

HORIBA
Scientific

LAQUA



pH	ORP	Ion	Conductivity
Resistivity	Total Dissolved Solids	Dissolved Oxygen	Salinity

ELECTRODES



LAQUA Electrode Technology

Born from the fusion of our technical expertise and state-of-the-art manufacturing

As a leading pH electrode manufacturer, HORIBA uses the latest technology for all your measurement needs.

Since the development of Japan's first glass electrode for pH meter, HORIBA has focused on continually improving our electrode technology, especially in materials and manufacturing. HORIBA is committed to continually explore and employ groundbreaking solutions in manufacturing next-generation electrodes so that we always provide you with the newest and best electrodes.

pH Electrode Selection Guide

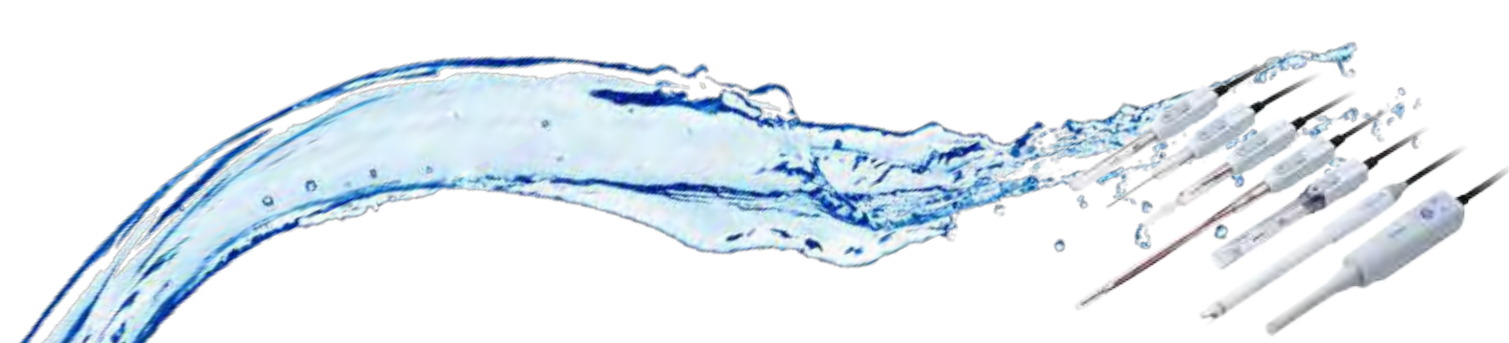
Specification		3-in-1 ELECTRODES								
		PLASTIC					STANDARD ToupH	LONG ToupH	MICRO ToupH	SLEEVE ToupH
		9651-10D	9625-10D	9630-10D	9631-10D	9632-10D	9615S-10D	9680S-10D	9618S-10D	9681S-10D
Applicable temperature range (°C)	0-60	0-100	0-100	0-60	0-100	0-100	0-100	0-100	0-60	0-60
Diameter (mm)	16	16	16	16	16	12	8	3	12	
Length (mm)	150	150	150	155	150	198	283	185	203	

pH - Sample Conditions

Aqueous Solution	Conductivity	Normal (over 100 mS/m)	●	●	●	●	●	●	●	●	●
		Low (approx. 10 ~100 mS/m)			●						○
		Very low (approx. 5 ~100 mS/m)			○						○
		High (approx. 5 S/m)	○	○	○	○	○	○	○	○	●
	Strong alkaline (pH 10-12)					●	○	○		○	
	Strong acidity (pH 0-2) * Except HF sample				●		●				
	Quick heat change (within 50°C)	●	●	●	●	●					
	High viscosity (approx. 5 Pa-S)									●	
	Containing non-aqueous solvent						○	○	○	○	
Suspension						○	○	○	●		
Solid/ Semisolid	Inside										
	Surface										

Sample Containers	Microtube/plate (> 50 µL)								●	
	Ampule > ø4 mm								●	
	Micro container (> 2 mL)							○	●	
	Tube ID:13 mm, L:100 - 150 mm								●	
	Beaker 10 mL - 1 L	●	●	●	●	●	●	○	○	○
	Large container (> 1 L)	○	○	○	○	○	○	○	●	
	Petri dish									
Droplet										

Water	Pure/ion-exchange water (approx. 0.1 mS/m)/ Distilled water (approx. 0.5 mS/m)						○			
	Tap/drinking water (approx. 10 mS/m)	○	○	●			○			○
	Surface water			●			○			○
	Pharmaceutical water/ Environmental water/acid rain	○	○	○			○			○
Chemical reagent/ solvent	Caustic/strong acid (Except HF sample)				●		●			○
	Hydrofluoric acid				●					
	Surfactant						○			●
	Water-based paint						○			●
	Dye/coloring agent									●
Pharmaceutical/ biological sample	Protein-containing sample						○		○	●
	Medicinal preparation								○	○
	Enzyme solution							○	●	
	Tris buffer						●		○	○
	Suspension						○			●
Food	Agar medium									●
	Jam						○			●
	Meat/fish/Fruit/vegetable/ Dough									
	Honey									
	Cheese/butter									
Beverage/ seasoning	Yogurt	○	○	○			○			○
	Beer	○	○	○			○			●
	Milk/Carbonated drink/juice/ sauce/soy sauce						○			●
Cosmetic/ lotion	Mayonnaise/ketchup						○			●
	Beauty cream/mascara						○			●
	Gel/soap/shampoo/Hairdye lotion						○			●
	Emulsified liquid						○			○



			COMBINATION ELECTRODES							ISFET ELECTRODES	
SLEEVE	NON-AQUEOUS	NEEDLE	PLASTIC	STANDARD ToupH	MICRO ToupH	SLEEVE ToupH	LONG	LONG ToupH	FLAT	GENERAL	
6367-10D	6377-10D	6252-10D	9425-10C	9415-10C	9418-10C	9481-10C	6069-10C	9480-10C	6261-10C	0040-10D	
0-60	0-60	0-60	0-100	0-100	0-60	0-60	0-60	0-100	0-50	0-60	
12	12	12	16	12	3	12	3	8	12	16	
150	150	150	150	198	185	203	291	283	150	190	

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Expertise in Manufacturing

Sophisticated processing technology

HORIBA's in-house expertise in the manufacture of electrodes is the accumulation of more than 60 years of experience. Our sophisticated electrode processing technology provides flexibility in designing various shapes of the electrode bulb and different structural designs of the electrodes.

Thick membrane technology

HORIBA's glass moulding technology allows the manufacture of tougher pH glass bulbs.

Miniaturization



Unique flat electrode design as well as 3mm diameter micro-electrode with integrated temperature sensor (US Patent No. 7314541/ China Patent No. ZL0315796)

Fast response & highly accurate

ToupH glass bulb does not compromise responsiveness and sensitivity (US Patent No. 8262877). Specially designed electrodes are available for hydrofluoric acid & strong alkaline application.

Double-junction electrodes

All HORIBA pH combination electrodes are double-junction electrodes. Flexible to use in a wide-range of applications.

