Meters and Electrodes

pH, ISE, COND AND O_2 | PRECISE - RELIABLE - SELECTIVE
IN LAB AND FIELD

大久生物科技股份有限公司
GRANDEVER BIOTECHNOLOGY CO., LTD.

SI Analytics
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1.1 Meters decision tree

Laboratory meters Lab and ProLab series

	Lab pH meters			Oxygen meter	Lab Conductivity meters		Multifunctional meters		
Parameters		pH	pH + ISE	oxygen	Conductivity	Conductivity	pH/mV + LF + oxygen (D.O. optisch)	pH/mV + LF + ISE + oxygen (D.O. optisch)	pH/mV + LF + ISE + oxygen (D.O.)
Channels		1 channel for pH/mV	1 channel for pH/mV/ISE	1 channel	1 channel	1 channel	1 channel IDS for pH/mV	3 channel IDS for pH/mV or 2 channel IDS +1 channel DIN for ISE	up to 4 channel
Display	LCD display	black/white grafics display	grafics LCD display	grafics LCD display	grafics LCD display	LCD display	black/white grafics display	Color grafics display	TFT display with touch control
Accuracy	0.005 pH	0.005 pH	0.01 pH	+/- 0.5%	+/- 0.5%	+/- 0.5%	dependent of the sensor being used	dependent of the sensor being used	0.005 pH all others +/- 0.5%
Calibration points	3-point	5-point	3-point	1-point	1-point	1-point	5-point	5-point	pH: 3-point all others 1-point
Buffer sets	Autocal with technical or DIN buffer solutions	24 buffer sets	4 buffer sets	Steam saturated air	0.01N KCl oder 0.1N KCl	0.01N KCl	24 buffer sets	24 buffer sets	pH: 21 buffer sets pre-set + 3 free to define
Calibration log								10 data sets calibration log	
Data base		500 data sets man. 5,000 automatical	4,000 data sets	4,000 data sets	4,000 data sets		500 data sets man. 4,500 automatical	500 data sets man. 10,000 automatical	100,000 data sets 48h data log
Data output / Interface		Mini USB slave	4-pin USB	4-pin USB	4-Pol USB		Mini USB slave	Mini USB slave USB 2.0 Host	RS232, Ethernet, USB active
Sensor ID							Sensor ID	Sensor ID	
User ID							User ID	User ID	
Password			Password protection	Password protection	Password protection				Password protection
Instrument	Lab 855	Lab 865	Lab 845	Lab 745	Lab 945	Lab 955	Lab 875 (P)	ProLab 2500	ProLab 5000









*Product pictures are not to scale

Lab and ProLab

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Functionalities at a glance

Laboratory meters Lab and ProLab series

Features	Lab 745	Lab 845	Lab 945	Lab 855	Lab 865	Lab 875	Lab 875 P	ProLab 2500	ProLab 5000
Page	8	8	8	10	10	12	14	16	20
Measuring parameters & special functions									
pH	■	■		■	■	■	■	■	■
Measuring channels (electrically isolated)	1	1	1	1	1	1	1	3	4
4 pre-programmed pH buffer sets		■							
24 pre-programmed pH buffer sets					■	■	■	■	
21 pre-programmed and 3 free defineable pH buffer sets									■
automatic buffer recognition display		■	■	■		■	■	■	■
pH calibration points, max.		3		3	3	5	5	5	3
ConCal: manual calibration with optional buffers		■			■	■	■	■	■
mV		■		■	■	■	■	■	■
ISE		■						■	■
Activation of external burettes in ISE measuring mode									■
Conductivity			■				■	■	■
Oxygen (diss.), optical (ProLab 5000: amperometrical)						■	■	■	■
Temperature - simultaneaous display	■	■	■	■	■	■	■	■	■
GLP and ease of use									
Automatical recognition of IDS sensores						■	■	■	
Automatical user recognition						■	■	■	■
Additional password security	■	■	■			■	■	■	■
Sensor evaluation	■	■	■	■	■	■	■	■	■
Programmable frequency of checks				■	■	■	■	■	■
Display of current calibration data including date / time	■	■	■	■	■	■	■	■	■
Display of calibration history (10 records) incl. date / time					■	■	■	■	
Measurement with stability control					■	■	■	■	
Adjustable resolution of measuring value	■	■	■	■	■	■	■	■	
Display	LCD graphics	LCD graphics	LCD graphics	LCD	LCD	LCD	B/W LCD graphics	QVGA-colour	QVGA-colour
Recording function (Display of measured values)		■							■
Tactile feedback	■	■	■	■	■	■	■	■	■
Data storage	■	■	■		■	■	■	■	■
USB (Slave)		■	■	■	■	■	■	■	■
USB host interface: plug-and-play connection of USB hub, USB printer, USB storage, keyboard, mouse								■	■
Quality and service									
Scope of delivery: • Device, power supply and tripod • Set: plus electrode and buffer	■	■	■	■	■	■	■	■	
IQ and OQ documents available	■	■	■	■	■	■	■	■	■
Applicable for 3 years warranty	■	■	■	■	■	■	■	■	■

