



## Ion-selective Measurements

Ion-selective measurement is a method for determining the concentration of dissolved ions. Potassium ions, sodium ions, fluoride or chloride are examples of such cations and anions that are directly measured in solutions. Indirect methods such as titration allow the determination of aluminum, nickel ions, or sulfate.

Measurement with ISEs, like the measurement of pH, is a potentiometric method. ISEs are in two configurations:

1. Separate ion-selective electrode and reference electrode
2. Combined ion-selective electrode with built-in reference electrode

The ion-selective membrane of the electrode consists of a sparingly soluble salt of the ion to be measured (solid state electrodes), a PVC-membrane, modified by an ion exchanger or ion carrier (matrix electrodes), glass (glass electrode) or a gas-permeable plastic (gas-sensitive electrodes). The activity of the ions to be measured determines the electrode voltage. With increasing activity of the anions the voltage turns more negative; with increasing activity of cations, more positive. A pH/ISE meter uses the electrode signal to calculate the concentration of the sample.

The wide range of possible applications include the measurement of fluoride concentration according to DIN 38405-4. Chloride content determination in concrete samples or nitrate concentration determination in fruit juices are further examples of the ways in which ion-selective measurement technology can be applied.

An introduction to ion-selective measurement technology, as well as application reports, are available on our CD-ROM entitled "Principles of measurement technology".

Determination of	Application
Lead (Pb <sup>2+</sup> )	Soil samples
Bromide (Br <sup>-</sup> )	Wine, plants
Cadmium (Cd <sup>2+</sup> )	Soil samples
Calcium (Ca <sup>2+</sup> )	Dairy products
Chloride (Cl <sup>-</sup> )	Drinking water, food
Cyanide (CN <sup>-</sup> )	Electroplating baths
Fluoride (F <sup>-</sup> )	Toothpaste, cement
Iodide (I <sup>-</sup> )	Saltwater
Potassium (K <sup>+</sup> )	Wine, fertilizer
Copper (Cu <sup>2+</sup> )	Electroplating baths
Sodium (Na <sup>+</sup> )	Wine, boiler feed water
Nitrate (NO <sub>3</sub> <sup>-</sup> )	Baby food, fertilizer, wastewater
Silver (Ag <sup>+</sup> )	Electroplating baths
Sulfide (S <sup>2-</sup> )	Proteins, sediments

## Application Range Ion-selective Measurements

● Recommended by WTW      ○ Suitable

Application Range	inoLab®	Portable meters
	pH/ION 7320	pH/ION 340i/3400i*, Multi 350i/3500i*
Occasional, simple ISE measurement	○	●
Routine and standard measurement	●	○
Advanced methods and procedures	●	-
<i>see page</i>	49	22, 51

## Laboratory ISE Benchtop Meters

### Reliable documentation of ISE measurements...

... with the inoLab® pH/ION 7320

The new inoLab® pH/ION 7320 is ideal for precision measurements and automatic documentation acc. to GLP/ AQA in quality laboratories for all branches. Optional available with built-in printer.

### inoLab® pH/ION 7320\*\*

- 2-channel instrument for simultaneous measuring of pH, ISE or Redox
- Data transfer via USB interface
- For fast data transfer in .csv format or via the optional integrated printer
- CMC function for monitoring the measuring range for pH and ISE measurements

\* North American version

\*\* available in Q4/2012



Parameter

Multi-parameter

pH

ORP

ISE

Dissolved Oxygen (D.O.)

Conductivity

Data logger/flow + level

BOD/Respiration

Photometers

Turbidity

Colony Counter

Software/Printers

### Measuring stability

- Repeatable measuring results through active, automatic and stable measuring values
- The CMC function for pH and ISE visualizes the ideal measuring range and supports correct measuring.
- Graphic display with text menu for convenient handling

### Documentation acc. to GLP/AQA

- Alphanumeric entry of electrode serial number
- Transfer of all data in .csv format via USB interface to PC, a formatted transfer to Excel is also possible (MultiLab® Importer software, included in the delivery scope or available as download).
- Data can be printed directly from the instrument via the optional integrated printer.