Convenient slider

Refillable electrodes are equipped with a slider to open or close the refilling port easily.

Built-in clip for hooking onto electrode stand arm

Top housing of electrodes is designed with a built-in clip to hook onto HORIBA's electrode stands.

ORP Electrode

Model	Part No.	Material	Temp. Range (°C)	Application
9300-10D	3014046710	Pt / Glass	0 - 60	Waterproof; Platinum on the flat tip allows measurement of small volume samples

Ion Selective Electrodes (ISEs)

Model	Part No.	Combination ISE	Temp. Range (°C)	Measurement Range	Replacement Tip	Part No.
5002S-10C	3200698386	Ammonia (NH ₃)	0 - 50	0.01 - 18,000 mg/L NH ₄ ⁺	NH ₃ Membrane Caps	3200705774
6583S-10C	3200697410	Calcium (Ca ²⁺)	0 - 50	0.4 - 40,080 mg/L Ca ²⁺	7683S	3200697414
6560S-10C	3200697407	Chloride (Cl ⁻)	0 - 50	0.35 - 35,000 mg/L Cl ⁻	7660S	3200697411
6561S-10C	3200693774	Fluoride (F ⁻)	0 - 50	0.02 - 19,000 mg/L F ⁻	7661S	3200693606
6581S-10C	3200697408	Nitrate (NO ₃ ⁻)	0 - 50	0.62 - 62,000 mg/L NO ₃ ⁻	7681S	3200697412
6582S-10C	3200697409	Potassium (K ⁺)	0 - 50	0.39 - 39,000 mg/L K ⁺	7682S	3200697413

Conductivity Cells

Type	Model	Part No.	Temp. Range (°C)	Cell Constant	Measurement Range	Application
Submersible	3551-10D	3014081712	0 - 60	0.1 cm ⁻¹	0.1 μS/cm - 10 mS/cm	Low conductivity water (e.g., deionized, distilled)
				10 m ⁻¹	10 μS/m - 1 S/m	
	9382-10D	3014046709	0 - 80	1 cm ⁻¹	1 μS/cm - 100 mS/cm	General purpose use; Waterproof
				100 m ⁻¹	0.1 mS/m - 10 S/m	
3552-10D	3014081545	0 - 100	1 cm ⁻¹	1 μS/cm - 100 mS/cm	General purpose use	
			100 m ⁻¹	0.1 mS/m - 10 S/m		
3553-10D	3014081714	0 - 60	10 cm ⁻¹	10 μS/cm - 1 S/cm	High conductivity water	
			1000 m ⁻¹	1 mS/m - 100 S/m		
Flow	3561-10D	3014082350	0 - 60	0.1 cm ⁻¹	0.1 μS/cm - 10 mS/cm	Low conductivity water (e.g., deionized, distilled)
				10 m ⁻¹	10 μS/m - 1 S/m	
	3562-10D	3014082513	0 - 60	1 cm ⁻¹	1 μS/cm - 100 mS/cm	General purpose use
				100 m ⁻¹	0.1 mS/m - 10 S/m	
3573-10C	3014082590	0 - 60	10 cm ⁻¹	10 μS/cm - 1 S/cm	High conductivity water	
			1000 m ⁻¹	1 mS/m - 100 S/m		
3574-10C	3014082592	0 - 60	10 cm ⁻¹	10 μS/cm - 100 mS/cm	Small volume sample (e.g., column chromatography)	
			1000 m ⁻¹	1 mS/m - 10 S/m		

• Material: All have platinum-platinum black / glass-body, except 9382-10D (titanium-platinum black / plastic-body).







Dissolved Oxygen Probes


Type	Model	Part No.	Temp. Range (°C)	Measurement Range	Replacement Tip	Part No.
Field	9551-20D	3014047090	0 - 40	0 - 19.99 mg/L DO	5401	3014072770
	9551-100D	3014047091	0 - 40	0 - 19.99 mg/L DO	5401	3014072770
Lab	9520-10D	3014046711	0 - 45	0 - 19.99 mg/L DO	7541	3014074145

pH Combination Electrodes

HORIBA pH Combination electrodes manufactured with 1 meter cable terminating in BNC connector allow these electrodes to be used with any pH meter¹. Enjoy the full spectrum of features and benefits of these electrodes on your existing pH meter¹. (For applications where temperature measurement and compensation is required, please refer to the 3-in-1 pH electrodes).

¹pH meters must have BNC connector






Model	pH Range	Operating Temperature Range (°C)	Liquid Junction	Application
<p>ToupH Standard Electrode 9415-10C General laboratory application</p>  <p>3200611623</p> <p>Overall length: 198 mm Diameter of probe: 12 mm Connector: BNC</p>	0-14	0-100	Ceramic	<p>The electrode offers quick stability and drift reduction.</p> <ul style="list-style-type: none"> Constructed with responsive glass that is 10X stronger than JIS standards The one-touch refilling port slider allows one-hand operation Waterproof, Pb-free glass <p>Perfect for preparing pH buffers and other aqueous test solutions.</p>
<p>Standard Plastic Electrode 9425-10C General field application</p>  <p>3200611625</p> <p>Overall length: 150 mm Diameter of probe: 16 mm Connector: BNC</p>	0-14	0-100	Ceramic	<p>The electrode has plastic body, which is ideal for field measurement.</p> <ul style="list-style-type: none"> Can be submerged up to 1m depth and 30mins (with refilling port closed) Waterproof, Pb-free glass <p>Recommended for field use. For measurement of tap water and drinking water.</p>
<p>ToupH Sleeve Electrode 9481-10C High viscosity application</p>  <p>3200611631</p> <p>Overall length: 203 mm Diameter of probe: 12 mm Connector: BNC</p>	0-14	0-60	Movable sleeve	<p>The electrode gives stable readings in highly viscous samples.</p> <ul style="list-style-type: none"> The liquid junction is designed with a movable sleeve that can be cleaned easily and prevents clogging Waterproof, Pb-free glass <p>For measurement of highly viscous samples and samples containing non-aqueous solvents (e.g., cosmetics, paints).</p>
<p>ToupH Micro Electrode 9418-10C Precious trace amount sample</p>  <p>3200611627</p> <p>Overall length: 185 mm Diameter of probe: 3 mm Connector: BNC</p>	0-14	0-60	Ceramic	<p>The electrode can measure samples as small as 50µL.</p> <ul style="list-style-type: none"> Compatible with extremely small containers (e.g., micro tubes) Temperature sensor is placed next to the bulb for quick response Waterproof <p>Suitable for low-volume samples and wide range of aqueous solutions.</p>
<p>ToupH Long Electrode 9480-10C For large containers and long test tubes</p>  <p>3200611628</p> <p>Overall length: 283 mm Diameter of probe: 8 mm Connector: BNC</p>	0-14	0-100	Ceramic	<p>The long, thin body of the electrode is perfect for large containers and test tubes.</p> <ul style="list-style-type: none"> 283mm length, 8mm diameter Constructed with responsive glass that is 10X stronger than JIS standards Waterproof, Pb-free glass <p>For measuring samples (e.g., microbial culture fluids) in test tubes and tall beakers.</p>
<p>Long Electrode 6069-10C For very slender test tubes</p>  <p>3014081107</p> <p>Overall length: 291 mm Diameter of probe: 3.15 mm Connector: BNC</p>	0-14	0-60	Ceramic	<p>The long, thin body of the electrode is perfect for very slender test tubes.</p> <ul style="list-style-type: none"> 291mm length, 3mm diameter Waterproof <p>For measuring samples in slender tubes (e.g., NMR test tube).</p>