1.1.1 Lab 745, Lab 845 and Lab 945

For all applications the right solution

SI Analytics is proud to present the new Lab and ProLab Series of pH, ISE, conductivity, and dissolved oxygen meters and accessories. The Lab and ProLab series of meters are ideal for any scientist looking to compliment their laboratory with reliable, robust and sensitive measurement readings.

For more information please visit our website **www.si-analytics.com.**

User-friendly design for training and routine measurements

Its intuitive operation and robust aluminum housing render the Lab x45 product series perfect for training and routine purposes.

1.1.1.1 Lab 745, Lab 845 and Lab 945

Ordering information

Type No.	Order No.	Description
Lab 745 Set	285206800	Measuring ranges 0.01…20 mg/l DO. Set includes stand, power supply, and DO measuring cell Ox1113T
Lab 845 Set/BL19pH	285206810	Measuring pH, mV, ISE, temp., 3-point-cal., micropr., BNC connection. Set includes stand, power supply, BlueLine 19 pH, and DIN buffers in ampules (6 pieces)
Lab 845 Set/BL25pH	285206820	Measuring pH, mV, ISE, temp., 3-point-cal., micropr., BNC connection. Set includes stand, power supply, BlueLine 25 pH, and DIN buffers in ampules (6 pieces)
Lab 845 Set/BL29pH	285206830	Measuring pH, mV, ISE, temp., 3-point-cal., micropr., BNC connection. Set includes stand, power supply, BlueLine 29 pH, and DIN buffers in ampules (6 pieces)
Lab 845 Set/TL29pH	285206870	Measuring pH, mV, ISE, temp., 2-point-cal., micropr., BNC connection. Set includes stand, power supply, BlueLine 29 pH, and DIN buffers in ampules (6 pieces)
Lab 945 Set/LF435T	285206840	Measuring ranges 0.000 µS/cm…500 mS/cm, salinity, total dissolved solids (TDS), temperature. Set includes stand, power supply, cond. cell LF435T, and cond. testing solution in ampules (6 pieces)
Lab 945 Set/LF513T	285206850	Measuring ranges 0.000 µS/cm…500 mS/cm, salinity, total dissolved solids (TDS), temperature. Set includes stand, power supply, cond. cell LF513T, and cond. testing solution in ampules (6 pieces)
Lab 945 Set/LF613T	285206860	Measuring ranges 0.000 µS/cm…500 mS/cm, salinity, total dissolved solids (TDS), temperature. Set includes stand, power supply, cond. cell LF613T, and cond. testing solution in ampules (6 pieces)
Z 611	285206380	Connector, stand, and electrode holder for Lab 745/845/945
Z 612	285206390	Universal power supply for Lab 745/845/945
Z 613	285206400	USB cable with data transfer software for Lab 745/845/945
Z 614	285206430	Rubber pads for Lab 745/845/945 (4pcs)
Ox 1113T	285206410	Membrane covered amperometric sensor, plastic shaft, with temperature compensation, 1 m fixed cable with 8-pole plug, length 120 mm, 12 mm Ø, -5...+45 °C
LF 435T	285206420	4 pole cell, plastic shaft, 1.5 m cable with 8 pole plug, sensor material graphite, cell constant 0.33 cm^{-1}, temp.-sensor NTC30kOhm, length 120 mm, 12 mm Ø, -5...+80 °C
Z 615	285206440	Maintenance set for Ox1113T (3 x exchange heads, 10 x electrolytes)
Z 616	285206450	Cable for connecting a RS232 printer to Lab 745/845/945

