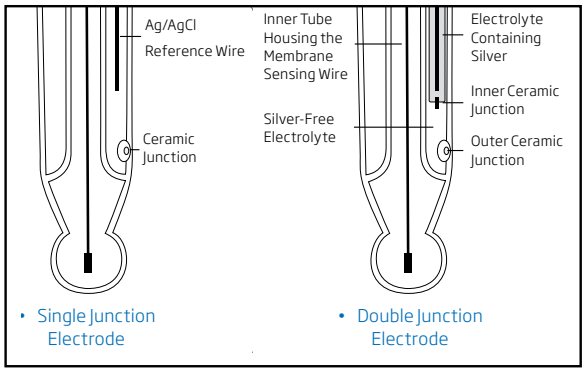
Getting To Know Your pH Electrode

1. Single vs Double Junction

Electrodes feature either a single or double junction design. Single junction electrodes serve to put the reference electrode system in contact with the sample. These electrodes are less expensive, however, under adverse conditions such as high pressure, high temperature, or highly acidic or alkaline solutions the positive flow of the electrolyte through the junction is often reversed resulting in the ingress of sample into the reference compartment. If this happens, the reference electrode can become contaminated, leading to electrode failure. Double junction electrodes isolate the reference electrode, so even if sample ingress were to happen, the contamination to the reference electrode is minimized. Also the outer fill solution of a double junction electrode is silver free, which reduces the risk of silver precipitation clogging the junction.



Single Junction: In a single junction electrode, the HI7071 fill solution that is used contains 3.5M KCl + AgCl.
BEST FOR: Single junction electrodes are economical and ideal for general-purpose applications.

Double Junction: In a double junction electrode, the silver chloride containing solution is behind the inner junction. The chamber between the inner and outer junction is filled with HI7082 3.5M KCl fill solution. No AgCl is present, so the fill solution is "silver free".
BEST FOR: Use double junction electrodes with samples that contain sulfides or heavy metals to prevent contamination of the reference cell.

2. Types of Junctions

The junction is the electrical pathway between the sample and the internal reference cell. The reference half-cell has a salt solution that diffuses through the junction into the sample. Any clogging of the junction will result in erratic and unstable readings. The junction type used with a pH electrode is one of the most important design considerations when selecting the right electrode.

Ceramic: A porous ceramic frit is one of the most common junctions used. For glass body electrodes, the ceramic junction material is easily fused with glass and also has a similar expansion coefficient. Electrodes may contain a single, a double, or a triple ceramic junction.
BEST FOR: Any aqueous solution. This is the most common junction found in a standard laboratory.

PTFE: Polytetrafluoroethylene (PTFE) has hydrophobic properties which provide one of the most chemically resistant junctions available. It is commonly used in pH electrodes for process applications.
BEST FOR: Samples where greases or oils are present, or in biological solutions containing large amounts of protein.

PTFE Sleeve: A sleeve made of polytetrafluoroethylene (PTFE) material surrounds an opening into the reference cell. The hydrophobic properties of the PTFE sleeve feature a clogging prevention system (CPS).
BEST FOR: Solutions with a high solids content such as sauces, juices, and wine.

Fiber Wick (Cloth): A fiber or cloth junction is used with plastic body gel filled probes. It has the advantage of being renewable. When readings are erratic or unstable, a small portion (1/8") is pulled out to expose a fresh new surface of the junction.
BEST FOR: General purpose, environmental, or home use.

Open: An open junction does not have a frit. The electrode uses an exposed hard gel as the junction. This layer is silver free. The open junction has a high flow rate making it ideal for semi-solids, emulsions, and other food products that would clog the junction of standard pH electrodes.
BEST FOR: Semi-solids, emulsions, and direct measurement of food products.

3. Type of Sensing Glass

The body of a pH electrode can be made of various materials.

General Purpose Glass (GP): Has the best response over the entire resistance of 100 megohms pH range and is the most common glass formulation used.
BEST FOR: Most applications at a temperature between 32°F to 140°F (0°C to 60°C).

Low-Temperature Glass (LT): Has a resistance of 50 megohms, which is lower than GP glass. As the temperature of the LT glass decreases, the resistance increases. At colder temperatures, the resistance of the glass approaches that of the GP glass.
BEST FOR: Measuring the pH of refrigerated/chilled samples.