Model	pH Range	Operating Temperature Range (°C)	Liquid Junction	Application
Flat Electrode 6261-10C  <p>Overall length: 150 mm Diameter of probe: 12 mm Connector: BNC</p>	0-12	0-50	Sleeve	<p>The sensor is located on the flat surface of the tip.</p> <ul style="list-style-type: none"> Measurement can be made from minute amount of moisture on solid sample surface Pure water can be applied for samples with no moisture Waterproof <p>Perfect for measuring samples in shallow containers (e.g., petri dishes) and gelatinous materials (e.g., nutrient agar). For surface measurement of meat, paper, skin, and cloth.</p>

3-in-1 pH Glass Body Electrodes²

HORIBA pH Combination electrodes with an integrated thermistor offer higher accuracy as these electrodes measure temperature concurrently with pH. The pH meter is able to continuously monitor and compensate for temperature effects automatically.






² Only compatible with HORIBA pH meters

Model	pH Range	Operating Temperature Range (°C)	Liquid Junction	Application
ToupH Standard Electrode 9615S-10D General laboratory application  <p>Overall length: 198 mm Diameter of probe: 12 mm Connectors: BNC & phono jack</p>	0-14	0-100	Ceramic	<p>The electrode offers quick stability and drift reduction.</p> <ul style="list-style-type: none"> Constructed with responsive glass that is 10x stronger than JIS standards The one-touch refilling port slider allows one-hand operation Waterproof, Pb-free glass <p>Perfect for preparing pH buffers and other aqueous test solutions.</p>
ToupH Sleeve Electrode 9681S-10D High viscosity application  <p>Overall length: 203 mm Diameter of probe: 12 mm Connectors: BNC & phono jack</p>	0-14	0-60	Movable sleeve	<p>The electrode gives stable readings in highly viscous samples.</p> <ul style="list-style-type: none"> The liquid junction is designed with a movable sleeve that can be cleaned easily and prevents clogging Waterproof, Pb-free glass <p>For measurement of highly viscous samples and samples containing non-aqueous solvents (e.g. cosmetics, paints).</p>
ToupH Micro Electrode 9618S-10D Precious trace amount sample  <p>Overall length: 185 mm Diameter of probe: 3 mm Connectors: BNC & phono jack</p>	0-14	0-60	Ceramic	<p>The electrode can measure samples as small as 50µL.</p> <ul style="list-style-type: none"> Compatible with extremely small containers (e.g. micro tubes) Temperature sensor is placed next to the bulb for quick response Waterproof <p>Suitable for low-volume samples and a wide range of aqueous solutions.</p>
ToupH Long Electrode 9680S-10D For large containers and long test tubes  <p>Overall length: 283 mm Diameter of probe: 8 mm Connectors: BNC & phono jack</p>	0-14	0-100	Ceramic	<p>The long, thin body of the electrode is perfect for large containers and test tubes.</p> <ul style="list-style-type: none"> 283mm length, 8mm diameter Constructed with responsive glass that is 10x stronger than JIS standards Waterproof, Pb-free glass <p>For measuring samples (e.g. microbial culture fluids) in test tubes and tall beakers.</p>
Needle Electrode 6252-10D For food application  <p>Overall length: 150 mm Diameter of probe: 12 mm Connectors: BNC & phono jack</p>	0-12	0-60	Ceramic	<p>Needle electrode allows measurement of food samples and aqueous solutions.</p>

Model	pH Range	Operating Temperature Range (°C)	Liquid Junction	Application
Low-Conductivity Electrode 6377-10D For pure water & non-aqueous solvents  Overall length: 150 mm Diameter of probe: 12 mm Connectors: BNC & phono jack 3014093085	0-14	0-60	Movable sleeve	Uses a glass membrane that is highly sensitive to low-conductivity water and non-aqueous solvents.
Standard Sleeve Electrode 6367-10D  Overall length: 150 mm Diameter of probe: 12 mm Connectors: BNC & phono jack 3014079136	0-14	0-60	Sleeve	Uses a sleeve at the liquid junction for improved stability and repeatability. For measuring pH at high accuracy.

3-in-1 pH Plastic Body Electrodes²

²Only compatible with HORIBA pH meters

Model	pH Range	Operating Temperature Range (°C)	Liquid Junction	Applications
Gel-filled pH Electrode 9651-10D  Overall length: 150 mm Diameter of probe: 16 mm Connectors: BNC & phono jack 3200642020	0-14	0-80	Porous sintered polyethylene	The plastic body of the electrode is filled with gel electrolyte. Less maintenance is needed as refilling is not required. <ul style="list-style-type: none"> • Can be submerged up to 1m depth of water for 30mins. • Waterproof, Pb-free glass Recommended for field use.
Standard Plastic Electrode 9625-10D; 9625-20D; 9625-30D For Field  Overall length: 150 mm Diameter of probe: 16 mm Connectors: BNC & phono jack 3200360505; 3200393025; 3200393026	0-14	0-100	Ceramic	The electrode has a plastic body which is ideal for field measurement. <ul style="list-style-type: none"> • Can be submerged up to 1m depth of water for 30mins. (with refilling port closed) • Waterproof, Pb-free glass Recommended for field use. For measurement of tap water and drinking water.
Hydrofluoric Acid Resistant Electrode 9631-10D  Overall length: 155 mm Diameter of probe: 16 mm Connectors: BNC & phono jack 3200524119	2-12	0-60	Ceramic	The electrode can measure 1% hydrofluoric acid solution (at 25°C, immersed at 1min.) for about 1000 times. <ul style="list-style-type: none"> • Rolled glass design for long-term reliable measurement and easy maintenance • Compliant with Japan's Measurement Act Certification • Waterproof, Pb-free glass Suitable for drain water measurement after etching process.
Strong Alkali Resistant Electrode 9632-10D  Overall length: 150 mm Diameter of probe: 16 mm Connectors: BNC & phono jack 3200524120	0-14	0-100	Ceramic	The alkali-resistant glass membrane has higher resistance and longer stability (about 5X in 0.1mol/L sodium at 60°C, pH 13) than conventional electrodes. <ul style="list-style-type: none"> • Waterproof, Pb-free glass Suitable for strong alkali samples such as plating solutions.
Standard Plastic Electrode 9630-10D For tap water  Overall length: 150 mm Diameter of probe: 16 mm Connectors: BNC & phono jack 3200528726	0-14	0-100	Ceramic	The electrode can measure samples with low conductivity or buffering capacity. <ul style="list-style-type: none"> • Made of high purity multicomponent lithium series glass • Waterproof, Pb-free glass Suitable for tap water measurement and quality control in water purification plant. Recommended to use with cleaning solution 230.

