

Based on ISO standard 10523:2008

1. Introduction

The pH value of water is an indicator of its corrosivity or possible toxicity on aquatic bodies. It can also control the efficiency of water treatment. The pH can be measured in all types of water including drinking water, mineral water, rainwater, bathing water, surface or ground water, industrial and waste water.

This application note is based on ISO standard 10523:2008 (Water quality – Determination of pH) and can be applied for a pH range from 2 to 12, between 0 °C and 50 °C for an ionic force lower than 0.3 mol/kg of solvent (equivalent to conductivity lower than 2000 mS/m at 25 °C).

2. Principle

pH is defined as follows:

$$pH = -\log \alpha_{H^+} \approx -\log C_{H^+}$$

where:

α_{H^+} is the relative activity (molality) of the hydrogen ion

C_{H^+} is the hydrogen ion concentration [mol/L]

The pH determination is based on the measure of a difference of potential between a glass electrode and a reference electrode, the potential of the measure electrode varying with the hydrogen ion activity.

The read potential is directly linked to the pH of the sample according to:

$$pH_{smp} = pH_{iso} + \frac{E_{smp} - E'_0}{S_{25}} \times \frac{298.15}{T_{smp}}$$

where:

pH_{smp} is the pH of the sample, at sample temperature [pH]

E_{smp} is the potential measured in the sample [mV]

T_{smp} is the sample temperature [K]

pH_{iso} is the pH value at which temperature has no impact – given by the IntelliCAL™ probe [pH]

E'_0 is the sensor potential at pH_{iso} [mV]

S_{25} is the sensor slope at 25 °C [mV/pH]

S_{25} and E'_0 are obtained by the probe calibration described in Electrode calibration.

3. Electrode

Electrode: Combined pH electrode with temperature sensor, IntelliCAL PHC805

Note: All other “PHC” probes can be used for this measurement.

4. Settings

4.1. pH determination

This application has been optimized with the following settings:

Name	Default parameter	Unit
Application		
Application name	pH in water	
Sample		
Name ¹	Water ?	
Amount	50	[mL]
QC		
Name	QC Sample	
Electrode		
Recommended	PHC805	
Sample homogenization		
Active	Yes	
Time	15	[s]
Stirring speed	25	[%]
Message	Sample homogenization, please wait...	
pH		
Active	Yes	
Max. stability time	120	[s]
Stability criterion	0.05	[pH/min]
Stirring speed	0	[%]
Result 1 (R1) name	pH	
R1 hide	No	
R1 min.	0	[pH]
R1 max.	14	[pH]
R1 QC min.	0	[pH]
R1 QC max.	14	[pH]

4.2. Recommendations for modifying the settings

The sample amount of 50 mL is given as an indication. The sample volume must be sufficient to allow the electrode to be immersed in the solution being measured.

If your SOP requires stirring during measurement, set the active field of the **Sample homogenization** section to **No** and set the stirring speed in the **pH** section to 25%, for example.

5. Procedure

5.1. Electrode calibration

If a pH electrode calibration is required, refer to section **8 Appendix: pH electrode calibration**.

5.2. Sample analysis

Rinse the probe with deionized water. Pour 50 mL of the sample and put a stir bar into a beaker. Place it on the titrator and launch the application. The sample is stirred for 15 seconds, and then the pH value is measured without stirring. Rinse the probe between samples.

6. Results

Performance is directly linked to that of the PHC805 pH probe:

	PHC805
pH range	0 to 12
Slope % at 25 °C	97 to 102%
Offset (mV)	0 ± 30
Operating temp range	0 to 80 °C

¹ "?" in the name, indicates that the sample name will be automatically incremented with a number for each analysis

7. Bibliography

- ISO 10523:2008 – Water quality – Determination of pH

8. Appendix: pH electrode calibration

8.1. Electrode and buffers

Electrode: Combined pH electrode with temperature sensor, IntelliCAL PHC805.

pH standards: IUPAC 1.679 pH, 4.005 pH, 7.000 pH, 10.012 pH and 12.454 pH are set by default. It is possible to change these according to your SOP (refer to the full user manual for details).

8.2. Electrode calibration settings

By default, the electrode calibration is done with the parameters described below:

Name	Default parameter	Unit
Application		
Application name	pH in water	
Electrode		
Type	pH	
Recommended electrode	PHC805	
Calibration frequency	7	[Days]
Stability criterion	0.050	[pH/min]
Max. stability time	300	[s]
Stirring speed	25	[%]
Stirring duration	15	[s]
Calibration mode	Auto	
Buffer set	IUPAC 1.679 pH; 4.005 pH; 7.000 pH; 10.012 pH and 12.454 pH	

Note: These parameters are defined to calibrate the electrode following the ISO 10523:2008 standard which recommends stirring the buffer before the measurement, and to stop stirring during the measurement. Set **Stirring duration** to 0 if your SOP requires stirring during the measurement.

The calibration mode is by default set as **Auto** but two other options are also available: **Fixed** and **Manual**. Refer to the full user manual for more details.

8.3. Electrode calibration procedure

It is recommended to calibrate the probe with buffers at the same temperature as the sample. For calibration, the pH is compensated at 25 °C according to the Nernst equation. By default, the buffers are automatically recognized by the instrument. They can be measured one after the other in any order.

Pour a sufficient amount of the first buffer into a 50 mL beaker and add a stir bar. Place it on the titrator under the probe holder and dip the probe into the beaker. Launch the calibration probe sequence. Rinse the probe between buffers. Repeat this operation for each buffer, up to a maximum of five. At the end of the calibration, the slope and offset are displayed and the user must validate the results.

8.4. Calibration results

At the end of the series of buffers, the following results are displayed:

- Slope in mV/pH
- Slope in % compared with the theoretical slope (-59.16 mV/pH)
- Offset in mV

The acceptance limits for the PHC805 electrode slope are 97-102%, and between -30 and + 30 mV for the offset.