pH Electrode Design

Choosing the right electrode for your needs begins with an understanding of the different structures that make up a pH electrode.

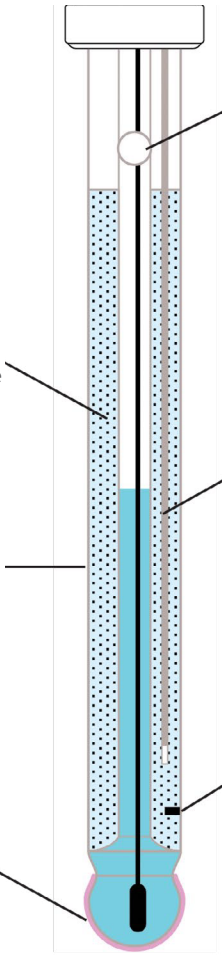
Temperature sensor (optional):
Some electrodes feature an integrated temperature sensor. pH values are dependent on temperature, so pH measurements should always be completed with an accurate temperature sensor.

Reference electrolyte:
The electrolyte has connection to the sample through the junction. Potassium chloride (KCl) is the most common electrolyte used and can be in the form of liquid or gel. Liquid electrolyte provides faster measurement results and decreases the possibility of measurement errors due to to diffusion potentials.

Electrode body:
Plastic body electrodes are more rugged, less likely to crack, and commonly feature gel electrolyte. Glass body electrodes have a wider range of operating temperatures and many are refillable.

Glass membrane:
Specialized glass that is sensitive to hydrogen ion activity. Filled with buffer of known pH, creating and environment of constant binding of hydrogen ions on the inside while the sample outside has a variable amount of hydrogen ions. This difference in hydrogen ions creates an electrical potential.

The shape of the membrane can vary in order to ensure optimal moistening. Unique applications may require a specialized membrane shape.



Refill opening (optional):
Since electrolyte escapes through the reference junction, electrodes that can be refilled with liquid electrolyte tend to have a longer life than non-refillable electrodes.

Reference electrode:
Designed to maintain a constant electrical potential. The difference in electrical potential between the reference and sensing electrode results in a voltage that is used to calculate a pH value.

The silver/silver chloride reference system is the most common, although the iodine/iodide system has many advantages.

Reference junction:
Allows for electrical contact between the reference electrode and the solution. Slightly permeable to prevent electrolyte from escaping too quickly. Different junctions are available, each with unique characteristics.

YSI pH Electrode Families

YSI has three different families of combination pH electrodes from which to choose, each with unique characteristics. The IDS electrodes are designed for use with the YSI MultiLab, a multiparameter digital lab instrument. TruLine and Science electrodes feature BNC connection and are designed for use with the YSI TruLab, although they can be connected to the MultiLab via a BNC adapter.

YSI IDS 4110

MultiLab IDS

- Intelligent digital sensors (IDS) for the YSI MultiLab
- Store calibration status and serial number, even if disconnected from the meter
- Double-junction with Ag/AgCl reference system
- All electrodes have an integrated temperature sensor
- Available in gel-filled or liquid electrolyte versions; glass or plastic body

YSI Science Electrodes

Science

- Designed for use in unique applications that require a particular junction
- Features the Silamid reference system, a unique construction of the Ag/AgCl reference system resulting in a more stable and longer lasting electrode with a fast response
- Double-junction reference and integrated temperature sensor
- Ground-joint junction with a fast electrolyte outflow is specifically designed for samples high in solids or with low ionic strength
- Platinum junction for applications that do not require a rate of electrolyte outflow as fast as the ground-joint
- BNC connector; compatible with any pH meter that has a BNC input

YSI TruLine Electrodes

TruLine

- Designed for use in typical laboratory applications
- Single-junction electrodes with Ag/AgCl reference system
- Integrated temperature sensor option
- Durable electrodes with gel electrolyte for general use; liquid electrolyte sensors for more critical measurements
- Electrodes with special membranes for unique applications
- BNC connector; compatible with any pH meter that has a BNC input

YSI pH Electrode Comparison

The following comparison is designed to assist in selecting the electrode that best fits your needs. For additional information, the manual for each electrode can be found on YSI.com.