High-Temperature Glass (HT): Has a resistance of 200 megohms which is higher than GP glass. As the temperature of the HT glass increases, the resistance decreases. At high temperatures, the resistance of the glass approaches that of the GP glass.
BEST FOR: Measuring the pH of samples above 95°F (35°C). It is important to note that using pH electrodes at high temperatures has a detrimental effect on the pH bulb, if not using HT glass.

Hydrofluoric Glass (HF): Hydrofluoric acid can dissolve glass rapidly. Hanna uses HF resistant glass for aggressive applications that have fluoride ions. Electrodes manufactured with this glass last ten times longer than electrodes made with standard pH glass formulations (from 10 to 100 days).The alkaline error is very high for this glass, so it is not suited for pH measurements above pH 10.
BEST FOR: pH range from 2 to 10 pH and for samples with less than 2 g/L fluoride.

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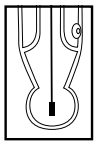
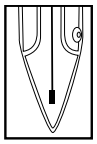
Getting To Know Your pH Electrode

4. Tip Shape

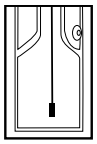
The glass bulb of a pH electrode is manufactured in different shapes. Each shape serves a unique purpose.



Spherical: A spherical tip or rounded bulb is the most common shape for a pH electrode. It provides a large surface area for the sample to interact with.
BEST FOR: The spherical bulb is ideal for aqueous samples and is considered general purpose.



Conical: As the name implies this tip has a cone shape, making testing of semi-solids easy.
BEST FOR: A conical tip bulb is ideal for direct penetration into semi-solids, emulsions, and slurries such as jams, cheeses, yogurt, and meats.



Flat Tip: The flat tip allows for the direct surface measurement of a sample.
BEST FOR: The flat tip is ideal for measuring skin, leather, and paper.

5. Body Material

pH electrodes are comprised of two half-cell electrodes; they are the reference half-cell and the pH indicating half-cell. When the two half-cells are located within a single electrode body, it becomes known as a combination electrode. Whichever style you use, the composition of the body material is an important consideration.

Glass: It is resistant to many chemicals and transfers heat easily so that thermal equilibrium is quickly reached between the solution in the electrode and the sample.
BEST FOR: Laboratory testing, general use, and where fast response is required.

PEI: Polyetherimide is a high-performance plastic that offers excellent resistance against aggressive chemicals. PEI offers durability and is one of the main probe types supplied with portable meters.
BEST FOR: Environmental, educational, industrial, or anywhere that durability is required.

PVDF: Polyvinylidene fluoride (PVDF) is a food grade plastic that stands up to most cleaning chemicals and solvents. It has high abrasion resistance, mechanical strength, and resistance to fungal growth. PVDF offers excellent durability.
BEST FOR: Semi-solids, emulsions and direct measurement of food samples.

Stainless Steel: Made with AISI 316 stainless steel, this robust material can withstand chloride concentrations that cause corrosion.
BEST FOR: Industrial, environmental, or rugged applications.

6. Refillable vs Non-Refillable

All pH electrodes have a solution inside the reference cell. This solution provides the stable reference potential and the ions necessary to complete the electrical pathway through the junction and into the sample. The inner solution of pH electrodes can be refillable or non-refillable.

Refillable: A refillable pH electrode is one in which the reference fill solution can be replenished or replaced as needed. Depending on the type of outer junction, the rate at which the fill solution diffuses from the electrode ranges from 15 to 50 µL/hour. It is important to understand if you have a single or double junction electrode so the correct fill solution can be used to maintain the proper level.
BEST FOR: Lab use, education, or anywhere fast response and long life is required.

Gel Filled: A gel filled electrode is also known as a maintenance free pH electrode. Inside these electrodes is a viscous solution. The gel does not require any refilling, but over the lifetime of an electrode it does become exhausted. At this point, the electrode will have to be replaced.
BEST FOR: Field, education, or where a rugged design is required.

7. Type of Electrode Connector

BNC: A BNC is a universal connector type. Any pH meter that has a BNC connector can use any pH electrode regardless of manufacturer.
BEST FOR: pH meters with BNC connectors.

DIN: A DIN or multi-pin connector is proprietary (manufacturer specific) and can only be used with a compatible meter. The advantage of the DIN connector is that additional wires are used for a built-in temperature sensor, amplifier, and/or a matching pin.
BEST FOR: pH meters that are designed for specific electrode.

