



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 which are directly measured in solutions. Indirect methods such as – titration allow the determination of aluminum, nickel ions, or sulfate.

Measurement with ISE's, like the measurement of pH, is a potentiometric method. ISE's 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 current. With increasing activity of the anions the voltage turns more negative, with increasing activity of cations, more positive. A pH/ionmeter uses the electrode signal to calculate the concentration of the sample.

The wide range of possible applications includes, for example, the measurement of fluoride concentration according to DIN 38 405. 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 ²⁺)	Soil samples
Bromide (Br ⁻)	Wine, plants
Cadmium (Cd ²⁺)	Soil samples
Calcium (Ca ²⁺)	Dairy products
Chloride (Cl ⁻)	Drinking water, foodstuffs
Cyanide (CN ⁻)	Electroplating baths
Fluoride (F ⁻)	Toothpaste, cement
Iodide (I ⁻)	Salt water
Potassium (K ⁺)	Wine, fertilizer
Copper (Cu ²⁺)	Electroplating baths
Sodium (Na ⁺)	Wine, boiler feed water
Nitrate (NO ³⁻)	Baby food, fertilizer, wastewater
Silver (Ag ⁺)	Electroplating baths
Sulfide (S ²⁻)	Proteins, sediments

Ion-Selective Electrodes

WTW offers a complete range of ion selective electrodes and measuring instruments; you can choose between two types: Half cells of the 500 series which require a reference electrode from the R 503 type (an exception is the gas sensitive NH 500/2 which has a built-in reference electrode), or the combination electrodes from the 800 series.

These combination electrodes with built-in reference are excellent in handling and additionally offer the possibility to measure in small volumina. More over this they have an outstanding price performance ratio.



Applications for Ion-selective and Gas-sensitive Electrodes

Electrode type	Membrane ^②	Determinable ions	ISE Type 500 (Half cell, reference electrode necessary)	Reference electrode	combined ISE Type 800 (built-in reference electrode)	Measuring range	Bridge electrolyte	Ionic strength adjustment solution	Standard solution (conc. 10 g/l)	pH range
Ammonia (NH ₄ ⁺)		Ammonia	NH 500/2	—	—	0,02...900 mg/l 10 ⁻⁶ ...5 x 10 ⁻² mol/l	—	MZ/NH ₃ /CN	ES/NH ₄	4-12
Lead (Pb ²⁺)	S	Lead	Pb 500	For all ion selective electrodes from the 500 series: ↑	Pb 800	0,2...20000 mg/l 10 ⁻⁶ ...10 ⁻¹ mol/l	ELY/BR/503	ISA/FK	ES/Pb	4-7
Bromide (Br ⁻)	S	Bromide	Br 500		Br 800	0,4...79000 mg/l 5 x 10 ⁻⁶ ...1 mol/l	ELY/BR/503	ISA/FK	ES/Br	1-12
Cadmium (Cd ²⁺)	S	Cadmium	Cd 500		Cd 800	0,01...11000 mg/l 10 ⁻⁷ ...10 ⁻¹ mol/l	ELY/BR/503	ISA/FK	—	2-8
Calcium (Ca ²⁺)	L	Calcium, Magnesium ^③	Ca 500 ^①		Ca 800 ^①	0,02...40000 mg/l 5 x 10 ⁻⁷ ...1 mol/l	ELY/BR/503	ISA/Ca	ES/Ca	2,5-11
Chloride (Cl ⁻)	S	Chloride	Cl 500		Cl 800	2...35000 mg/l 5 x 10 ⁻⁵ ...1 mol/l	ELY/BR/503	ISA/FK	ES/Cl	2-12
Cyanide (CN ⁻) ^④	S	Cyanide	CN 500	R 503/P (2 mm pin plug) or R 503 D (4 mm banana plug)	CN 800	0,2...260 mg/l 8 x 10 ⁻⁶ ...10 ⁻² mol/l	ELY/BR/503	MZ/NH ₃ /CN	—	0-14
Fluoride (F ⁻)	S	Fluoride, Aluminum Phosphate ^⑤ , Lithium ^⑤	F 500		F 800	0,02...sat. mg/l 10 ⁻⁶ ...sat. mol/l	ELY/BR/503	TISAB	ES/F	5-7
Iodide (I ⁻)	S	Iodide, Thiosulfate Mercury	I 500	I 800	0,006...127000 mg/l 10 x 10 ⁻⁸ ...1 mol/l	ELY/BR/503	ISA/FK	ES/I	0-14	
Potassium (K ⁺) ^⑤	L	Potassium	K 500 ^⑥	K 800 ^①	0,04...39000 mg/l 10 ⁻⁶ ...1 mol/l	ELY/BR/503/K	ISA/K	ES/K	2-12	
Copper (Cu ²⁺)	S	Copper, Nickel ^⑤	Cu 500	Cu 800	0,0006...6400 mg/l 10 ⁻⁸ ...10 ⁻¹ mol/l	ELY/BR/503	ISA/FK	ES/Cu	2-6	
Sodium (Na ⁺) ^⑤	G	Sodium	DX 223 NA		0,05...23000 mg/l 2 x 10 ⁻⁶ ...1 mol/l	—	ISA/Na	ES/Na	>10	
Nitrate (NO ₃ ⁻) ^⑤	L	Nitrate	NO 500 ^①	NO 800 ^①	0,4...62000 mg/l 7 x 10 ⁻⁶ ...1 mol/l	ELY/BR/503/N	TISAB/NO ₃	ES/NO ₃	2,5-11	
Silver (Ag ⁺) ^⑤	S	Silver	Ag/S 500	Ag/S 800	0,01...108000 mg/l 10 ⁻⁷ ...1 mol/l	ELY/BR/503	ISA/FK	—	2-12	
Sulfide (S ²⁻) ^⑤	S	Sulfide	Ag/S 500	Ag/S 800	0,003...32000 mg/l 10 ⁻⁷ ...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