	Electrode	Item Number	Connector	Shaft	Refillable	Temp Sensor	Reference System	Junction Type	Number of Junctions	Membrane Shape	Reference Electrolyte
IDS	4110	103740Y	Digital	Plastic (PPE/PS)	No	Yes	Ag/AgCl	Fiber	Double	Cylindrical	Gel, KCl
	4110-3	103741Y	Digital	Plastic (PPE/PS)	No	Yes	Ag/AgCl	Fiber	Double	Cylindrical	Gel, KCl
	4120	103750Y	Digital	Plastic (Polyamide)	Yes	Yes	Ag/AgCl	Ceramic	Double	Cylindrical	Liquid, 3 M KCl
	4130	103780Y	Digital	Glass	Yes	Yes	Ag/AgCl	Platinum	Double	Conical	Liquid, 3 M KCl
TruLine	pH 15	400350	BNC	Glass	Yes	Yes	Ag/AgCl	Platinum	Single	Conical	Liquid, 3 M KCl
	pH 17	400351	BNC	Glass	Yes	No	Ag/AgCl	Platinum	Single	Conical	Liquid, 3 M KCl
	pH 25	400353	BNC	Plastic (PPE/PS)	No	No	Ag/AgCl	Fiber	Single	Cylindrical	Gel, KCl
	pH 26	400352	BNC	Plastic (PPE/PS)	No	Yes	Ag/AgCl	Fiber	Single	Cylindrical	Gel, KCl
	pH 21	400357	BNC	Plastic (PPE/PS)	No	No	Ag/AgCl	Hole	Single	Spear tip	Polymer
	pH 27	400354	BNC	Glass	No	No	Ag/AgCl	KPG annular gap	Single	Flat	Polymer
Science	pHT-Pt	400360	BNC	Glass	Yes	Yes	Silamid®*	Platinum	Double	Sphere (bulb)	Liquid, 3 M KCl
	pHT-G	400361	BNC	Glass	Yes	Yes	Silamid®*	Ground Joint	Double	Sphere (bulb)	Liquid, 3 M KCl
	pHT-Micro	400362	BNC	Glass	Yes	Yes	Silamid®*	Platinum	Double	Cylindrical	Liquid, 3 M KCl

	Shape	Property / Application
	sphere (bulb)	constant quality, low resistance because of large surface area, **for most applications**
	cone	robust, smooth, easy to clean, **universally applicable**
	cylinder	shock-proof, **for general applications,** especially useful for fermenter electrodes
	spear	high resistance, **suitable for penetrating semi-solid media**
	flat	high resistance, shock-proof, easy to clean, **suitable for surface measurements**

Electrode	Item Number	Temp. Sensor Connector	pH Range	Temp. Range	Length	Diameter	Minimum Immersion Depth*	Cable Length (meter)	Warranty (months)
4110	103740Y	Included in digital connection	0 … 14	0 … 80 °C	120 mm	12 mm	12-13 mm	1.5	12
4110-3	103741Y	Included in digital connection	0 … 14	0 … 80 °C	120 mm	12 mm	12-13 mm	3	12
4120	103750Y	Included in digital connection	0 … 14	0 … 80 °C	120 mm	12 mm	12-13 mm	1.5	12
4130	103780Y	Included in digital connection	0 … 14	0 … 100 °C	120 mm	12 mm	16-18 mm	1.5	12
pH 15	400350	Banana plug	0 … 14	0 … 100 °C	120 mm	12 mm	16-18 mm	1	12
pH 17	400351	N/A (no temp. sensor)	0 … 14	0 … 100 °C	120 mm	12 mm	16-18 mm	1	12
pH 25	400353	N/A (no temp. sensor)	0 … 14	0 … 80 °C	120 mm	12 mm	12-13 mm	1	12
pH 26	400352	Banana plug	0 … 14	0 … 80 °C	120 mm	12 mm	12-13 mm	1	12
pH 21	400357	N/A (no temp. sensor)	2 … 13	0 … 80 °C	top: 65 mm bottom: 25 mm	top: 15 mm bottom: 5 mm	11-12 mm	1	12
pH 27	400354	N/A (no temp. sensor)	2 … 13	0 … 50 °C	120 mm	12 mm	N/A (flat membrane)	1	12
pHT-Pt	400360	Banana plug	0 … 14	-5 … 100 °C	170 mm	12 mm	17-19 mm	1	12
pHT-G	400361	Banana plug	0 … 14	-5 … 100 °C	170 mm	12 mm	12-14 mm	1	12
pHT-Micro	400362	Banana plug	0 … 14	-5 … 100 °C	top: 70 mm bottom: 130 mm	top: 12 mm bottom: 5 mm	10-11 mm	1	12

* Minimum immersion depth is the distance from the tip of the membrane to the outer junction. The junction must always be completely immersed when taking a measurement.

