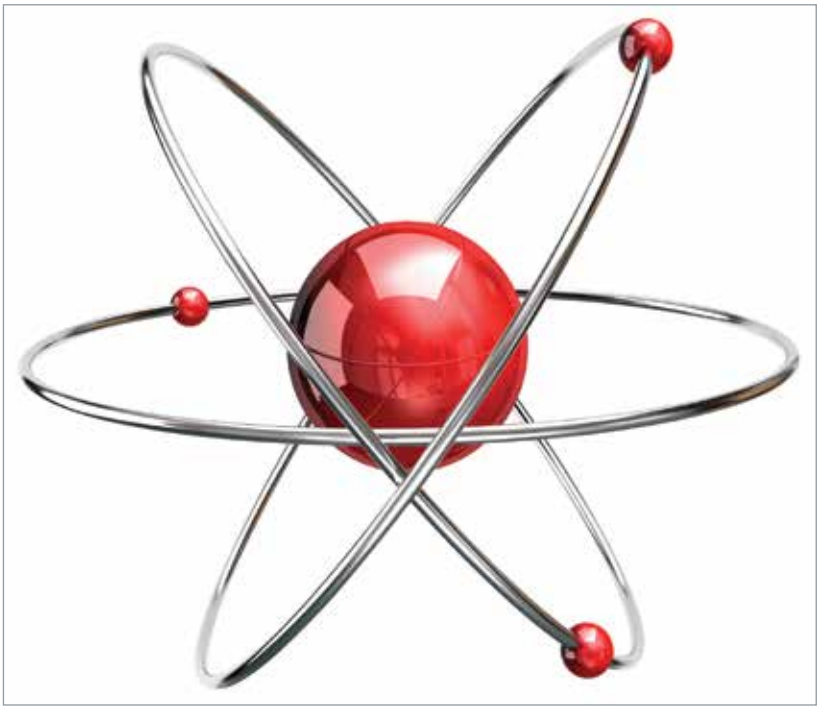
STREF2 is saturated calomel electrode (SCE)(Hg/Hg_2Cl_2 in saturated KCl) which traditionally is the most widely used electrode. The disadvantage is that it cannot be used above 50°C due to Hg_2Cl_2 instability.

STREF1 is Silver/Silver Chloride (Ag/AgCl in Saturated KCl), which represents another type of reference electrode.

Care and Maintenance

Maintenance of reference electrodes can help avoid stability problems and keep them in proper working condition.

Check that the reference electrode compartments are filled with electrolyte solution and the junction is not blocked.



Model	STREF2	STREF1
Item Number	30059254	30059253
Description	Saturated Calomel (SCE)	Silver/Silver Chloride (Ag/AgCl)
E vs. SHE (Standard Hydrogen Electrode) (V)	0.241	0.198
Connector	2 mm Banana	2 mm Banana
Dimensions (Shaft)	120 × 12 mm	110 × 12 mm
Cable Length	1 m	1 m

ORP Electrodes

Basic Principle of ORP

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.

ORP is expressed in millivolts (mV). -1000 mV to 1000mV is a common range for ORP tests. The pH value influences the ORP value significantly.

Care and Maintenance

To ensure accurate measurements, it is important to keep the electrode clean. Contamination can cause inaccurate results and slow response times.

Model	STORP2	STORP1
Item Number	30038553	30038555
Shaft Material	Glass	Plastic
Temperature Range	0-100 ˚C	0-80 ˚C
Internal Reference Type	Ag/AgCl	Ag/AgCl
Refillable/Non-refillable	Refillable	Non-refillable, Gel
Reference Junction Type	Annular Ceramic	Ceramic Pin
Refilling Reference Electrolyte	3M KCl Solution	3M KCl Gel
Dimensions (Shaft)	120 × 12 mm	120 × 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 Probes

Basic Theory of Conductivity

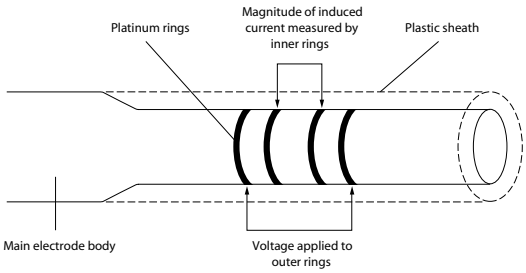
Conductivity is measured in a wide range of industries and gives a readout of total ionic concentration within the sample. It is a rapid and inexpensive way of determining the ionic strength of a solution.

A basic conductivity cell consists of a pair of electrodes that are placed in a sample. 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 $^{-1}$]

Each measuring cell has its own particular cell constant. It is recommended that you always determine the exact cell constant by using a calibration standard.