Quick Connect DIN: Is a DIN Connector that allows for a quick, waterproof, and secure connection without having to tighten a threaded connection. This type of connector is proprietary to the meter.
BEST FOR: pH meters that are designed for specific electrode.

3.5 mm Digital: This style is a four pole connection used with digital pH electrodes. They transfer measurement data digitally from the pH electrode to the meter. This style is meter specific.
BEST FOR: pH meters that are designed for specific electrode.

Hanna has put together this guide to serve as a quick reference tool for best practices. Always remember to consult the instruction manual or contact us for detailed instructions for your specific needs.

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Getting To Know Your pH Electrode

pH Electrode Reference Guide

Abbreviation Guide

Spherical (S)	Glass (G)
Conical (C)	Plastic (P)
Flat (F)	Metal (M)

Application	Recommended Electrodes	Tip Shape	Body Material	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Viscolene Electrolyte	Gel Electrolyte	KCl 3.5M Electrolyte	KCl 3.5M + AgCl Electrolyte	Refillable	Temperature Sensor
Acids, Strong	HI1043B/P	S	G		•		•				•		•	
	HI10430*	S	G		•		•				•		•	•
Alkaline, Strong	HI2111B (half-cell) + HI5311	S	P/G		•		•				•			
Aquariums	HI1332B/P	S	P		•		•				•		•	
Bases, Strong	HI1043B/P	S	G		•		•				•		•	
	HI10430*	S	G		•		•				•		•	•
Beer	HI1131B/P/D	S	G	•			•					•	•	
	HI11310*	S	G		•		•				•		•	•
	HI11311*	S	G		•		•				•		•	•
	FC214D	S	M	•		•				•				•
Biotechnology (< 100 µl)	HI1083B/P	S	G	•				•	•					
Boilers and Cooling Towers	HI72911D	F	M		•		PTFE			Polymer				•
Cheese	FC242D	C	M	•			•		•					•
	FC240B	C	M	•				•	•					
Chemicals	HI1332B/P/D	S	P		•		•				•		•	
Conductivity, Low	HI1053B/P	C	G		•		•					•	•	
	HI10530*	C	G		•		•				•		•	•
Conductivity, High	HI1043B/P	S	G		•		•				•		•	
	HI10430*	S	G		•		•				•		•	•
Creams	FC210B	C	G		•			•	•					
	FC220B	S	G	•			•					•		
	FC911B	S	P		•		•				•		•	
Dairy Products	HI2031B	C	G	•			•					•	•	
	FC200B/S	C	P	•				•	•					
	FC240B	C	M	•				•	•					
	FC201D, FC202D	C	P	•				•	•					•
	FC2100*	C	G		•			•	•					•
	FC2020*	C	P		•			•	•					•
	FC260B (half-cell)	S	G											
Emulsions	HI1053B/P	C	G	•			•					•	•	
	HI10530*	C	G		•		•				•		•	•
	HI1612D	C	G	•			•					•	•	•
	HI1413B	F	G	•				•	•					
	HI1414D	F	G	•				•	•					•
Fats and Creams	HI1053B/P	C	G	•			•					•	•	
	HI10530*	C	G		•		•				•		•	•
Flasks	HI1331B	S	G	•			•					•	•	
Fluoride, Samples with	HI1143B	S	G		•		•				•		•	
Food Industry (General Use)	FC100B	S	P		•		•				•		•	
	FC911B	S	P		•		•				•		•	
Food, Semi-solid	FC201D, FC202D	C	P	•				•	•					•
	FC200B/D	C	P	•				•	•					

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pH Electrode Reference Guide

