

STARTER ELECTRODES

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 also 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 electrodes that can be used in conjunction with our bench and portable meters. In this section, you will find 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.

Basic Theory of pH

pH is a one of the most commonly measured parameters in chemical and life science research, as well as in 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:

$$\text{pH} = -\log [\text{H}^+]$$

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.

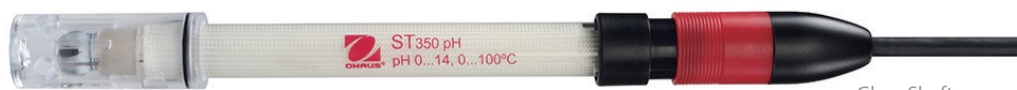
A potential is developed on the membrane surface when a pH electrode comes into contact with a sample.

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

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

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 electrode that can be used together with a meter to compensate temperature changes without the need for an external temperature electrode.

PH ELECTRODES STRUCTURE



Glass Shaft



Plastic Shaft

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



Non-Refillable

Fill Type	Characteristic	Advantage
Refillable	Reference electrolytes can be replenished when necessary.	Reusable
Non-Refillable	The electrode must be replaced when contaminated.	No maintenance is required



Ceramic Junction



Annular Junction

Reference Junction Type	Characteristic	Advantage
Ceramic Junction	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 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.



	ST410	ST420	ST350	ST322	ST320	ST320 IP67	ST310	ST272	ST270
pH Range	0 to 14	2 to 12	0 to 14	0 to 14	0 to 14	0 to 14	0 to 14	2 to 12	0 to 14
Temperture	5 to 90°	5 to 90°	0 to 100°	5 to 60°	0 to 80°	0 to 80°	0 to 80°	0 to 50°	0 to 100°
Type of junction	Ceramic	Ceramic	Annular Ceramic	Fiber Pin	Fiber Pin	Fiber Pin	Ceramic	Annular Ceramic	Annular Ceramic
Shaft Material	Glass	Glass	Glass Body	Plastic	Epoxy Body	Epoxy Body	Epoxy Body	Epoxy Body	Glass Body
Connector	BNC	BNC	BNC&Cinch	BNC & Cinch	BNC & Cinch	BNC & Cinch	BNC & Cinch	BNC	BNC
Sensor Type	Combined Electrode	Combined Electrode	3 in1	3 in1	3 in1	3 in1	3 in1	Combined Electrode	Combined Electrode
Reference System	Ag/AgCl Double Junction	Ag/AgCl Double Junction	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Reference electrolyte	3.3 M KCl	3.3 M KCl	3.3 M KCl	Polymer Gel	Gel Filled	Gel Filled	3.3 M KCl	Gel Filled	Gel Filled
Cable	1 m	1 m	1 m	1 m	1 m	3 m	1 m	1 m	1 m
Fill Type	Refillable	Refillable	Refillable	Non-Fillable	Non-refillable	Non-refillable	Refillable	Non-refillable	Non-refillable
Description	Double Junction combination pH electrode	Double Junction combination pH electrode	pH/ATC with glass body	3-in-1 pH/ATC electrode with low maintenance	pH/ATC with epoxy body, low maintenance	pH/ATC with epoxy body, low maintenance gel	pH/ATC with epoxy body, refillable	Combination pH electrode with stainless steel cutting blade	Combination pH electrode, glass body, spear tip
Application	Strong Acid/Alkali Solution	Low ionic strength solutions. TRIS, protein, sulfide, or any other samples that react chemically with the Ag/AgCl reference element.	Top performance for QC and research	Laboratory general purpose, routine or research applications	General purpose, high performance	High performance ph analysis in the field	General purpose for everyday use	For meat, cheese and sludge where glass alone may break	For meat, cheese and fruit samples
Feature	Chemical resistant glass body	Chemical resistant glass body	Chemical resistant glass body	Low maintenance	Epoxy body for ruggedness	Epoxy body and built-in ATC	Long-lasting	Annular junction prevents clogging	Annular junction prevents clogging

PH ELECTRODES

OHAUS Starter series electrochemistry instruments include electrodes that support advanced pH analysis, including a glass shaft 3-in-1 electrode, micro sample, double salt-bridge, and flat surface pH electrodes.