Next-Generation Electrode Technology

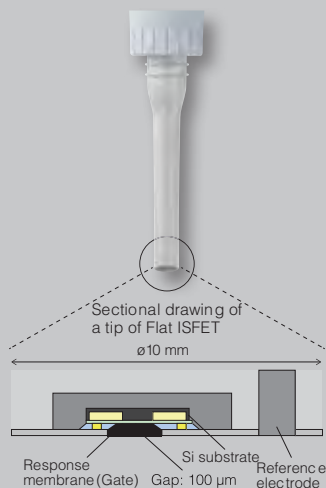
Semiconductor technology without glass

HORIBA started researching **ISFET (Ion Sensitive Field Effect Transistor)** using semiconductor technology many years ago and continued to improve its quality. This has provided a new solution for environments where glass material cannot be used.



ISFET

Applicable electrode: 0040-10D



What is an ISFET (semiconductor sensor)?

ISFET is the abbreviation of **Ion Sensitive Field Effect Transistor**. The response part uses a semiconductor based sensor.

Special features of the ISFET

1. Will not crack or break like conventional glass electrodes
2. The sensor is flat and very small enabling the measurement of extremely small samples
3. Easy handling and maintenance - simply clean with a toothbrush
4. Can be stored dry

The flat electrode has a distance of less than 100 μm between the housing and sensor


The unique structure allows measurements to be taken from the smallest amount of moisture on solid objects and prevents bubbles being trapped on the sensor when measuring samples in a beaker.

Reduction of static electricity effect


The combination of HORIBA's unique semiconductor device structure together with the improved electrostatic protection circuit results in a significant reduction of the static electricity effect that had previously been the weak point of a semiconductor sensor.

ISFET ELECTRODES ISFET

ISFET is the abbreviation of Ion Sensitive Field Effect Transistor. Since ISFET is robust and will not crack like the conventional glass electrodes, it can be easily handled and maintained. The response part is equipped with a flat and miniature semiconductor-based sensor, which makes the measurement even on extremely small samples possible. Combination of HORIBA's unique semiconductor device structure and improvement of the electrostatic protection circuit enables to reduce greatly the static electricity effect that had been the weak point of the semiconductor sensor. Now the measurement has become more comfortable and reliable.

Model	pH Range	Operating Temperature Range (°C)	Liquid Junction	Applications
<p>General ISFET pH electrode 0040-10D</p>  <p>3200367925</p> <p>Overall length: 190.6 mm Diameter of probe: 16 mm Connectors: BNC & phono jack</p>	0-14	0-60	Porous sintered polyethylene	<p>The sensor is located on the flat surface of the tip (<100μm from the housing).</p> <ul style="list-style-type: none"> • Measurement can be made from minute amount of moisture on solid sample surface • Pure water can be applied for samples with no moisture • Use of semiconductor sensor prevents damage such as crack or breakage • Waterproof • Replacement sensor (0141) 3200367926 <p>Perfect for measuring samples in shallow containers (e.g., petri dishes) and gelatinous materials (e.g., nutrient agar). For surface measurement of meat, paper, skin, and cloth.</p>

Metallic Electrode (For ORP Measurement)





Model	Operating Temperature Range (°C)	Electrode Material	Internal Solution	Applications
<p>ORP Electrode 9300-10D Waterproof platinum 3-in-1 type</p>  <p>3014046710</p> <p>Overall length: 150 mm Diameter of probe: 12 mm Connectors: BNC & phono jack</p>	0-60	Pt / Glass	#300 (KCl)	Waterproof; Platinum on the flat tip allows measurement of small volume samples

Conductivity Electrode Cells

HORIBA Conductivity cells are available as Submersible type and Flow type, as well as in a variety of cell constants ranging from 0.1 to 10.0.

The HORIBA Conductivity cells are integrated with temperature sensor (except for 3573 & 3574) and the wetted material is **Platinum / Titanium, coated with Platinum black**. Rugged Titanium allows cell to be used in a wide range of applications, including highly corrosive samples such as concentrated acids and sea water. Maintenance is simple – soak in deionized/demineralized water or with the conditioning solution.

Conductivity Cells (Submersible Type)

Model	Cell Constant	Measurement Range	Temp. Range (°C)	Cell Material	Thermistor	Minimum Sample Volume (ml)	Application
3551-10D  3014081712 Overall length: 175 mm Diameter of probe: 23 mm Connectors: BNC & phono jack	0.1 cm ⁻¹	0.1 μS/cm - 10 mS/cm	0 - 60	Pt-Pt black / Glass	Built-in	50	Low conductivity water (e.g., deionized, distilled)
	10 m ⁻¹	10 μS/m - 1 S/m					
3552-10D  3014081545 Overall length: 150 mm Diameter of probe: 12 mm Connectors: BNC & phono jack	1 cm ⁻¹	1 μS/cm - 100 mS/cm	0 - 100	Pt-Pt black / Glass	Built-in	15	General purpose use
	100 m ⁻¹	0.1 mS/m - 10 S/m					
3553-10D  3014081714 Overall length: 175 mm Width of probe: 28 mm Connectors: BNC & phono jack	10 cm ⁻¹	10 μS/cm - 1 S/cm	0 - 60	Pt-Pt black / Glass	Built-in	50	High conductivity water
	1000 m ⁻¹	1 mS/m - 100 S/m					
9382-10D  3014046709 Overall length: 150 mm Diameter of probe: 16 mm Connectors: BNC & phono jack	1 cm ⁻¹	1 μS/cm - 100 mS/cm	0 - 80	Ti-Pt black / Plastic	Built-in	20-30	General purpose use; Waterproof
	100 m ⁻¹	0.1 mS/m - 10 S/m					






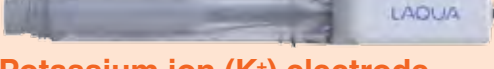
Conductivity Cells (Flow Type)