Technical data

Lab 745 DO Meter

Measuring range	0 ... 200 %; 0 ... 20 mg/l; temperature: -10 ... 100 °C
Resolution	1 %; 0.01 mg/l; 0.1 °C
Temperatur compensation	Automatic with NTC30kOhm or fixed temperature
Accuracy	±1 digit, ± 0.5 % of the measuring range, T [°C] ± 0.1 (5…50 °C)
Connectors	8-pole sensor socket, 4-pole USB interface socket
Calibration	Direct input
	Temperature offset
	Single-point
	Automatic
Data storage	4.000 Entries with date, time, value 1+2 and temperature

Lab 845 pH Meter

Measuring range	pH: -2 ... 16; - 1,999 ... 1,999 mV;
	Temperature: -10 ... 100 °C
	ISE: 0 ... 30,000 ppm
Resolution	0.01 pH; 1 mV; 0.1 °C
Accuracy	pH: ± 0.01 (± 2 pH around calibration point), U [mV] ± 0.3, T [°C] ± 0.1 (0..100 °C)
Temperature compensation	automatic with Pt1000 or fix temperature
Connectors	BNC, 2 x banana socket (4 mm), 4-pole USB Interface socket
Calibration	Direct input
	Temperature offset
	Three-point
	Automatic (DIN19266, TechDIN19267, Merck, Mettler)
Data storage	4.000 Entries with date, time, value 1+2 and temperature

Lab 945 Conductivity Meter

Measuring range	0 ... 200 µS/cm; 0 ... 2,000 µS/cm; 0 ... 20 mS/cm; 0 ... 500 mS/cm;
	Automatic range
	TDS: 0 ... 200 mg/l; 0 ... 2,000 mg/l; 0 ... 20 g/l; 0 ... 500 g/l
	Salinity: 0 ... 70 (after IOT)
	Temperature: -10 ... 100 °C
Resolution	0.1 µS; 1 µS; 0.01 mS; 0.1 mS; 0.1 °C
Accuracy	±1 digit, ± 0.5 % of the measuring range, T [°C] ± 0.1 (5…50 °C)
Temperature compensation	Automatic with NTC30kOhm or fixed temperature
Connectors	8-pol sensor socket, 4-pole USB interface socket
Calibration	Direct input
	Temperature offset
	Single-Point
	Automatic
Data storage	4.000 Entries with date, time, value 1+2 and temperature

For all:

Display	Graphic LCD Display, 128 x 64 pixel, backlid
Interface	USB, isolated
Ambient temperature	-10 ... 55 °C
Housing protection	Aluminum IP40
Dimensions	145 x 185 x 55 mm (L x W x H)
Weight	Approximatly 1 lb 9 oz (incl. power supply and stand)
EMC	Acc. EN 61326 class B

1.1.2 Lab 855, Lab 865 and Lab 955

Precise. Reliable. Selective.

The Lab 855, Lab 865, and Lab 955 unite the most modern measuring technology available along with new functionality such as AutoRead and CMC (measuring range monitoring) wich makes lab measurements even more reliable.

The newly designed, clearly structured keyboards are adapted to operators' logic with tactile feedback as well as large, easy-to-read displays wich are used to support and enhance the interface between the meter and the user.

pH Cond

Precise measurements …

… with Lab 855 and Lab 955

pH

Reliable documentation …

… with Lab 865

Precise measurements...

... with Lab 855 and Lab 955.

pH LF

Modern meters for everybody who wants to simply measure accurately.