YSI calibration buffers are available in pH values of 4, 7, and 10.

003821	pH 4 Buffer (box of 6 pints)
003822	pH 7 Buffer (box of 6 pints)
003822	pH 10 Buffer (box of 6 pints)
603824	Assorted Case (2 pints each of pH 4, 7, and 10 buffers)

External temperature sensors are available for electrodes that do not have an integrated temperature sensor.

ScienceLine Temp 135 and ScienceLine Temp 136 Sensors

Potassium chloride (3 M KCl) solution is available (109 705Y) for refillable electrodes. 3 M KCl is also the recommended storage solution for all YSI lab pH electrodes.

MultiLab

YSI.com/MultiLab

Customize your **MultiLab system** to meet the demands of your laboratory application.

With the ability to measure up to **25 different parameters** and simultaneously connect up to three sensors, the **MultiLab** is a line of flexible, bench top meters that can be configured to meet a variety of laboratory applications.

MultiLab **Benefits**

MultiLab
4010-1W

4010-1W
Parameters
pH
ORP
DO/BOD
Conductivity
Resistivity
Salinity
Total Dissolved Solids (TDS)
Temperature
Barometric Pressure

4010-1W

- One-channel input for pH, ORP, DO/BOD, or conductivity sensors
- Intelligent digital sensors (IDS) – calibration data is saved in the sensor and sensors are automatically recognized by instrument making it easy to setup
- Direct replacement for YSI 5000 and 5100 instruments
- Data storage - 500 data sets in manual mode and 5,000 data sets in automatic logging mode
- Easy-to-read graphic display
- GLP traceability (saves calibration data for later review or export)
- USB connectivity to export data
- MultiLab Importer (Excel® add-in) included
- 3-year warranty

YSI.com/4010-1W

MultiLab **4010-2W** and **4010-3W**

4010-2W and 4010-3W Parameters

pH
ORP
DO/BOD
Conductivity
Resistivity
Salinity
TDS
Temperature
Barometric Pressure
ISEs:*
Ammonia
Ammonium
Bromide
Cadmium
Calcium
Carbon Dioxide
Chloride
Copper
Cyanide
Fluoride
Iodide
Lead
Nitrate
Potassium
Silver/Sulfide
Sodium
*Only with BNC adapter

4010-2W and 4010-3W

- Two (4010-2W) or three (4010-3W) channel input for pH, ORP, DO/BOD, ISEs, or conductivity
- Intelligent digital sensors (IDS) - calibration data is saved in the sensor and sensors are automatically recognized by instrument making it easy to setup
- Built-in OUR/SOUR functionality (Oxygen Uptake Rate and Specific Oxygen Uptake Rate)
- Replaces your YSI 5100 with more features
- Data storage – 500 data sets in manual mode and 10,000 data sets in automatic logging mode
- Large, easy-to-read graphic color displays
- GLP traceability (saves calibration data for later review or export)
- Antibacterial keypad
- USB connectivity to export data to a PC
- MultiLab Importer (Excel® add-in) included
- Easily send data to flash drive or external printers with the built-in USB port
- 3-year warranty

YSI.com/4010-2W **YSI.com/4010-3W**

Sensor **Selection**

Intelligent Digital Sensors

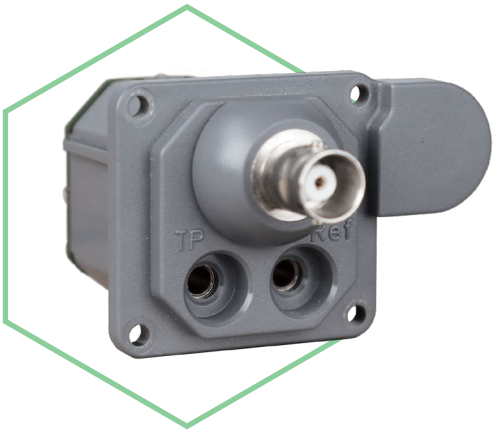
- Install any Intelligent Digital Sensor (IDS) sensor in any channel
- Smart pH, ORP, conductivity, DO, and self-stirring BOD sensors available
- Auto-recognized upon connection
- Traceable calibrations stored in sensor – recalibration not required if moved to another port or another instrument