Ordering Information for ISE electrodes and accessories see brochure "Product Details".

Application Range Ion-Selective Measurements

● recommended by WTW

○ suitable

Application Range	inoLab®				Handheld meters
	pH/ION 735	pH/ION 740	pH 740, pH/Cond 740, Multi 740	pH/ION/Cond 750	pH/ION 340i, Multi 350i
Occasional, simple ISE measurement	○	○	●	○	●
Routine and standard measurement	●	●	○	●	○
Advanced methods and procedures	●	●	-	●	-
<i>see page</i>	24	25	13, 50	25, 52	27, 55

Laboratory Ionmeters

inoLab® pH/ION 735

inoLab
innovations that make sense

- Incremental Methods
- Advanced Incremental Methods
- Menu-driven user interface

pH, mV and Concentration Measurements with a single Instrument

Whether routine measurements or demanding analysis: the pH/ION 735 is the ideal precision instrument for all uses. A graphical user interface makes high-resolution pH and ion measurement easy and comfortable. 5-point calibration for pH and up to 7 calibration points for ion measurements guarantees a high-precision measurement by calculating non-linear calibration curves. The Model pH/ION 735 has user defined method capability as well as preprogrammed incremental techniques.

For those who need to document their results: a datalogger with storage for 4,500 entries, bi-directional RS 232 interface, real-time clock, and GLP-supporting calibration protocols, as well as date, time and selectable sample identification number identify all data sets.

This instrument is also available with a built-in printer.



inoLab® pH/ION 740

- Advanced incremental methods
- Free software downloads
- Comprehensive documentation options

flexible and powerful

High-performance pH/mV/ion meter with graphic display and digital recorder function for pH, temperature and ion-selective measurement, automatic temperature compensation, high resolution (0.001 pH), MultiCal® calibration system, built-in measurement storage with GLP-conform documentation and digital interface. PC keyboard interface for connecting an external keyboard or barcode reader, and software for direct control by PC is included. With a built-in printer option available.

inoLab® pH/ION/Cond 750

- Two galvanically isolated pH/mV/ISE inputs
- Menu-operated with back-lit graphic display
- One pH and one ISE calibration record per each input

Premium class from WTW:

Two galvanically isolated inputs allow independent measurements of pH-value, ORP or ion concentration. For accurate measurements along the characteristic curve of the electrode it is possible to carry out calibrations with up to seven standard solutions. The calculation of the calibration curve by using a modified Nikolski algorithm also takes the non-linear parts of the curve in to account. The following methods are used to evaluate the ionic concentration:

- Known addition/known subtraction
- Sample addition/sample subtraction
- Double known addition
- Blank value correction
- Known addition with blank value correction
- Reference measurement

Features

- 5-point pH calibration by linear regression
- Selectable buffer sets
- Graphic evaluation possible
- Built-in digital recorder
- Connection for barcode reader or PC keyboard
- User Selectable Languages
- Multi-Level GLP Functions (password-protected operator levels)
- Free-of-charge downloads for MultiLab® pilot or terminal
- Four to seven point ISE calibration with a modified nikolski algorithm
- Known addition, double-known addition and known subtraction
- Sample addition/subtraction
- Blank value addition



Parameter

pH

ORP

ISE

Oxygen (D.O.)

Conductivity

Multi-parameter

BOD/Respiration

Photometers

Turbidity

Colony Counter

Software/Printers

A further highlight of this instrument is the possibility of conductivity measurement. Not only can specific resistance, salinity, and TDS be determined but also sample specific temperature coefficients. A wide range of additional functions like data administration, PC-operation by MultiLab® pilot, GLP-compliant calibration and data recording allow an easy integration into modern laboratory environment.

For further details see page 52.