The Lab 855 for pH and Lab 955 for conductivity measurements are perfectly suited benchtop meters for measurements in laboratories in the chemical and pharmaceutical industries as well as in medical labs.

Precise measurements
Users achieve reproducible measured results due to the active automatic AutoRead function with independent detection of stable measuring values. An adjustable calibration timer assists in an increased improvement of the accuracy.

Easy to operate
The user-friendly keyboard with large, easy to read LCD display, deliver all relevant information at a glance.

Type No.	Order No.	Description
Lab 855 Set	285206700	Simple, easy-to-use pH/mV benchtop meter (DIN) with universal power supply, stand and operating instructions, pH electrode BlueLine 14 pH, buffer solutions, 3 mol/l electrolite solution.
Lab 955 Set	285206760	Simple, easy-to-use conductivity benchtop meter. Set includes conductivity measuring cell, device with universal power supply, stand, 4-pole graphite cell LF413T, and 0.01 mol/l KCl conductivity standard.

- Reproducible measuring results with active AutoRead function
- Simple calbration with adjustable calibration timer
- Intuitive operation with clearly arranged keyboard

Benefits
Lab 855 / Lab 955

Lab and ProLab

Reliable documentation...

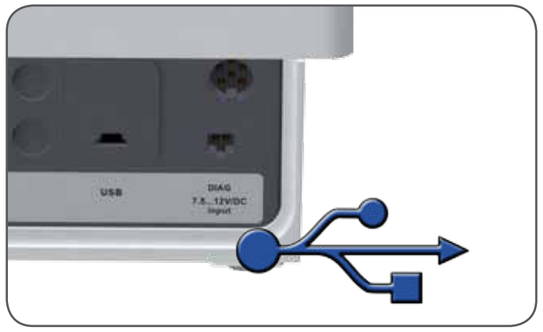
... with Lab 865

pH

Precise measurements with documentation

Lab 865

- USB interface for rapid data transfer



Data output in *.csv format

The Lab 865 is perfect for pH measurements in quality assurance labs requiring the documentation for GLP. Built on the Lab 855 platform, the Lab 865 offers additional convenient functionality.

Modern documentation via USB

Transmission of measured values or other data to PCs is possible via the modern USB interface. Automatic recording of measured values enables the time-controlled data logger. Protocols including date, time and ID numbers support the good laboratory practice as well as the possibility to enter the sensor's serial number. Measurement data is transmitted in * .csv format. A supplied Excel add-in is used for the formatted output of all data and calibration protocols.

Type No.	Order No.	Description
Lab 865 Set	285206710	Measuring parameters pH, mV, temp., 5-point-cal., micropr., Mini USB-B, data storage, DIN 19262 connect. Including stand, power supply, pH-temp. comb. electrode BlueLine 14 pH, calibr. solutions.

CMC function

Also available as application set incl. sensor, power supply and stand..

Easy to use

Graphic display with text menu for easy handling.

pH measurement on sight

Optimize measuring results: With the new CMC function to monitor the congruency of measuring and calibration
range for pH.