Abbreviation Guide

Spherical (S)
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Glass (G)
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Application	Recommended Electrodes	Tip Shape	Body Material	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Viscolene Electrolyte	Gel Electrolyte	KCl 3.5M Electrolyte	KCl 3.5M + AgCl Electrolyte	Refillable	SMART	Temperature Sensor	Amplifier	Pressure (Bar)
Fruits	FC200B/D	C	P	•				•	•								0.1
	FC230B	C	P	•				•	•								0.1
	FC202D	C	P	•				•	•						•	•	0.1
Fruit Juices, Organic	FC220B	S	G	•			•					•	•				0.1
	FC911B	S	P		•		•				•		•			•	0.1
Frozen, Semi	FC230B	C	P	•				•	•								0.1
Ham and Sausages	FC200B/D	C	P	•				•	•								0.1
	FC202D	C	P	•				•	•						•	•	0.1
	FC230B	C	P	•				•	•								0.1
Horticulture and Nurseries	HI1053B/P	C	G	•			•				•		•				0.1
	HI1292D	C	G	•			•					•	•		•	•	0.1
Humidity, High	FC911B	S	P		•		•				•		•			•	0.1
Hydrocarbons	HI1043B/P	S	G		•		•				•		•				0.1
	HI10430*	S	G		•		•				•		•		•	•	0.1
Laboratory (General Use)	HI1131B/P/D	S	G		•		•					•	•				0.1
	HI1230B/D	S	P		•		•			•							2
	HI1217D	S	P	•			•			•					•	•	2
	HI1610D	S	G	•			•					•	•		•	•	0.1
	HI1332B/P/D	S	P		•		•				•		•				0.1
	HI11310*	S	G		•		•				•		•		•	•	0.1
	HI11311*	S	G		•		•				•		•		•	•	0.1
	HI12300*	S	P		•		•			•					•	•	2
	HI12301*	S	P		•		•			•					•	•	2
	HI1291D	S	P	•			•			•					•	•	2
Leather	HI1413B	F	G	•				•	•								0.1
	HI1414D	F	G	•				•	•						•	•	0.1
Meats	FC230B	C	P	•				•	•								0.1
	FC400B	C	P		•			•	•								0.1
	FC232D	C	P	•				•	•					•	•	•	0.1
	FC201D, FC202D	C	P	•				•	•					•	•	•	0.1
	FC2320*	C	P		•			•	•						•	•	0.1
Milk and Yogurt	FC200B/D	C	P	•				•	•								0.1
	FC100B	S	P		•		•				•		•				0.1
	FC101D	S	P		•		•				•		•		•	•	0.1
	FC210B	C	G		•			•	•								0.1
	FC213D	C	G		•			•	•						•	•	0.1
	FC201D, FC202D	C	P	•				•	•					•	•	•	0.1
	FC2100*	C	G		•			•	•						•	•	0.1
	FC2020*	C	P		•			•	•						•	•	0.1
Monitoring, Continuous	HI1135B	S	G		•		•				•		•				3
	HI1611D	S	G	•			•			•					•	•	2
NMR Tubes	HI1093B	S	G	•				•	•								0.1
Paints	HI1043B/P	S	G		•		•				•		•				0.1

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Getting To Know Your pH Electrode

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Spherical (S)	Glass (G)
Conical (C)	Plastic (P)
Flat (F)	Metal (M)

Application	Recommended Electrodes	Tip Shape	Body Material	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Viscolene Electrolyte	Gel Electrolyte	KCl 3.5M Electrolyte	KCl 3.5M + AgCl Electrolyte	Refillable	SMART	Temperature Sensor	Amplifier	Pressure (Bar)
Paper	HI1413B	F	G	•				•	•								0.1
	HI1414D	F	G	•				•	•						•	•	0.1
Photographic Chemicals	HI1230B/D	S	P		•		•			•							
Plating Baths	HI62911D	F	M		•	PTFE				Polymer					•	•	3
Quality Control	HI1332B/P/D	S	P		•		•				•		•				0.1
Sauces	FC220B	S	G	•			•					•	•				0.1
	FC911B	S	P		•		•				•		•			•	0.1
Seawater	HI1043B/P	S	G		•		•				•		•				0.1
	HI10430*	S	G		•		•				•		•		•	•	0.1
Semi-solid Products	HI1053B/P	C	G		•		•				•		•				0.1
	HI10530*	C	G		•		•				•		•		•	•	0.1
	HI1612D	C	G	•			•					•	•		•	•	0.1
	FC200B/D	C	P	•				•	•								0.1
	FC201D, FC202D	C	P	•				•	•					•	•	•	0.1
	HI2031B	C	G	•			•					•	•				0.1
Skin, Scalp	HI1413B	F	G	•				•	•								0.1
	HI1414D/50	F	G	•				•	•						•	•	0.1
Soil, Direct	HI1292D	C	G	•			•					•	•		•	•	0.1
Soil Samples	HI1053B/P	C	G		•		•				•		•				0.1
	HI10530*	C	G		•		•				•		•		•		0.1
	HI1230B/D	S	P		•		•			•							2
	HI1292D	C	G	•			•					•	•		•	•	0.1
Solvents	HI1043B/P	S	G		•		•				•		•				0.1
	HI10430*	S	G		•		•				•		•		•	•	0.1
Surface Measurements	HI1413B	F	G	•				•	•								0.1
	HI1414D	F	G	•				•	•						•	•	0.1
Swimming Pools	HI1297D	C	M	•		•				•					•	•	3
Titrations, Non Aqueous	HI1151	S	G		•		•					•	•				0.1
Tris Buffer	HI1043B/P	S	G		•		•				•		•				0.1
	HI10430*	S	G		•		•				•		•		•	•	0.1
	HI1144B/D	S	G	•			•				•		•				0.1
	HI1343B	S	P	•			•				•						0.1
Vials and Test Tubes	HI1330B/D	S	G	•			•				•		•				0.1
Wastewater	HI1296D/HI12963	S	M	•		•				•					•	•	3
	HI1297D	C	M	•		•				•					•	•	3
Water, High Purity	HI1053B/P	C	G		•		•				•		•				0.1
Water, Municipal	HI1297D	C	M	•		•				•					•	•	3
Water, Potable	HI1053B/P	C	G		•		•				•		•				0.1
	HI10530*	C	G		•		•				•		•		•		0.1
	FC215D	C	G	•			•					•	•		•	•	0.1
Water Treatment	HI1297D	C	M	•		•				•					•	•	3
Wine and Must	HI1048B/P/D, HI1048B/50	S	G		•			•			•		•		•	•	0.1
	HI10480*	S	G		•			•			•		•		•	•	0.1