OHAUS launched several pH electrodes, include glass shaft 3-in-1 ST350, micro sample pH electrode STMICRO5 and STMICRO8; double-salt bridge pH electrode ST260 which is fit for tris-buffer solution pH measurement, flat surface pH electrode STSURF and puncture electrodes ST270 and ST272.



	ST280	ST260	ST230	ST210	STMICRO8	STMICRO5	STPURE	STSURF
pH Range	0 to 14	0 to 14	0 to 14	0 to 14	0 to 14	0 to 14	2 to 12	0 to 14
Temperture	5 to 60°	0 to 100°	0 to 100°	0 to 80°	0 to 100°	0 to 100°	0 to 80°	0 to 100°
Type of junction	Open Junction	Ceramic	Annular Ceramic	Ceramic	Annular Ceramic	Annular Ceramic	Ground Glass	Ground Glass
Shaft Material	Glass	Glass Body	Glass Body	Epoxy Body	Glass Body	Glass Body	Glass Body	Epoxy Body
Connector	BNC	BNC	BNC	BNC	BNC	BNC	BNC	BNC
Sensor Type	Combined Electrode	Combined Electrode	Combined Electrode	Combined Electrode	Combined Electrode	Combined Electrode	Combined Electrode	Combined Electrode
Reference System	Ag/AgCl	Ag/AgCl Double Junction	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl	Ag/AgCl
Reference electrolyte	Polymer gel	3.3 M KCl	3.3 M KCl	3.3 M KCl	3.3 M KCl	3.3 M KCl	3.3 M KCl	3.3 M KCl
Cable	1 m	1 m	1 m	1 m	1 m	1 m	1 m	1 m
Fill Type	Non-Fillable	Refillable	Refillable	Refillable	Refillable	Refillable	Refillable	Refillable
Description	Open junction combination pH electrode	Double junction refillable combination pH electrode	Combination pH electrode with rugged bulb	Combination pH electrode with epoxy body	Combination pH electrode with glass body, long length	Combination pH electrode with glass body, semi-micro tip	Combination pH electrode	Combination pH electrode with epoxy body, flat surface
Application	Highly suspended, dirty samples	Use in dirty water or TRIS, sulfide and protein samples	For soil, sludge, colloids, viscous material	For routine applications	For routine or research applications	For samples with size constraints For samples with size limitations	For samples with low ionic strength	Measure moist surfaces such as agar gel lates, meats and cheese
Feature	Toughened bulb for rugged lab use	Long-lasting	Toughened bulb for rugged lab use	Economical	Measure samples as small as 0.5 mL in tube	Measure samples as small as 0.2 mL in 96 well plates	Economical	A flat pH bulb and refillable designs

ESSENTIALS OF PH MEASUREMENT

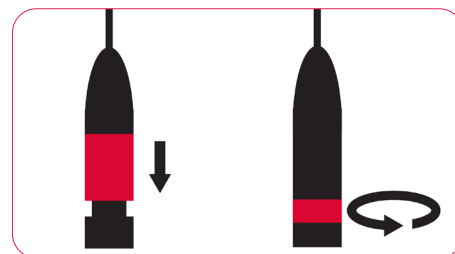
Electrode calibration is necessary in order to establish the slope and zero point of the electrode. Since both of these can change over time, frequent calibration is necessary. The frequency of calibration depends on the application, with some applications requiring daily calibration while others may require only weekly or monthly calibration. More frequent calibration is recommended when measuring in heavily contaminated, low-ion, strongly acidic, and high temperature solutions. The following is a general procedure for preparing most pH electrodes.