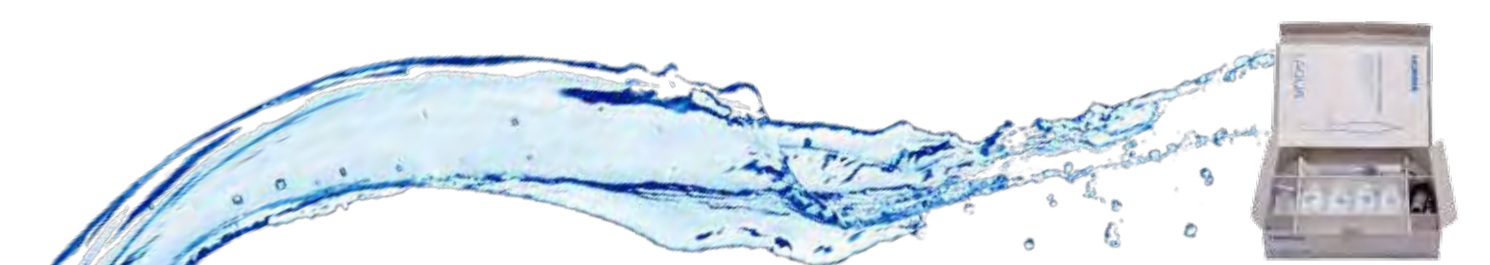
Model	Cell Constant	Measurement Range	Temp. Range (°C)	Cell Material	Thermistor	Minimum Sample Volume (ml)	Application
3561-10D  3014082350 Overall length: 143 mm Diameter of probe: 18 mm Connectors: BNC & phono jack	0.1 cm ⁻¹	0.1 μS/cm - 10 mS/cm	0 - 60	Pt-Pt black / Glass	Built-in	10	Low conductivity water (e.g., deionized, distilled)
	10 m ⁻¹	10 μS/m - 1 S/m					
3562-10D  3014082350 Overall length: 205 mm Diameter of probe: 18 mm Connectors: BNC & phono jack	1 cm ⁻¹	1 μS/cm - 100 mS/cm	0 - 60	Pt-Pt black / Glass	Built-in	16	General purpose use
	100 m ⁻¹	0.1 mS/m - 10 S/m					
3573-10C  3014082590 Overall length: 222 mm Diameter of probe: 18 mm Connector: BNC	10 cm ⁻¹	10 μS/cm - 1 S/cm	0 - 60	Pt-Pt black / Glass	—	4	High conductivity water
	1000 m ⁻¹	1 mS/m - 100 S/m					
3574-10C  3014082592 Overall length: 136 mm Diameter of probe: 66 mm Connector: BNC	10 cm ⁻¹	10 μS/cm - 100 mS/cm	0 - 60	Pt-Pt black / Glass	—	0.25	Small volume sample (e.g., column chromatography)
	1000 m ⁻¹	1 mS/m - 10 S/m					

Combination ISE

Ion-selective electrodes are responsive to concentration of particular ions in the test liquid and are variable-potential electrodes. They are used in conjunction with reference electrodes to measure the concentration of particular ions. HORIBA's years of experience and know-how in this field are behind the wide range of ion electrodes we offer.

When measurements are made using an ion meter, calibrating it with various standard solutions will give direct readings of the ion concentration. Note that since volume-detection level changes with temperature, measurements must be taken at a fixed temperature.

Model	Accessories Included	Temp. Range (°C)	Measurement Range	pH Range
 <p>Ammonia ion (NH₃) electrode 5002S-10C 3200698386 Overall length: 161 mm Diameter of probe: 15 mm Connector: BNC</p>	<ul style="list-style-type: none"> • membrane cap, 3pcs • 1000mg/L ammonium ion standard solution, 50ml • 100mg/L ammonium ion standard solution, 50ml • ammonia electrode filling solution, 50ml • syringe • dropper • protective pipe • manual 	0 - 50	0.01 - 18,000 mg/L NH ₄ ⁺ (5 x 10 ⁻⁷ to 1 mol/L NH ₄ ⁺)	pH 12 or more
 <p>Calcium ion (Ca²⁺) electrode 6583S-10C 3200697410 Overall length: 150 mm Diameter of probe: 16 mm Connector: BNC</p>	<ul style="list-style-type: none"> • calcium electrode tip, 2pcs • 1000mg/L calcium ion standard solution, 50ml • 100mg/L calcium ion standard solution, 50ml • calcium electrode filling solution, 50ml • calcium ionic strength adjustor, 50ml • syringe • dropper • protective pipe • manual 	0 - 50	0.4 - 40,080 mg/L Ca ²⁺ (10 ⁻⁵ to 1 mol/L Ca ²⁺)	4.0 mg/L (10 ⁻⁴ mol/L) Ca ²⁺ , pH 5 to 11
 <p>Chloride ion (Cl⁻) electrode 6560S-10C 3200697407 Overall length: 150 mm Diameter of probe: 16 mm Connector: BNC</p>	<ul style="list-style-type: none"> • chloride electrode tip • 1000mg/L chloride ion standard solution, 50ml • 100mg/L chloride ion standard solution, 50ml • chloride electrode filling solution, 50ml • chloride ionic strength adjustor, 50ml • syringe • dropper • protective pipe • water-resistant abrasive sheet • manual 	0 - 50	0.35 - 35,000 mg/L Cl ⁻ (10 ⁻⁵ to 1 mol/L Cl ⁻)	350 mg/L (10 ⁻² mol/L) Cl ⁻ , pH 3 to 11
 <p>Fluoride ion (F⁻) electrode 6561S-10C 3200693774 Overall length: 150 mm Diameter of probe: 16 mm Connector: BNC</p>	<ul style="list-style-type: none"> • fluoride electrode tip • 1000mg/L fluoride ion standard solution, 50ml • 100mg/L fluoride ion standard solution, 50ml • fluoride electrode filling solution, 50ml • fluoride ionic strength adjustor, 50ml • syringe • dropper • protective pipe • manual 	0 - 50	0.02 - 19,000 mg/L F ⁻ (10 ⁻⁶ to 1 mol/L F ⁻)	0.1 to 1,000 mg/L F ⁻ , pH 5 to 8
 <p>Nitrate ion (NO₃⁻) electrode 6581S-10C 3200697408 Overall length: 150 mm Diameter of probe: 16 mm Connector: BNC</p>	<ul style="list-style-type: none"> • nitrate electrode tip, 2pcs • 1000mg/L nitrate ion standard solution, 50ml • 100mg/L nitrate ion standard solution, 50ml • nitrate electrode filling solution, 50ml • nitrate ionic strength adjustor, 50ml • syringe • dropper • protective pipe • manual 	0 - 50	0.62 - 62,000 mg/L NO ₃ ⁻ (10 ⁻⁵ to 1 mol/L NO ₃ ⁻)	62 mg/L (10 ⁻³ mol/L) NO ₃ ⁻ , pH 3 to 7
 <p>Potassium ion (K⁺) electrode 6582S-10C 3200697409 Overall length: 150 mm Diameter of probe: 16 mm Connector: BNC</p>	<ul style="list-style-type: none"> • potassium electrode tip, 2pcs • 1000mg/L potassium ion standard solution, 50ml • 100mg/L potassium ion standard solution, 50ml • potassium electrode filling solution, 50ml • potassium ionic strength adjustor, 50ml • syringe • dropper • protective pipe • manual 	0 - 50	0.39 - 39,000 mg/L K ⁺ (10 ⁻⁵ to 1 mol/L K ⁺)	3.9 mg/L (10 ⁻⁴ mol/L) K ⁺ , pH 5 to 11