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ORP Electrode Reference Guide

Abbreviation Guide

Platinum (Pt) — Glass (G)
Gold (Au) — Plastic (P)

Application	Recommended Electrodes	Sensor	Body Material	Single Reference	Double Reference	Cloth Junction	Ceramic Junction	Open Junction	Gel Electrolyte	KCl 3.5M Electrolyte	KCl 3.5M + AgCl Electrolyte	Refillable	SMART	Temperature Sensor	Amplifier	Pressure (Bar)
Laboratory (General Use)	HI3131B/P	Pt	G	•			•				•	•				0.1
	HI3618D	Pt	G	•			•				•	•		•	•	0.1
	HI36180*	Pt	G		•		•				•	•	•	•	•	0.1
	HI36200*	Pt	P	•			•		•				•	•	•	2
Oxidants	HI4430B	Au	P	•			•		•							2
Ozone	HI4430B	Au	P	•			•		•							2
Quality Control	HI3230B	Pt	P	•			•		•							2
Titrations, ORP	HI3131B/P	Pt	G	•			•				•	•				0.1
Water, Municipal	HI3230B	Pt	P	•			•		•							2
Wine	HI3148B	Pt	G		•			•		•		•				0.1

*edge® specific electrode

Half-Cell and Reference Electrode Reference Guide

Abbreviation Guide

Spherical (S) — Glass (G)
Cylindrical (C) — Plastic (P)
Platinum (Pt)
Gold (Au)

Application	Recommended Electrodes	pH Half Cell	ORP Half Cell	Reference	Tip Shape	Body Material	Single Reference	Double Reference	PTFE Sleeve Junction	Ceramic Junction	KCl 3.5M Electrolyte	Pressure (Bar)
Laboratory (General Use)	HI5313			•		P	•			•		0.1
	HI2111B	•			S	G						
	HI2112B	•			S	P						
	HI3133B		•		Pt	G						
	HI5412			•		G	•			•	•	0.1
	HI5311			•		G		•		•	•	0.1
Milk	FC260B	•			S	G						
Remote Filling	HI5314			•		G		•		•	•	3
	HI5414			•		G	•			•	•	3
Strong Alkaline Solutions	HI2111B	•			S	G						
Suspended Solids	HI5413			•		G	•		•		•	0.1
	HI5312			•		G		•	•		•	0.1
	HI5313			•		P	•			•		0.1
Titration, Argentometric	HI5110B		•		C	G						
Titrations, General	HI5412			•		G	•			•	•	0.1
	HI5311			•		G		•		•	•	0.1
	HI5312			•		G		•	•		•	0.1
	HI5313			•		P	•			•		0.1
Titration, Potentiometric	HI3133B		•		Pt	G						
Wide Temperature Range	HI5311			•		G		•		•	•	0.1

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