Benefits
Lab 865

1.1.2.1 Lab 855, Lab 865 und Lab 955

Connectivity

Lab 855

Lab 865

Lab 955

Technical data

Model	Lab 855	Lab 865	Lab 955
Temperature compensation	Automatic/manual	Automatic/manual	Automatic, can be switched off
Calibration points	1 to 3	1 to 5	1
Calibration records	1	10	1
Calibration timer	■	■	■
Memory entries	500/5000*		
Interface	Mini USB-B		
GLP/AQS supporting	■		
Display	LCD	Graphic b/w, backlit	LCD
Electrode connection	DIN	DIN	8-pin
Additional		CMC, input of sensor serial number	
Power supply	Battery or universal power supply	Battery or universal power supply	Battery or universal power supply
pH	– 2.0 … 20.0 ± 0.1 pH – 2.00 … 20.00 ± 0.01 pH – 2.000 … 19.999 ± 0.005 pH	– 2.0 … 20.0 ± 0.1 pH – 2.00 … 20.00 ± 0.01 pH – 2.000 … 19.999 ± 0.005 pH	
mV	± 1200.0 ± 0.3 mV ± (2000 ± 1) mV	± 1200.0 ± 0.3 mV ± (2500 ± 1) mV	
Temperature	– 5.0 … 105.0 °C ± 0.1 °C	– 5.0 … 105.0 °C ± 0.1 °C	
CMC		■	
Conductivity			0.00 … 1000 mS/cm ± 0.5 % of meas. val. 0.000 … 1.999 µS/cm, K = 0.01 cm^{-1} 0.000 … 1.999 µS/cm, K = 0.01 cm^{-1} 0.00 … 19,99 µS/cm, K = 0.1 cm^{-1}
Specific resistance			0.00 … 199.9 MΩcm
Cell constants fix			0.01 cm^{-1}
with calibration			0.450 … 0.500 cm^{-1} 0.800 … 0.880 cm^{-1}
adjustable			0.090 … 0.110 cm^{-1} 0.250… 2.500 cm^{-1}
Salinity			0.0 … 70.0 (nach IOT)
TDS			1 … 1999 mg/l
Temperature			-5.0 … 105.0 °C ± 0.1 °C
T_{ref}			20 °C/25 °C
Temperature compensation			none, nlF, 0.000 … 3.000 %/K

all measured values ± 1 decimal place

* manual/automatic

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1.1.3 IDS

New features

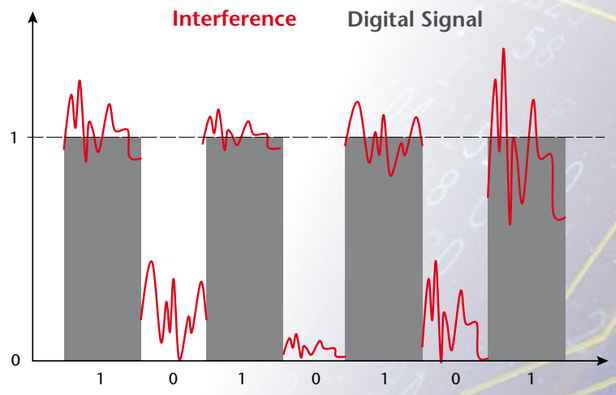
INTELLIGENT I
DIGITAL D
SENSORS S

SI Anayltics' IDS: Intelligent, Digital Sensors technology for the standard parameters pH, conductivity and dissolved oxygen consists of two components, Digital sensors and matching field or benchtop meters. This new processing of the measured values no longer takes place in the device, exclusively in the sensor so that every sensor has it's own data base when connected.

Built on the basic sensor of the BlueLine and ScienceLine series that have proven themselves tens of thousands of times over, the IDS sensors have added precision and reliability and cover almost any application.

I intelligent:
IDS sensors are intelligent. They log into the device automatically, submit their name, serial number, calibration status and history as well as all parameters.

D digital:
IDS sensors transform the sensitive measuring signals in the sensor head into digital signals and transmit them to the output device without interference and errors.



S sensor:
IDS sensors are based on proven and continuously developed sensors by SI Analytics. They cover almost any lab application, like pH, conductivity or dissolved oxygen measurements.

SI Analytics also offers titrators with IDS:
TitroLine® 7800

Cond
O_2
pH

SI Analytics
also offers
Field meters with IDS:
HandyLab 680

O_2
pH
Cond

Lab and ProLab

1.1.3.1 Lab 875 and Lab 875P

Safe measurements...
... with the innovative Lab 875 and Lab 875P.

The Lab 875 with a digital measuring channel is optimal in the world of digital multi-parameter measurement using IDS. The IDS technology allows optimized measurements and efficient documentation in the simplest manner.