### Flexile and high-performing:

- 1 to 5 point calibration for pH
- 1 to 7 point calibration for ISE, also non-linear
- Blank value correction, increment methods: known addition, known subtraction, sample addition, sample subtraction, double known addition
- Value of concentration for different units
- Selectable AutoRead criterion
- DIN- or BNC model
- Backlit graphic display with CMC

Technical Data	
Model	pH/ION 7320
Range/ Resolution	pH -2.000 ... +20.000 pH
	mV -999.9 ... +999.9 mV -2000 ... +2000 mV
Temperature	-5 ... +105 °C / 0,1 °C (23.0 ... 221 °F)
Concentration	0.000 ... 10.000 mg/l
	0.00 ... 100.00 mg/l
	0.0 ... 1000.0 mg/l
	0 ... 2000 mg/l
Accuracy (±1 digit)	pH ±0.004 pH ±0.01 pH
	mV ±0.2 mV, ±1 mV
	Temperature ±0.1 K
Calibration	<b>MultiCal® automatic calibration:</b> AutoCal 2-/3-/4-/5-point AutoCal-Tec 2-/3-/4-/5-point ConCal® 1-/2-point ISECal 2- bis 7-point Special functions: Known addition (single) Known subtraction Sample addition Sample subtraction Blank value addition Known addition with Blank value correction



Ordering Information		□ Order No.	▲ Order No.
<b>inoLab® Laboratory ISE Meter SETs</b>			
inoLab® pH/ION 7320	Precise and convenient pH/mV/ISE benchtop meter for measurements/documentation according GLP/AQA, with dual channel input. Single instrument with universal power supply, stand and operation manual, software and USB cable.	1GA340	1GA330
inoLab® pH/ION 7320P	Precise and convenient pH/mV/ISE benchtop meter for measurements/documentation according GLP/AQA, with dual channel input, with integrated thermal printer. Single instrument with universal power supply, stand and operation manual, software and USB cable.	1GA340P	1GA330P



□ with BNC plug ▲ with DIN plug

# Portable ISE Meter

## pH/ION 340i/3400i\*

- Handy, waterproof
- Up to 1500 hours continuous operation
- GLP

### pH, mV and ISE measurements in one hand

The pH/mV and ISE meter pH/ION 340i/3400i\* offer the highest degree of flexibility possible. For pH measurements the instrument can be calibrated manually or automatically and offers simultaneous display of pH and temperature. For measurements with ion-selective electrodes the pH/ION 340i/3400i\* offers concentration display in mg/l. Direct display in mV to  $\pm 999.9$  mV in 0.1 mV steps; and to  $\pm 1999$  mV in 1 mV steps.

Even in these higher ranges the concentration is calculated from a mV resolution of 0.1 mV. Calibration is carried out with up to three standards (selected from 16 standards in the range of 0.01 to 1000 mg/l).

The instrument can be used in-the-lab or in-the-field, operating on either AC power or rechargeable battery for up to 1500 hours, with convenient "LoBat" warning.



Lightweight and compact, these robust meters are both waterproof and submersible to IP 66/67.

The built-in data logger for up to 500 measurements together with GLP calibration protocol offer a comprehensive system for documenting results. With analog or digital data transfer (RS 232), automatic recognition of stable measurements (AutoRead), electrode evaluation and calibration interval monitoring functions ensure reproducible and comprehensible measurements.

## Technical Data

Model	pH/ION 340i/3400i*	
Range/Resolution	pH	-2.000 ... +19.999 pH
	mV	-999.9 ... +999.9 mV
		-1999 ... +1999 mV
	Temperature	-5 ... +105 °C/0.1 °C (23.0 ... 221 °F)
	Concentration	0.01 ... 1999 mg/l
Accuracy (±1 digit)		±0.003 pH ±0.01 pH ±0.2 mV, ±1 mV ±0.1 K
Calibration	MultiCal® automatic calibration:	
	AutoCal	2-point
	AutoCal-Tec	2-point
	ConCal®	1-/2-point
	ISECal	2-/3-point

## Ordering Information

Portable ISE Meter		Order No.
pH/ION 340i/3400i*	Robust and waterproof portable ISE meter with data logger and serial interface	2G30-100
Universal power supply	100 V - 240 V, 50-60 Hz; for 340i series	902 867



\* North American version

# Ion-selective Electrodes

WTW offers a complete range of ion-selective electrodes for challenging ISE applications. Choose between two types: the 500 Series half cells, which require a separate reference electrode, or the 800 Series combination electrodes.