Selection Coefficient	Replacement Tip	Electrode Filling Solution	100mg/L Standard Solution	1000mg/L Standard Solution	Ionic Strength Adjustor	Applications
—	 <p>NH₃ electrode membrane caps 3200705774</p>	500-NH3-IFS 3200697173	500-NH4-SL 3200697172	500-NH4-SH 3200697171	500-NH3-ISA 3200697174 	Agriculture, Soil, Power Station Water, Fish Tanks, Sea Water, Waste Water, Plating Baths, Air / Stack Gases and Biological Cultures or Samples
Fe ³⁺ = 0.1, Fe ²⁺ , Zn ²⁺ = 1, Sr ²⁺ = 50 Ni ²⁺ , Cu ²⁺ = 70, Co ²⁺ = 350 Mn ²⁺ = 500, Mg ²⁺ = 1,000 Na ⁺ , K ⁺ , Ba ²⁺ , NH ₄ ⁺ = over 1,000	 <p>7683S 3200697414</p>	500-CA-IFS 3200697177	500-CA-SL 3200697176	500-CA-SH 3200697175	500-CA-ISA 3200697178	Agriculture / Plant Tissue, Soil, Water Softening Systems, Boiler Feed Water, Drinking / Mineral Water, Biological Cultures, Dental / Clinical Analysis and Dairy / Food / Beverages Applications
S ₂ O ₃ ²⁻ , S ²⁻ , I ⁻ , Ag ⁺ , Hg ²⁺ = Not acceptable SCN ⁻ = 0.3, MnO ₄ ⁻ = 0.1 Br ⁻ = 0.03 NO ₃ ⁻ , F ⁻ , HCO ₃ ⁻ , SO ₄ ²⁻ , PO ₄ ²⁻ = 1,000	 <p>7660S 3200697411</p>	500-CL-IFS 3200697169	500-CL-SL 3200697168	500-CL-SH 3200697167	500-CL-ISA 3200697170	Agriculture, River / Tap Water, Plant Tissue, Soils, Boiler Feed Water, Clinical Analysis, Sweat, Urine, Cement, Plating Baths and Dairy / Food / Beverages Samples
Possible interference when multiply-charged ion (ex. Al ³⁺ , Fe ³⁺) coexisted and foamed the complex.	 <p>7661S 3200693606</p>	500-F-IFS 3200697165	500-F-SL 3200697164	500-F-SH 3200697163	500-F-TISAB 3200697166	Dental / Toothpaste / Mouth Wash, Drinking / Seawater, Wastewater, Air / Stack Gases, Acids, Soils, Food, Biological Fluids, Plant Tissue, Coal, Carbonated Beverages and Bone
ClO ₄ ⁻ , I ⁻ = Not acceptable, Br ⁻ = 2 NO ₂ ⁻ = 3, Cl ⁻ = 300 HCO ₃ ⁻ , H ₂ PO ₄ ⁻ , SO ₄ ²⁻ = over 1000	 <p>7681S 3200697412</p>	500-NO3-IFS 3200697181	500-NO3-SL 3200697180	500-NO3-SH 3200697179	500-NO3-ISA 3200697182	Agriculture / Plant Tissue / Fertilizers, Surface / Seawater / Drinking Water, Sewage Effluent, Soils, Meats, Vegetables, Foods / Beverages
Rb ⁺ = 0.4, Cs ⁺ = 3, NH ₄ ⁺ = 70 Li ⁺ , Na ⁺ , Mg ²⁺ , Ca ²⁺ , Sr ²⁺ , Ba ²⁺ = over 1,000	 <p>7682S 3200697413</p>	500-K-IFS 3200697185	500-K-SL 3200697184	500-K-SH 3200697183	500-K-ISA 3200697186	Agriculture / Plant Tissue, Soils, Wastewater, River / Tap Water, Clinical Analysis, Saliva, Serum, Fertilizers, Soils and Wines, Dairy / Foods / Beverages

DISSOLVED OXYGEN (DO) ELECTRODE & TIPS

HORIBA Dissolved Oxygen (DO) electrodes are galvanic probes with integrated temperature sensors. With galvanic DO probes, calibration can be performed immediately and in air. The HORIBA DO probes use unique and innovative tips which are replaceable. No need to replace membranes or refill electrolytes.

Two models are available: a Laboratory model (9520) that can be used for BOD measurements, and a Field immersible model (9551) housed in a rugged casing available in 2m and 10m cable configurations. The Laboratory 9520 DO probe is fitted with a rotor as well as an adaptor to facilitate BOD measurements.

Dissolved Oxygen Electrodes

Model	Measurement Range	Response Time	Temperature Range (°C)	Features
9520-10D For laboratories  3014046711 Overall length: 184 mm Diameter of probe: 15 mm Connectors: BNC & phono jack	0-19.99mg/L DO	20 seconds (90% response time at constant temperature)	0-45	Waterproof; It operates with the built-in temperature sensor and replaceable DO tip 7541.
9551-20D For field immersible type (2 m cable)  3014047090 Overall length: 165 mm Diameter of probe: 32 mm Connectors: BNC & phono jack	0-19.99mg/L DO	30 seconds (90% response time at constant temperature)	0-40	Waterproof; It operates with the built-in temperature sensor and replaceable DO tip 5401.
9551-100D For field immersible type (10 m cable)  3014047091 Overall length: 165 mm Diameter of probe: 32 mm Connectors: BNC & phono jack	0-19.99mg/L DO	30 seconds (90% response time at constant temperature)	0-40	Waterproof; It operates with the built-in temperature sensor and replaceable DO tip 5401.

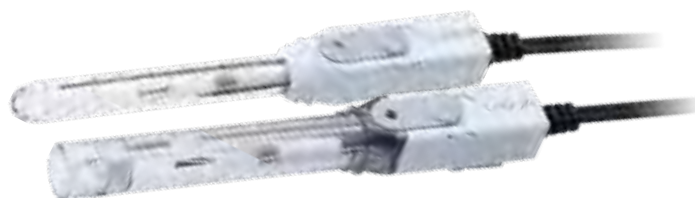
Dissolved Oxygen Electrode Tips

Model	Description
5401  3014072770	Replacement DO tip for 9551-20D and 9551-100D
7541  3014074145 Overall length: 26.5 mm Diameter: 15 mm	Replacement DO tip for 9520-10D



pH Electrode Care and Maintenance Procedures

Your pH electrode will eventually reach the end of its useful life as its performance naturally degrades over time. To maximize the performance of your pH electrode and extend its life span, proper care and regular maintenance are equally required.



Part no. 3014028653
Cleaning Solution 220 - contains 10% thiourea and 1% hydrochloric acid (HCl) for removing inorganic residues on glass membrane and junction



Part no. 3200366771
Cleaning Solution 250 - contains less than 0.5% enzyme protease, less than 0.1% sodium azide, and other ingredients (See SDS) for removing protein residues on glass membrane and junction



Part no. 3999960023
525-3 3.33M KCl pH electrode filling solution (for liquid-filled electrodes)



Part no. 3999960031
500-7 pH 7.00 buffer



Part no. 3999960029
500-4 pH 4.00 buffer



Mild detergent



Soft lint-free tissue



Clean water (e.g., tap, distilled or deionized water) in a squirt bottle

Refer to the safety data sheet (SDS) of the chemical solution to be used in cleaning and wear the appropriate personal protective equipment for safe handling. Download the SDSs of HORIBA solutions at www.horiba-laqua.com.