- One-channel multi-parameter meter for all IDS sensors
- Digital sensor recognition
- Optionally installed printer: Lab 875P

pH Cond O_2

Lab 875

Lab 875P

Lab and ProLab

Documentation as per GLP/AQS

- Automatic, digital capture of all sensor data.
- User administration capabilities for the safe allocation of user and measuring results.
- Transmission of all data in *.csv format via USB interface to PC.
- Output directly to an optional integrated printer.

Benefits
Lab 875 and Lab 875P

1.1.3.2 ProLab 2500

If there is the need for a little more...

The ProLab 2500 is a digital high-performance meter with three channels. With its color graphic display protected by glass, high-quality zinc die-casting base as well as the anti-bacterial keyboard cover, it meets even the highest demands.

- Three universal measuring channels
- Digital sensor recognition
- Antibacterial keyboard

ProLab 2500

Flexible performance

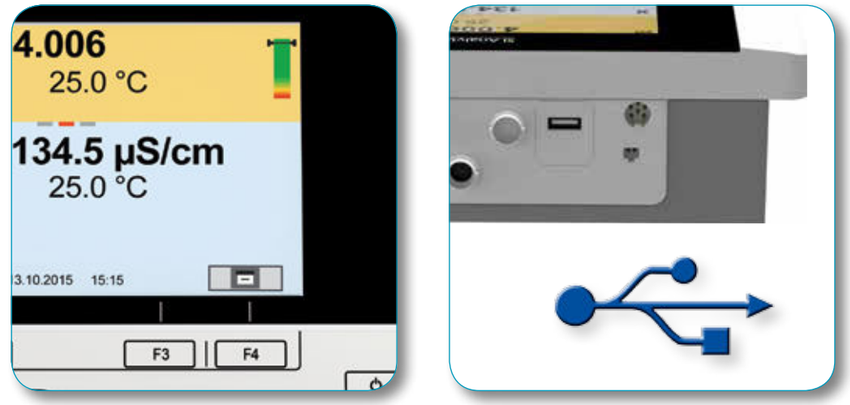
- Measures pH, ORP, ISE, dissolved oxygen, and conductivity.
- Any combination of the same or different parameters.
- Color backlit graphic display with CMC, QSC and channel display.
- An adapter for conventional pH electrodes (DIN plug) included in the delivery.
- Memory with 10,000 possible entries.

Measuring certainty

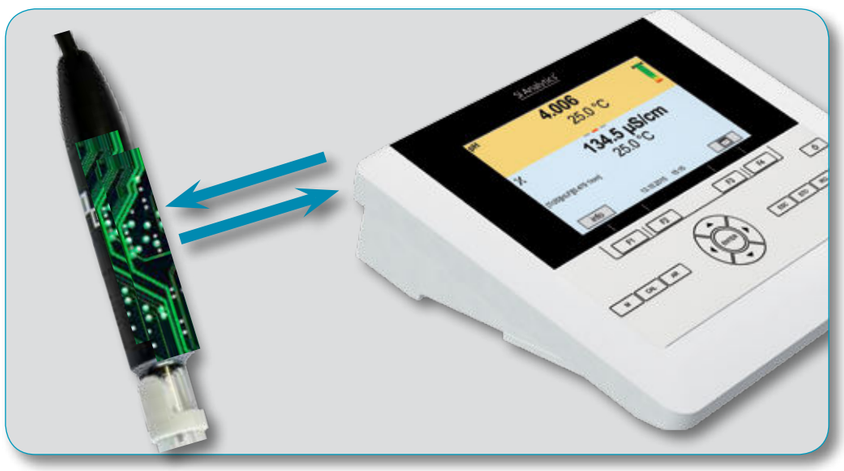
- The digital signal transfer eliminates interference, safely allocates calibration data, automatically transmits sensor data.
- The Quality Sensor Control (QSC) icon provides precise information about the actual state of the electrode and therefore increases the operational safety.

Documentation

- Automatic, digital capture of all sensor data for retraceability of measured values.
- Available user administration for the safe allocation of user and measuring results or sample and measuring results.
- Data output to PC, USB memory stick or selected printers.