Intelligent Digital Wireless Sensors

- Wireless pH, ORP, conductivity, and FDO sensors available
- Range of 10 meters; measure anywhere in your lab
- No need to hassle with cables
- Quickly save data by pressing a button on the sensor
- Bluetooth LE radio technology

BNC Adapter

- Connect BNC electrodes to the 4010-2W or 4010-3W with an adapter that covers one of the digital inputs
- pH, ORP, and ISEs with BNC connection can be used, including specialty pH electrodes



YSI sensors approved for wastewater and/or drinking water compliance reporting.

EPA Approved Methodology

pH	Chloride
DO/BOD	Cyanide
Conductivity	Fluoride
Temperature	Nitrate
Ammonia	Potassium
Bromide	Sulfide

Visit the link bit.ly/EPAMethods for a complete list of parameters and the EPA approved methodology used.

MultiLab Line Benchtop General Specifications

Instrument Model	Model 4010-1W	Model 4010-2W and Model 4010-3W
Measurement Channels	1	2 (4010-2) or 3 (4010-3)
Data Storage	500 data sets manual; 5,000 automatic	500 data sets manual; 10,000 automatic
Interface	Mini USB	Mini USB; USB-A
Display	Graphic, Backlit	Color, Graphic, Backlit
Power Supply	Universal power supply, 4 AA 1.5 V batteries	Universal power supply
	All Models (4010-1W, 4010-2W, 4010-3W)	
Parameters	pH, ORP (mV), Dissolved Oxygen % and mg/L with Electrochemical BOD, Optical-based BOD or FDO probe, Barometric Pressure, Conductivity, Resistivity, Salinity, Total Dissolved Solids, Temperature , extensive offering of ISEs and specialy pH electrodes*	
Temperature Compensation	Yes	
Calibration Points	DO = 2; pH = 1 to 5; 4310 conductivity probe = 1 point; ISEs: 2 to 7	
Calibration Storage	Max. 10	
Calibration Timer	1 to 999 days	
GLP/AQA Compliant	Yes	
LIMS Connection	Yes	
Certifications	CE, cETLus	
Warranty	3 years	

*ISEs and speciality electrodes compatible with 2 and 3 channel instruments with BNC adapter

MultiLab Line Benchtop Sensor Specifications

Instrument Model	4110 pH Electrode	4120 pH Electrode	4130 pH Electrode (refillable)	4210W & 4211 ORP (refillable)
pH Range	0.000 to 14.000 (±0.004**)	---	---	-1200 to +1200 mV (±0.2 mV)
Temperature Range	0 to 80°C (32 to 176°F)	0 to 80°C (32 to 176°F)	0 to 100°C (32 to 212°F)	0 to 100°C (32 to 212°F)
Temperature Accuracy	±0.2°C	±0.2°C	±0.2°C	±0.2°C
Reference Electrode	Gel	3 mol/l KCl	3 mol/l KCl	3 mol/l KCl
Membrane Shape	Cylinder	Cylinder	Cone	---
Diaphragm	Fiber	Ceramic	Platminum Wire	Ceramic
Material	Plastic	Plastic	Glass	Glass
Dimensions	Length 120 mm (4.7 in); diameter 12 mm (0.47 in)	Length 120 mm (4.7 in); diameter 12 mm (0.47 in)	Length 120 mm (4.7 in); diameter 12 mm (0.47 in)	Length 120 mm (4.7 in); diameter 12 mm (0.47 in)
Cable Length	Wireless, 1.5 m, or 3 m	Wireless or 1.5 m	Wireless or 1.5 m	Wireless or 1.5 m
Battery Life (Wireless)	60 hours	60 hours	60 hours	60 hours
Warranty	1 year	1 year	1 year	1 year