Technical Data inoLab® pH/ION 735 and 740

Model		pH/ION 735	pH/ION 740
Range/ Resolution	pH	-2.000 ... +20.000 pH	-2.000 ... +20.000 pH
	mV	-999.9 ... +999.9 mV	-999.9 ... +999.9 mV
Temperature	Conc..	-2000 ... +2000 mV	-2000 ... +2000 mV
		23.0 ... 221 °F (-5 ... +105 °C/0.1 °C)	23.0 ... 221 °F (-5 ... +105 °C/0.1 °C)
Accuracy (±1 digit)		0.000 ... 10.000 mg/l	Measuring range 1 (Resolution): 0,000 ... 9,999 (0,001) mg/l
		0.00 ... 100.00 mg/l	Measuring range 2: 0,00 ... 99,9 (0,01) mg/l
		0.0 ... 1000.0 mg/l	Measuring range 3: 0,0 ... 999,9 (0,1) mg/l
		0 ... 2000 mg/l	Measuring range 4: 0 ... 1999 mg/l
Calibration		±0.004 pH	±0,004 pH
		±0.01 pH	±0,01 pH
AutoCal		±0.2 mV, ±1 mV	±0,2 mV, ±1 mV
		±0.1 K	±0,1 K
AutoCal-Tec	MultiCal® automatic calibration:		MultiCal® automatic calibration:
		2-/3-/4-/5-point	2-/3-/4-/5-point
ConCal®		2-/3-/4-/5-point	2-/3-/4-/5-point
		1-/2-point	1-/2-point
ISECal		2- to 7-point	2- to 7-point
		Special functions:	Special functions:
		Known addition (single)	Known addition (single and double)
		Known subtraction	Known subtraction
		Sample addition	Sample addition
		Sample subtraction	Sample subtraction
		Blank value addition	Blank value addition
		Blank value correction	Blank value correction

Technical Data inoLab® pH/ION/Cond 750

Model		pH/ION/Cond 750
Range/ Resolution	pH	-2 ... 20.000 pH
	mV	-2.00 ... 20.00 pH
Conc. (mg/l)		-999.9 ... +999.9 mV
		-2000 ... +2000 mV
Temperature		0.000 ... 10.000
		0.00 ... 100.00
Accuracy (±1 digit)		0.0 ... 1000.0
		0 ... 2000
Temperature compensation	Automatic	23 ... 221 °F (-5 ... +105 °C)
	Manuell	23.0 ... 221 °F (-5 ... +105 °C)
NTC		23.0 ... 212 °F (-5.0 ... 100 °C)
	Pt 1000	-4 ... 266 °F (-20 ... +130 °C)
Calibration		30 KOhm: ±0.1
		±0.1 K
AutoCal	MultiCal® automatic calibration:	
		2-/3-/4-/5-point
AutoCal-Tec		2-/3-/4-/5-point
		1-/2-point
ConCal®		2- to 7-point
		Special functions:
ISECal		Known addition (single and double)
		Known subtraction
		Sample addition
		Sample subtraction
		Blank value addition, Blank value correction

Ordering Information

inoLab® Laboratory Ionmeters – with wide-range power supply 100-240 VAC (50/60 Hz) included		□ Order No.	▲ Order No.
pH/ION 735P	inoLab® pH/ION 735P with built-in printer for GLP-conform documentation	1G21-210	1G21-110
pH/ION 740P	inoLab® pH/ION 740P with built-in printer for GLP-conform documentation; extended measuring and storage options	1G31-210	1G31-110
pH/ION/Cond 750	Flexible and powerful precision bench-top pH/mV/Ion/conductivity-meter with two inputs, single instrument	1K30-210	1K30-110



□ with BNC plug
▲ with DIN plug

Handheld Ionmeter

pH/ION 340i

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

pH, mV and Concentration Measurements in one Hand

The pH/mV and ionmeter pH/ION 340i offers 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 offers concentration display in mg/l. Direct display in mV to ± 999.9 mV in 0.1 mV steps; and to ± 1999 mV in 1 mV steps.

Of course, 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).

Operating on either line power or rechargeable battery for up to 1500 hours with "LoBat" warning means that the instrument can be used in the Lab or in the field.



Lightweight and compact, these impact meters are IP 66 (hose proof) and IP 67 (submersible).

The built-in datalogger for up to 500 measurements together with GLP calibration protocol offers a comprehensive documentation of the 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	
Range/Resolution	pH	-2.000 ... +19.999 pH
	mV	-999.9 ... +999.9 mV
		-1999 ... +1999 mV
	Temperature	-5 ... +105 °C/0.1 °C
	Conc.	0.01 ... 1999 mg/l
Accuracy (±1 digit)		±0.005 pH ±0.01 pH ±0.3 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

Handheld ionmeter		Order No.
pH/ION 340i	Robust and waterproof handheld ionmeter with datalogger and serial interface	2G30-100
Universal wide-range power supply	100 V - 240 V, 50-60 Hz; for 340i series	902 867