Digital sensor recognition



Lab and ProLab

1.1.3.3 Lab 875 (P) and ProLab 2500

Technical data

Model	Lab 875 (P)	ProLab 2500
Parameter	pH, mV, saturation, concentration, partial pressure, conductivity, spec. resistance, salinity, TDS, temperature	
IDS - Intelligent Digital Sensors	■	■
Universal measuring channels	1	3
Analog pH/ORP sensors	Z600 IDS analog adapter (optional)	Z600 IDS analog adapter (included in delivery)
Temperature compensation	all except for ORP	all except for ORP
Calibration points pH	1–5	1–5
ISE	-	2–7 (requires adapter)
Dissolved oxygen	1	1
Conductivity	1	1
Calibration records	Max. 10	Max. 10
Calibration timer	1 – 999 days	1 – 999 days
Memory entries	manual: 500 data sets automatic: 4,500 data sets	manual: 500 data sets automatic: 10,000 data sets
Logger	■	■
Interface	Mini USB-B	USB-A, Mini USB-B
GLP/AQS supporting	■	■
Display	Graphic, BW	Color graphic
Printer option	Yes: Lab 875P	external
Additional	CMC, QSC	antibacterial keypad, QSC, CMC, replaceable firmware
Power supply	Universal power supply, battery (4 x 1.5 V AA Type)	Universal power supply

Lab 875P

ProLab 2500

Ordering information

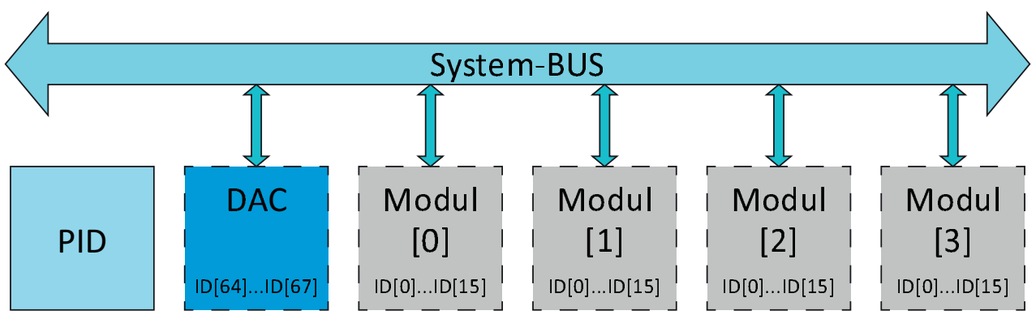
Type No.	Order No.	Desciption
Lab 875	285206320	One channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., Mini USB-B interface, Data storage. Including stand and power supply.
Lab 875 pH Set	285206720	One channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., Mini USB-B interface, Data storage. Including stand, power supply, BlueLine 14 pH IDS and buffer solutions.
Lab 875 Cond Set	285206730	One channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., Mini USB-B interface, Data storage. Including stand, power supply, LF 413T IDS and cond. testing solutions.
Lab 875P	285206330	One channel instrument with integrated printer for IDS sensors in order to measure pH, mV, Cond., DO and Temp., Mini USB-B interface, Data storage. Including stand and power supply.
Lab 875P pH Set	285206740	One channel instrument with integrated printer for IDS sensors in order to measure pH, mV, Cond., DO and Temp., Mini USB-B interface, Data storage. Including stand, power supply, BlueLine 14 pH IDS and buffer solutions.
Lab 875P Cond Set	285206750	One channel instrument with integrated printer for IDS sensors in order to measure pH, mV, Cond., DO and Temp., Mini USB-B interface, Data storage. Including stand, power supply, LF 413T IDS and cond. testing solutions.
ProLab 2500	285206350	Three channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., USB-A and Mini USB-B interface, Data storage. Including stand, power supply and IDS analog adapter.
ProLab 2500 pH Set	285206770	Three channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., USB-A and Mini USB-B interface, Data storage. Including stand, power supply, A 162 IDS, buffer solutions and IDS analog adapter.
ProLab 2500 pH/Cond Set	285206780	Three channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., USB-A and Mini USB-B interface, Data storage. Including stand, power supply, A 162 IDS, LF 413T IDS, testing solutions and IDS analog adapter.
ProLab 2500 pH/ Cond/Ox Set	285206790	Three channel instrument for IDS sensors in order to measure pH, mV, Cond., DO and Temp., USB-A and Mini USB-B interface, Data storage. Including stand, power supply, A 162 IDS, LF 413T IDS, FDO 1100 IDS, testing solutions and IDS analog adapter.
Z 600	285206360	Adapter IDS socket / DIN plug for connecting analog DIN electrodes to an IDS socket.
Z 610	285206370	Printer paper, document quality, one roll for Lab 875P.
Z 850	285204889	Universal power supply unit, 230 and 120 V for all Lab and ProLab meters.
Z 865	285201520	Stand set S4D, including arm and electrode holder for docking to the meters of the Lab- and ProLab family as well as for autonomous usage.
Z 866	285204940	Flexible electrode arm for fixed attachement to Lab & ProLab meter family.
Z 875	285201540	USB cable for Lab and ProLab meters.