Perform Routine Maintenance

- On a weekly basis, inspect the pH electrode for scratches, cracks, salt crystal build-up, or membrane/junction deposits.
- Keeping an electrode clean can help eliminate calibration issues. Clean any salt deposits from the electrode exterior by rinsing it with distilled water before use. Always check the meter and electrode manuals for calibration and routine maintenance information.
- Place the electrode for 10 minutes in 0.1 M HCl or 0.1 M NaOH. If the buildup is not removed, the solution should be cautiously heated up to 45 °C - 55 °C for 10 minutes before the acid or alkaline concentration is increased.

Open the Refill Slider/Ring

- For pH electrodes featuring a refillable reference, the first step to calibrating and/or taking a measurement is to open the refill opening. Depending on the model, the refill opening is either a slider (left image) or a ring (right image). The refilling opening must always be open during calibration and measurement.



Check the Electrolyte Level

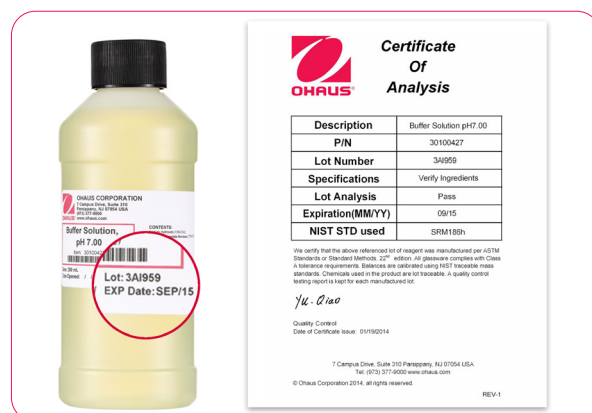
- For refillable electrodes, ensure the fill level of the electrolyte is at least 2 cm above the level of the measurement solution. Replace the electrolyte if it has become contaminated.

Check the Selected Buffer Set

- The pH values of buffer solutions are temperature dependent and the response can vary from manufacturer to manufacturer. Also, the pH values of buffers in a buffer set can vary from one set to another. Modern pH meters automatically adjust for the respective temperature profile once the buffer set used has been correctly set.

Use Fresh, Unused, Unexpired Buffers

- Once buffers are used for calibration, they are assumed contaminated and should not be used again. Reusing buffers can lead to slow pH electrode response or the inability to calibrate. The cause of calibration failure is difficult to determine if the pH buffers have already been used. Used buffer solutions can be kept for rinsing the calibration container and the electrode between calibration points.
- Expired buffer solutions should not be used and buffer bottles should not be left open. Carbon dioxide in the air can change the pH of basic buffer solutions, so basic buffer bottles should only briefly be opened. Use opened containers of buffer as soon as possible.

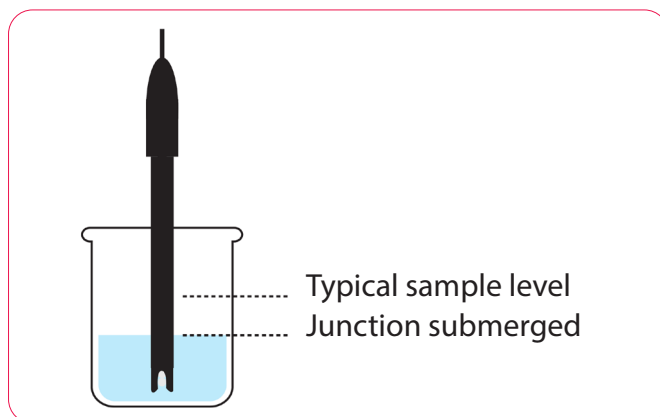
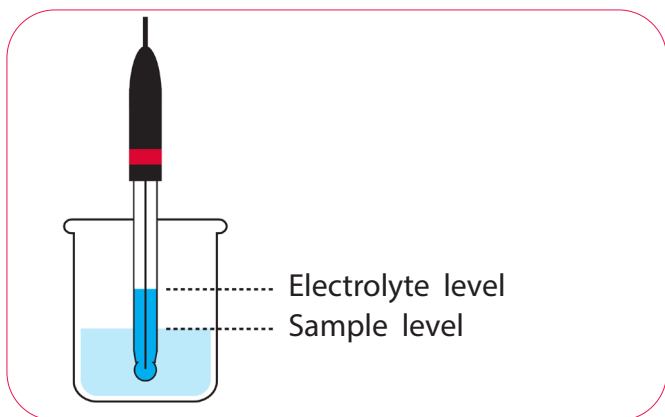