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 probe changes, for example through fingerprints, deposits, scratches or enclosed air bubbles. The conductivity probe should be stored in a clean and dry enivronment.



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 probe has a built-in temperature sensor which is 30kΩ. When using STCON3, please consider the following:

1. Make sure the plastic shield is in place when measuring.
2. Be sure the solution 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.
5. Allow sufficient time for the sensor to stabilize when measuring samples at different temperatures. A manual end-point is advised.

Model	STCON3	STCON3 IP67
Item Number	83033972	30468962
Connection	Mini-Din	IP67 LTW
Cable Length	1 m	3 m
Shaft Length	130 mm	130 mm
Shaft Diameter	14 mm	14 mm
Temperature Range	0-50 ˚C	0-50 ˚C
Measurement Range	70 µS/cm - 200mS/cm (0.5% accuracy) 2 µS/cm - 70µS/cm (1% to 5% accuracy)	70 µS/cm - 200mS/cm (0.5% accuracy) 2 µS/cm - 70µS/cm (1% to 5% accuracy)
Compatible with	ST300C portable meter	ST400M IP67 waterproof portable meter

Conductivity Probes

The newest conductivity probe to join the Starter Series is a 2-pole potentiometric probe, STCON7. STCON7 is especially designed for low conductivity measurements in mediums such as pure or distilled water. With a built-in 30KΩ temperature sensor, it performs automatic temperature compensation. The stainless steel measuring cell chamber can hold 316L.

Operation

For optimal performance, use the same procedure as described for STCON3 on the previous page. Moreover, when taking measurements, make sure the solution is above the cell chamber and remove any build-up of solids in the chamber. This can be done by dabbing the probe with cotton soaked in detergent solution and then rinsing it in distilled water.

Precautions and Limitations

1. Do not expose the shaft to organic solvents when cleaning or when taking measurements.
2. Do not use the probe outside the recommended temperature range.
3. Calibrate the electrode with standard solution for an accurate measurement.

Model	STCON7
Item Number	30080693
Connection	Mini-Din
Cable Length	1.0 m
Shaft Length	95mm
Shaft Diameter	12mm
Temperature Range	0-60 ˚C
Measurement Range	0.02 µS/cm - 200µS/cm (accuracy: 0.02µS/cm)

Dissolved Oxygen Probes

Basic Principle of Dissolved Oxygen (DO) Probes

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

STDO11 is a galvanic DO probe and the simplest among the three probes. 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.

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

Care and Maintenance

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.

Model	STDO11
Item Number	30031639
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

Calibration and Measurement

DO probes should be calibrated before being placed in the sample. Before calibrating a probe, do not forget to remove water droplets from the membrane by gently shaking the sensor.

Temperature Probes & Solutions

Temperature Compensation

Temperature variations can affect measurement values.

OHAUS offers a standalone temperature probe, STTEMP30. It can be used in conjunction with ST5000, ST3100, ST2100 and ST300 meters to check for temperature variations.

Standard Solutions

pH Buffer Solutions
1.68, 4.01, 6.86, 7.00, 9.18, 10.01, and 12.45 buffer solutions are available in 250ml bottles.

Conductivity standards
Four conductivity standard solutions for calibration include: 10µS/cm, 84µS/cm, 1413µS/cm and 12.88 mS/cm.

Reference Refilling Electrolyte
3M KCl saturated with AgCl reference fill solution for Ag/AgCl single junction electrodes.

Electrode Protection Solutions
After cleaning or when the electrode is not in use, always keep it in storage solution. To ensure proper conditions for pH electrodes, we offer pH electrode protection solution (3M KCl, 125ml).

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Model	STTEMP30
Item Number	83033970
Shaft Material	Stainless Steel
Shaft Length	120mm
Temperature Range	0-100 ˚C
Cable Length	1 m
Connection	Cinch

Solutions	Item Number
Buffer pH 1.68, 250ml Bottle	30100424
Buffer pH 4.01, 250ml Bottle	30100425
Buffer pH 6.68, 250ml Bottle	30100426
Buffer pH 7.00, 250ml Bottle	30100427
Buffer pH 9.18, 250ml Bottle	30100428
Buffer pH 10.01, 250ml Bottle	30100429
Buffer pH 12.45, 250ml Bottle	30100440
Cond. Solution 10µS/cm, 250ml Bottle	30100441
Cond. Solution 84µS/cm, 250ml Bottle	30100442
Cond. Solution 500 µS/cm, 250ml Bottle	30393269
Cond. Solution 1413µS/cm, 250ml Bottle	30100443
Cond. Solution 12.88mS/cm, 250ml Bottle	30100444
pH Electrode Reference Electrolyte	30059255
pH Electrode Protection Solution	30059256

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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