Refilling

The pH electrode may be filled with either an ionic liquid solution (refillable or liquid-filled pH electrode) or ionic gel solution (sealed or gel-filled pH electrode). Gel-filled pH electrodes do not require routine refilling and typically require less maintenance than liquid-filled electrodes. Liquid-filled pH electrodes are constructed with refilling port, which is securely covered with a slider. The refilling port allows you to fill or empty the reference chamber.

- To top up or re-fill the reference chamber of liquid-filled pH electrode, push the slider upward to uncover the refilling port and insert a dropper containing fresh 3.33M potassium chloride (KCl) solution. The filling solution should reach the bottom of the refilling port.
- The filling solution level must be maintained just below the refilling port and higher than the pH buffer or sample level during calibration and measurement. This creates a positive head pressure forcing the filling solution to leak into pH buffer or sample through the junction and preventing the reverse.
- Bubbles may form and get trapped within the solution of the sensing tip or reference chamber during transportation. This can affect the operation of your pH electrode. To dislodge the bubbles, gently shake the electrode body.
- If the filling solution inside the reference chamber gets contaminated with sample or microbial growth or the reading is drifting, change the filling solution. Tilt the pH electrode, uncover the refilling port, and draw out the old solution using a dropper before refilling it with fresh 3.33M KCl solution.

Conditioning

Nowadays, combination and 3-in-1 pH electrodes are commonly available. Both types of pH electrodes consist of glass electrode and reference electrode built in one body, but the latter is integrated with temperature sensor for detecting the temperature of the solution being measured.

The glass electrode has a silver-based electrical wire suspended in a neutral solution with KCl contained inside a special glass. The surface of the glass bulb or membrane at the tip of the electrode must be hydrated to function properly. This can be accomplished by immersing the glass membrane in an aqueous solution, where a hydrated layer that is responsible for the pH response of the glass, is developed.

Another component of the pH electrode that must remain hydrated is the junction of the reference electrode. The junction is made of porous material such as ceramic or sintered polyethylene, which allows filling solution of the electrode to leak into the solution being measured. Keeping the reference junction hydrated will prevent precipitation of KCl from the filling solution which may clog it and cause erratic or slow electrode response.

- All pH electrodes come with white protective cap. A sponge wet with pure water is positioned at the bottom of the cap to keep the glass membrane and junction moist. If you find KCl salts formed on the junction or refilling port of your pH electrode, simply rinse off using clean water. This KCl creep from the filling solution is normal.
- A dry pH electrode will give inaccurate reading in pH measurement. Condition a dry pH electrode by soaking the glass membrane and junction in pH 7.00, 4.01 buffer, or tap water for at least 1 hour to regenerate the hydrated layer. Note: High salt solutions such as 3.33M KCl and the like are not recommended for conditioning our pH electrodes. After conditioning, rinse the pH electrode with clean water and proceed with calibration.

Never touch the glass membrane with fingers as oil or dirt may coat the glass and interfere with measurement.

Cleaning

A clean, hydrated glass membrane and free-flowing junction are necessary in performing an accurate measurement of pH. The choice of cleaning solution should effectively remove all contaminants based on sample tested without damaging your pH electrode.

1. If the pH electrode is liquid-filled, uncover the refilling port.
2. Clean the tip of your pH electrode using the appropriate cleaning solution. Make sure that the glass membrane and junction are both immersed in cleaning solution.
 - General samples—Soak the pH electrode in diluted detergent solution for 5 to 10 minutes, while moderately stirring the solution. A strong cleaning solution is needed for clogged junction, stains, and electrodes exhibiting slow response. Soak the pH electrode in cleaning solution 220 or 0.1M HCl for at least 1 hour.
 - Oily samples—Soak the pH electrode in warm, diluted detergent solution for 5 to 10 minutes, while moderately stirring the

solution. Alternatively, rinse the pH electrode with methanol or ethanol. Note: Alcohol is only applicable for glass-body electrodes. Never use organic solvents such as alcohol, acetone etc. to clean any plastic-body electrode as they may damage the body and shorten the life span. Use of organic solvents will void the electrode warranty.

- Protein-containing samples—soak the pH electrode in cleaning solution 250 for at least 1 hour.
3. Rinse the pH electrode with clean water.
 4. If the pH electrode is liquid-filled, draw out the old filling solution from the reference chamber and refill it with fresh 3.33M KCl (See Refilling).
 5. Condition the pH electrode (See Conditioning).

If calibration with fresh pH buffers failed repeatedly and cleaning failed to restore the performance, replace the pH electrode with a new one.

Storage

pH electrodes must be clean before they are stored for any length of time.

1. If the pH electrode is liquid-filled, cover the refilling port with the slider to prevent evaporation of filling solution.
2. Wash the protective cap with clean water to wet the sponge and remove KCl salts.
3. Insert the pH electrode into the protective cap with wet sponge. The water will not dissipate easily as the cap fit snugly on the electrode body. This environment is enough to keep the glass membrane and junction moist. It is not necessary to fill the cap with clean water and soak the pH electrode tip.

Short-term storage:

Between measurements, the pH electrode can be soaked in pH 7.00 buffer or clean water (e.g., tap, distilled or deionized).

Scan to download





501-S NIST pH Buffer Solution Kit



502-S USA pH Buffer Solution Kit



503-S Conductivity Standard Solution Kit



ORP Powders



220

250



230

Cleaning Solutions

pH Buffer Solution Kits

Code	Part No.	Description	Volume
501-S	3999960015	NIST pH Buffer Solution Kit (pH 4.01, 6.86, 9.18 buffers & 3.33M KCl)	250ml each
502-S	3999960016	USA pH Buffer Solution Kit (pH 4.01, 7.00, 10.01 buffers & 3.33M KCl)	250ml each

pH Buffer Solutions

Code	Part No.	Description	Volume
500-2	3999960028	pH 1.68 Buffer Solution at 25°C	500ml
500-4	3999960029	pH 4.01 Buffer Solution at 25°C	500ml
500-686	3999960030	pH 6.86 Buffer Solution at 25°C	500ml
500-7	3999960031	pH 7.00 Buffer Solution at 25°C	500ml
500-9	3999960032	pH 9.18 Buffer Solution at 25°C	500ml
500-10	3999960033	pH 10.01 Buffer Solution at 25°C	500ml
500-12	3999960034	pH 12.46 Buffer Solution at 25°C	500ml

Conductivity Standard Solution Kit

Code	Part No.	Description	Volume
503-S	3999960017	Conductivity Standard Solution Kit (84µS/cm, 1413µS/cm, 12.88mS/cm & 111.8mS/cm)	250ml each

Conductivity Standard Solutions

Code	Part No.	Description	Volume
500-21	3999960035	84 µS/cm Conductivity Standard Solution	500ml
500-22	3999960036	1413 µS/cm Conductivity Standard Solution	500ml
500-23	3999960037	12.88 mS/cm Conductivity Standard Solution	500ml
500-24	3999960038	111.8 mS/cm Conductivity Standard Solution	500ml