Expiration dates are printed on the label of the buffer bottle, and according to the LOT code visit ohaus.com/Lot-Certificates

ESSENTIALS OF PH MEASUREMENT

The Reference Junction Should be Immersed

- The reference junction must be completely submerged in solution. The temperature sensor must also be in solution in order to accurately compensate pH for temperature.
- The sample solution level must be above the pH electrode reference junction when the electrode is immersed in the sample.



Perform at Least a 2-Point Calibration

- It is best to perform at least a 2-point calibration and pH 7 buffer must be one of those points.
- The pH buffers used should differ by at least two pH units and should bracket the expected in situ pH conditions. Calibration points need to bracket your sample range. Unless the sample is expected to be above pH 7, basic buffers should not be used, as their pH value quickly changes by absorbing CO_2 .
- When measurements are performed over a large range of pH values, it is recommended that one takes at least 3 calibration points. A 1-point calibration will only determine the zero point, not the electrode slope. The range of use of 1-point calibrations is limited and should only be completed with pH 7 buffer. The pH value obtained can be used to compare to previous results, but is not an absolute value.
- Between buffers, rinse the electrode with distilled water and then with the next buffer. To reduce the chance of error due to polarization, avoid rubbing or wiping the electrode bulb. Use a lint-free tissue and gently blot the bulb.
- The first calibration point should be pH 7. Although it is not always required, it is best to begin calibration with pH 7 buffer.

PH MEASUREMENT OF DIFFERENT SAMPLE TYPES

pH measurements of flat samples and very small samples

- Some samples are too small even for a micro sensor to measure accurately. In such cases, a surface sensor is the optimal configuration. The sample must be moist enough for the pH-sensing bulb and the reference junction to make adequate contact with the sample. If necessary, add a drop of distilled water or potassium chloride to wet the surface before placing the electrode on the sample. For the best reproducibility, all samples should have the same amount of liquid added before measurement.
- Surface pH sensors prevent sample contamination: Direct contact of the pH sensor with the sample during measurement can be a critical source of contamination. Reference electrolyte may flow into the sample; in addition, there is a risk of carryover from the rinsing solution, and residues may be present on the sensor. Pipetting at least 100 μL of sample onto a flat, clean surface and measuring with a flat membrane sensor can prevent such problems.

pH measurements in solid samples

- Solid and semi-solid samples include cheese, meat, powders, paper and agar gels. Standard pH electrodes are generally not able to withstand the pressure of being pushed into a solid sample; therefore one needs a special electrode which is able to penetrate the sample in order to measure the pH. There are many methods available for measuring the pH of solid and semi-solid samples that include using a flat surface pH electrode, using a spear tip pH electrode, and mixing or blending a fixed amount of sample with distilled water. The Ohaus electrodes most suitable for these kinds of applications are the ST272 pH electrode. While their spear shaped point enables them to pierce the sample, the membrane shape ensures accurate measurements. This electrode is typically used for quality control or checking production processes of cheese and meat.

pH measurements in dirty samples

- Measuring the pH of dirty samples can be somewhat tricky, since the dirt in the sample can hinder correct measurements. Sludge, suspension, colloid, slurry and viscous samples include wastewater, mud, paper pulp and corn syrup. The risk of blockages with such samples would be very high if one were to use a pH electrode with a ceramic junction. These samples clog the electrode junction and coat the pH-sensing bulb, resulting in slow electrode response, measurement drift and pH measurement errors.