**Accuracy of sensor electronics

Instrument Model	4310 Conductivity Probe	4320 Conductivity Probe
Type	4-electrode, graphite	2-electrode, stainless steel
Conductivity Range	1 µS/cm to 2,000 mS/cm (±0.5% of value)	0.01 µS/cm to 200 µS/cm (±0.5% of value)
Resistivity	0.5 Ohm cm to 100 kOhm cm (±0.5% of value)	5 kOhm cm to 100 MOhm cm (±0.5% of value)
Salinity	0.0 to 70.0 ppt (±0.5% of value)	---
Total Dissolved Solids	0 to 1,999 mg/L; 0.0 to 199l9 g/L (±0.5% of value)	---
Temperature Range	0 to 100°C (32 to 212°F)	0 to 100°C (32 to 212°F)
Temperature Accuracy	±0.2°C	±0.2°C
Cell Constant	0.475 cm ±1.5%	0.1 cm ±2%
Material	Epoxy	Stainless Steel
Dimensions	Length 120 mm (4.7 in); diameter 15.3 mm (0.6 in)	Length 120 mm (4.7 in); diameter 12 mm (0.47 in)
Cable Length	Wireless, 1.5 m, or 3 m	1.5 m
Battery Life (Wireless)	30 hours	--
Warranty	2 years	2 years

MultiLab Line Benchtop Sensor Specifications (Continued)

Instrument Model	ProOBOD IDS 626500
Type	Optical; lifetime luminescence detection with self-stirring mechanism
Dissolved Oxygen Range	0 to 50 mgL; 0 to 500% air saturation
Dissolved Oxygen Accuracy ***	0 to 20 mg/L, ±0.1 mg/L or ±1% of reading, whichever greater; 20 to 50 mg/L, ±10% reading (system)
Dissolved Oxygen Resolution	0.01 mg/L; 0.1%
Temperature Range	Ambient 10 to 40°C (50 to 104°F); Compensation mg/L -5 to 50°C (23 to 104°F) (extrapolates beyond 45°C)
Temperature Accuracy	±0.2°C
Temperature Resolution	0.1°C
Typical Response Time	95% in 22 seconds with stirring; 95% in 40 seconds without stirring
Warranty	2 years, 1 year DO sensor cap

Instrument Model	4100 ProBOD IDS
Type	Polarographic, membrane-covered BOD probe with self stirring mechnism
Dissolved Oxygen Range	0 to 50 mgL; 0 to 500% saturation
Dissolved Oxygen Accuracy ***	0 to 20 mg/L: ±0.2 mg/L or 2% of reading whichever is greater; 20 to 50 mg/L: ±6% of reading; 0 to 200%: ±2% or 2% of reading whichever is greater; 200 to 500%: ±6% of reading
Dissolved Oxygen Resolution	0.01 mg/L; 0.1%
Temperature Range	-5 to 50°C
Operating Temperature Range (Meter)	0 to 40°C
Temperature Accuracy	±0.2°C
Temperature Resolution	0.1°C
Typical Response Time	95% in 8 seconds with Yellow PE membrane; 95% in 18 seconds with Teflon® membrane
Cable Length	1.5 m
Warranty	1 year

Instrument Model	4410 FDO IDS
Type	Optical, lifetime luminescence detection, green light, not designed for BOD bottles.
Dimensions	Cabled version: Sensor Length: 206 mm (8.1 in); Maximum: Diameter: 21.7 mm (0.85 in) Wireless version: Sensor Length: 252 mm (9.9 in) ; Maximum: Diameter: 21.7 (0.85 in)
Dissolved Oxygen Range	0 to 20 mg/L; 0 to 200% saturation
Dissolved Oxygen Accuracy ***	±01.5% of reading
Dissolved Oxygen Resolution	0.01 mg/L; 0.1%
Temperature Range	0 to 50°C
Operating Temperature Range (Meter)	0 to 40°C
Temperature Accuracy	±0.2°C
Temperature Resolution	0.1°C
Typical Response Time	95% in 45 seconds
Cable Length	Wireless, 1.5 m or 3 m
Battery Life (Wireless)	9 hours
Warranty	1 year

***Accuracy of system including probe, cable & instrument