## 500 Series

The 500 Series half cells require a separate reference electrode (exception: the Ammonia electrode NH 500/2 contains an integrated reference electrode).



### Half Cells Series 500

Electrode type	Mem-brane <sup>②</sup>	Determinable ions	Half cell, reference electrode necessary:	Measuring range	Bridge electrolyte	Ionic strength adjustment solution	Standard solution (Conc. 10 g/l)	pH range
Ammonia (NH <sub>4</sub> <sup>+</sup> )		Ammonia	NH 500/2	0.02...900 mg/l 10 <sup>-6</sup> ...5 x 10 <sup>-2</sup> mol/l	—	MZ/NH <sub>3</sub> /CN	ES/NH <sub>4</sub>	4-12
Lead (Pb <sup>2+</sup> )	S	Lead	Pb 500	0.2 ... 20000 mg/l 10 <sup>-6</sup> ... 10 <sup>-1</sup> mol/l	ELY/BR/503	ISA/FK	ES/Pb	4-7
Bromide (Br <sup>-</sup> )	S	Bromide	Br 500	0.4 ... 79000 mg/l 5 x 10 <sup>-6</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	ES/Br	1-12
Cadmium (Cd <sup>2+</sup> )	S	Cadmium	Cd 500	0.01 ... 11000 mg/l 10 <sup>-7</sup> ... 10 <sup>-1</sup> mol/l	ELY/BR/503	ISA/FK	—	2-8
Calcium (Ca <sup>2+</sup> )	L	Calcium, Magnesium <sup>③</sup>	Ca 500 <sup>④</sup>	0.02 ... 40000 mg/l 5 x 10 <sup>-7</sup> ... 1 mol/l	ELY/BR/503	ISA/Ca	ES/Ca	2,5-11
Chloride (Cl <sup>-</sup> )	S	Chloride	Cl 500	2 ... 35000 mg/l 5 x 10 <sup>-5</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	ES/Cl	2-12
Cyanide (CN <sup>-</sup> ) <sup>⑤</sup>	S	Cyanide	CN 500	0,2 ... 260 mg/l 8 x 10 <sup>-6</sup> ... 10 <sup>-2</sup> mol/l	ELY/BR/503	MZ/NH <sub>3</sub> /CN	—	0-14
Fluoride (F <sup>-</sup> )	S	Fluoride, Aluminum Phosphate <sup>⑥</sup> , Lithium <sup>⑥</sup>	F 500	0.02...sat. mg/l 10 <sup>-6</sup> ...sat. mol/l	ELY/BR/503	TISAB	ES/F	5-7
Iodide (I <sup>-</sup> )	S	Iodide, Thiosulfate Mercury	I 500	0.006 ... 127000 mg/l 10 x 10 <sup>-8</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	ES/I	0-14
Potassium (K <sup>+</sup> ) <sup>⑤</sup>	L	Potassium	K 500 <sup>④</sup>	0.04 ... 39000 mg/l 10 <sup>-6</sup> ... 1 mol/l	ELY/BR/503/K	ISA/K	ES/K	2-12
Copper (Cu <sup>2+</sup> )	S	Copper, Nickel <sup>⑥</sup>	Cu 500	0.0006 ... 6400 mg/l 10 <sup>-8</sup> ... 10 <sup>-1</sup> mol/l	ELY/BR/503	ISA/FK	ES/Cu	2-6
Sodium (Na <sup>+</sup> ) <sup>⑤</sup>	G	Sodium	DX 223 NA	0.05 ... 23000 mg/l 2 x 10 <sup>-6</sup> ... 1 mol/l	—	ISA/Na	ES/Na	>10
Nitrate (NO <sub>3</sub> <sup>-</sup> ) <sup>⑤</sup>	L	Nitrate	NO 500 <sup>④</sup>	0.4 ... 62000 mg/l 7 x 10 <sup>-6</sup> ... 1 mol/l	ELY/BR/503/N	TISAB/NO <sub>3</sub>	ES/NO <sub>3</sub>	2,5-11
Silver (Ag <sup>+</sup> ) <sup>⑤</sup>	S	Silver	Ag/S 500	0.01 ... 108000 mg/l 10 <sup>-7</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	—	2-12
Sulfide (S <sup>2-</sup> ) <sup>⑤</sup>	S	Sulfide	Ag/S 500	0.003 ... 32000 mg/l 10 <sup>-7</sup> ... 1 mol/l	ELY/BR/503	④	—	2-12

① Exchange measuring head

② S = solid state electrode, L = matrix electrode, G = glass electrode

③ Titration

④ Use according to operating instructions

⑤ Formulations for additionally required solutions are given in the application steps and operating instructions

*For ordering information for ISE electrodes and accessories, see WTW Product Details.*

## 800 Series

These combination electrodes with built-in reference are easy-to-use, and offer the option of measuring in small volume samples. Plus, they have an out-standing price performance ratio.