ORP Powders

Code	Part No.	Description	Volume
160-51	3200043618	89 mV at 25°C (for 250ml solution)	10 sachets/pack
160-22	3200043617	258 mV at 25°C (for 250ml solution)	10 sachets/pack

pH/ORP Electrode Filling Solutions

Code	Part No.	Description	Volume
525-3	3999960023	3.33M KCl	250ml
300	3200043640	3.33M KCl	250ml

pH Electrode Cleaning Solutions

Code	Part No.	Description	Volume
220	3014028653	For removing inorganic residues from glass membrane and liquid junction	2 x 50ml
230	3200530494	For removing inorganic and organic residues from glass membrane (30ml Solution A & 100ml Solution B)	30ml & 100ml
250	3200366771	For removing protein residues from glass membrane and liquid junction	400ml



Calcium Ion Electrode Solutions



Chloride Ion Electrode Solutions



Fluoride Ion Electrode Solutions



Potassium Ion Electrode Solutions



Ammonia Ion Electrode Solutions



Nitrate Ion Electrode Solutions

Ion Standard Solutions

Code	Part No.	Description	Volume
500-NH4-SH	3200697171	1000 mg/L Ammonium Ion Standard Solution	500ml
500-NH4-SL	3200697172	100 mg/L Ammonium Ion Standard Solution	500ml
500-CA-SH	3200697175	1000 mg/L Calcium Ion Standard Solution	500ml
500-CA-SL	3200697176	100 mg/L Calcium Ion Standard Solution	500ml
500-CL-SH	3200697167	1000 mg/L Chloride Ion Standard Solution	500ml
500-CL-SL	3200697168	100 mg/L Chloride Ion Standard Solution	500ml
500-F-SH	3200697163	1000 mg/L Fluoride Ion Standard Solution	500ml
500-F-SL	3200697164	100 mg/L Fluoride Ion Standard Solution	500ml
500-NO3-SH	3200697179	1000 mg/L Nitrate Ion Standard Solution	500ml
500-NO3-SL	3200697180	100 mg/L Nitrate Ion Standard Solution	500ml
500-K-SH	3200697183	1000 mg/L Potassium Ion Standard Solution	500ml
500-K-SL	3200697184	100 mg/L Potassium Ion Standard Solution	500ml

Ionic Strength Adjustors

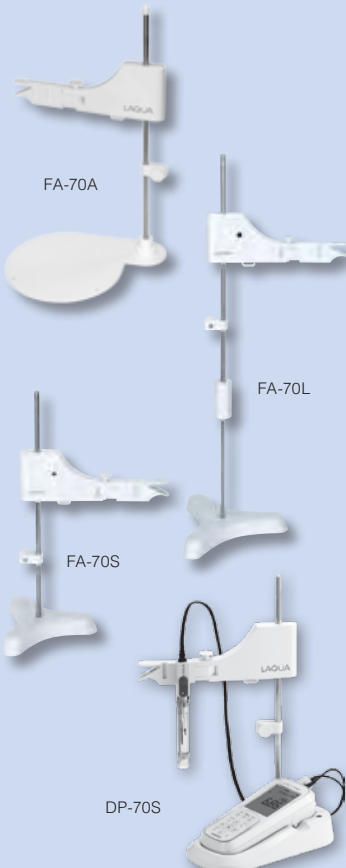
Code	Part No.	Description	Volume
500-NH3-ISA	3200697174	Ammonia Ionic Strength Adjustor	500ml
500-CA-ISA	3200697178	Calcium Ionic Strength Adjustor	500ml
500-CL-ISA	3200697170	Chloride Ionic Strength Adjustor	500ml
500-F-TISAB	3200697166	Fluoride Ionic Strength Adjustor	500ml
500-NO3-ISA	3200697182	Nitrate Ionic Strength Adjustor	500ml
500-K-ISA	3200697186	Potassium Ionic Strength Adjustor	500ml

Ion Selective Electrode Filling Solutions

Code	Part No.	Description	Volume
500-NH3-IFS	3200697173	Ammonia Electrode Filling Solution	500ml
500-CA-IFS	3200697177	Calcium Electrode Filling solution	500ml
500-CL-IFS	3200697169	Chloride Electrode Filling Solution	500ml
500-F-IFS	3200697165	Fluoride Electrode Filling Solution	500ml
500-NO3-IFS	3200697181	Nitrate Electrode Filling Solution	500ml
500-K-IFS	3200697185	Potassium Electrode Filling Solution	500ml

Accessories

Code	Part No.	Description
FA-70A	3200644455	Integrated Electrode Stand (Height: 338mm) for bench meter
FA-70S	3200382557	Adjustable, free-standing electrode stand (Height: 384 mm)
FA-70L	3200382560	Long, free-standing electrode stand (Height: 450-650mm)
DP-70S	3200528474	Electrode stand for 100 Series and D-70, ES-70, OM-70 Series handheld meters (Height: 400mm)
	3200373991	Arm for electrode stand FA-70A, FA-70S, & FA-70L
	3200373961	Electrode holders, 2pcs (for mounting electrode with round cap on electrode stand arm)
	3200382477	Electrode protection caps, 3pcs (for 9615S-10D, 9618S-10D, 9681S-10D pH electrode)
	3200043508	Electrode protection caps, 5pcs (for 9621-10D, 9625-10D, 9630-10D, 9631-10D, 9632-10D, 6367-10D, 6377-10D, 6252-10D, 6261-10C, 1066A-10C, 1076-10C, 2060-10T, 9300-10D, 9382-10D, 3552-10D pH electrode)
	3200382482	Electrode protection cap for long electrode (for 9680S-10D, 9480-10C pH Electrode)



Water Quality Analyzers

With over 60 years of engineering excellence, HORIBA's diverse range of water quality analyzers and electrodes are ideal for everyday laboratory needs through to the most demanding of applications. Visit our website for a wealth of useful information and water quality measurement tips to help you obtain the best results in your work.



Benchtop Meters

Developed using extensive feedback from users, our new LAQUA meters deliver the best solution for water quality analysis. Our LAQUA website features an online 'Selection Guide' to enable you to find the perfect LAQUA meter and electrode for your need.



Handheld Meters

In the lab, in the field or anywhere you need it. LAQUA Handheld meters are designed for use with one hand and with an IP67 waterproof rating and shock-resistant casing. Meters can be used for long periods, even in dark places, making it ideal for field measurements in rivers and lakes.



Pocket Meters

Analyzing water quality is simplified when using our LAQUAtwin range of meters. Designed to produce accurate and reliable results. Anyone, anywhere, at any time can measure samples easily with a LAQUAtwin meter. See just how good they are at our website.



Application Notes

LAQUAtwin pocket meters offer quick and convenient alternative to analyze important parameters with high accuracy. Several application notes are available at (<http://goo.gl/znwE6j>) detailing the use of LAQUAtwin and the results achieved for the respective applications. Additional application notes will be added when available.