### Combined ISE Electrodes Series 800

Electrode type	Mem-bran <sup>①</sup>	Determinable ions	Built-in reference electrode	Measuring range	Bridge electrolyte	Ionic strength adjustment solution	Standard solution (Conc. 10 g/l)	pH range
Lead (Pb <sup>2+</sup> )	S	Lead	Pb 800	0.2 ... 20000 mg/l 10 <sup>-6</sup> ... 10 <sup>-1</sup> mol/l	ELY/BR/503	ISA/FK	ES/Pb	4-7
Bromide (Br <sup>-</sup> )	S	Bromide	Br 800	0.4 ... 79000 mg/l 5 x 10 <sup>-6</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	ES/Br	1-12
Cadmium (Cd <sup>2+</sup> )	S	Cadmium	Cd 800	0.01 ... 11000 mg/l 10 <sup>-7</sup> ... 10 <sup>-1</sup> mol/l	ELY/BR/503	ISA/FK	—	2-8
Calcium (Ca <sup>2+</sup> )	L	Calcium, Magnesium <sup>②</sup>	Ca 800 <sup>③</sup>	0.02 ... 40000 mg/l 5 x 10 <sup>-7</sup> ... 1 mol/l	ELY/BR/503	ISA/Ca	ES/Ca	2,5-11
Chloride (Cl <sup>-</sup> )	S	Chloride	Cl 800	2 ... 35000 mg/l 5 x 10 <sup>-5</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	ES/Cl	2-12
Cyanide (CN <sup>-</sup> ) <sup>④</sup>	S	Cyanide	CN 800	0.2 ... 260 mg/l 8 x 10 <sup>-6</sup> ... 10 <sup>-2</sup> mol/l	ELY/BR/503	MZ/NH <sub>3</sub> /CN	—	0-14
Fluoride (F <sup>-</sup> )	S	Fluoride, Aluminum Phosphate <sup>⑤</sup> , Lithium <sup>⑥</sup>	F 800	0.02...sat. mg/l 10 <sup>-6</sup> ...sat. mol/l	ELY/BR/503	TISAB	ES/F	5-7
Iodide (I <sup>-</sup> )	S	Iodide, Thiosulfate Mercury	I 800	0.006 ... 127000 mg/l 10 x 10 <sup>-8</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	ES/I	0-14
Potassium (K <sup>+</sup> ) <sup>⑦</sup>	L	Potassium	K 800 <sup>⑧</sup>	0.04 ... 39000 mg/l 10 <sup>-6</sup> ... 1 mol/l	ELY/BR/503/K	ISA/K	ES/K	2-12
Copper (Cu <sup>2+</sup> )	S	Copper, Nickel <sup>⑨</sup>	Cu 800	0.0006 ... 64000 mg/l 10 <sup>-8</sup> ... 10 <sup>-1</sup> mol/l	ELY/BR/503	ISA/FK	ES/Cu	2-6
Nitrate (NO <sub>3</sub> <sup>-</sup> ) <sup>⑩</sup>	L	Nitrate	NO 800 <sup>⑪</sup>	0.4 ... 62000 mg/l 7 x 10 <sup>-6</sup> ... 1 mol/l	ELY/BR/503/N	TISAB/NO <sub>3</sub>	ES/NO <sub>3</sub>	2,5-11
Silver (Ag <sup>+</sup> ) <sup>⑫</sup>	S	Silver	Ag/S 800	0.01 ... 108000 mg/l 10 <sup>-7</sup> ... 1 mol/l	ELY/BR/503	ISA/FK	—	2-12
Sulfide (S <sup>2-</sup> ) <sup>⑬</sup>	S	Sulfide	Ag/S 800	0.003 ... 32000 mg/l 10 <sup>-7</sup> ... 1 mol/l	ELY/BR/503	⑭	—	2-12

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