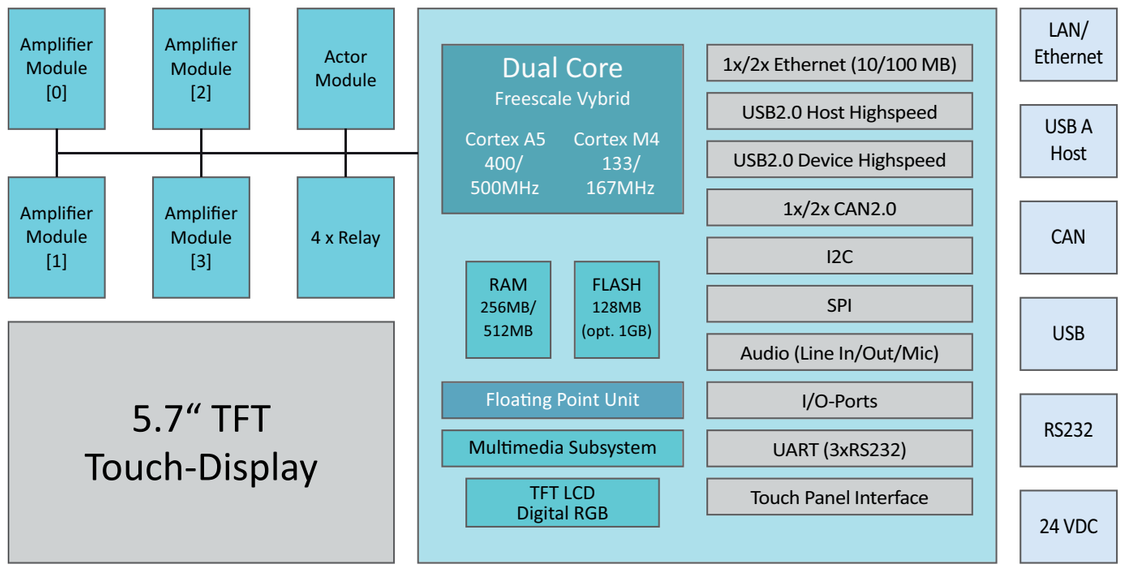
1.1.4 ProLab 5000

Complete system for measurement, control, and regulation of pH, conductivity, and dissolved oxygen in laboratories and technical centers.

- Measurement of pH/ISE/mV, conductivity, and dissolved oxygen
- Up to 4 measurement modules (inputs) in a variety of configurations
- 5.7" RGB TFT display with touch control
- PC software with extensive operating functions
- Coupling of auto-sampler and burettes for dosing and automated measurements
- Special electrodes for pH
- Current outputs for each parameter
- Additional modules for current output available
- Timer function
- Alarm/threshold function
- 2 PID regulators
- Virtual channels to calculate different parameters from the measured value
- Data storage and recording
- Data transfer with RS232/USB or ethernet
- Logbook (i.e. documentation of setting changes)
- Password protection

ProLab 5000





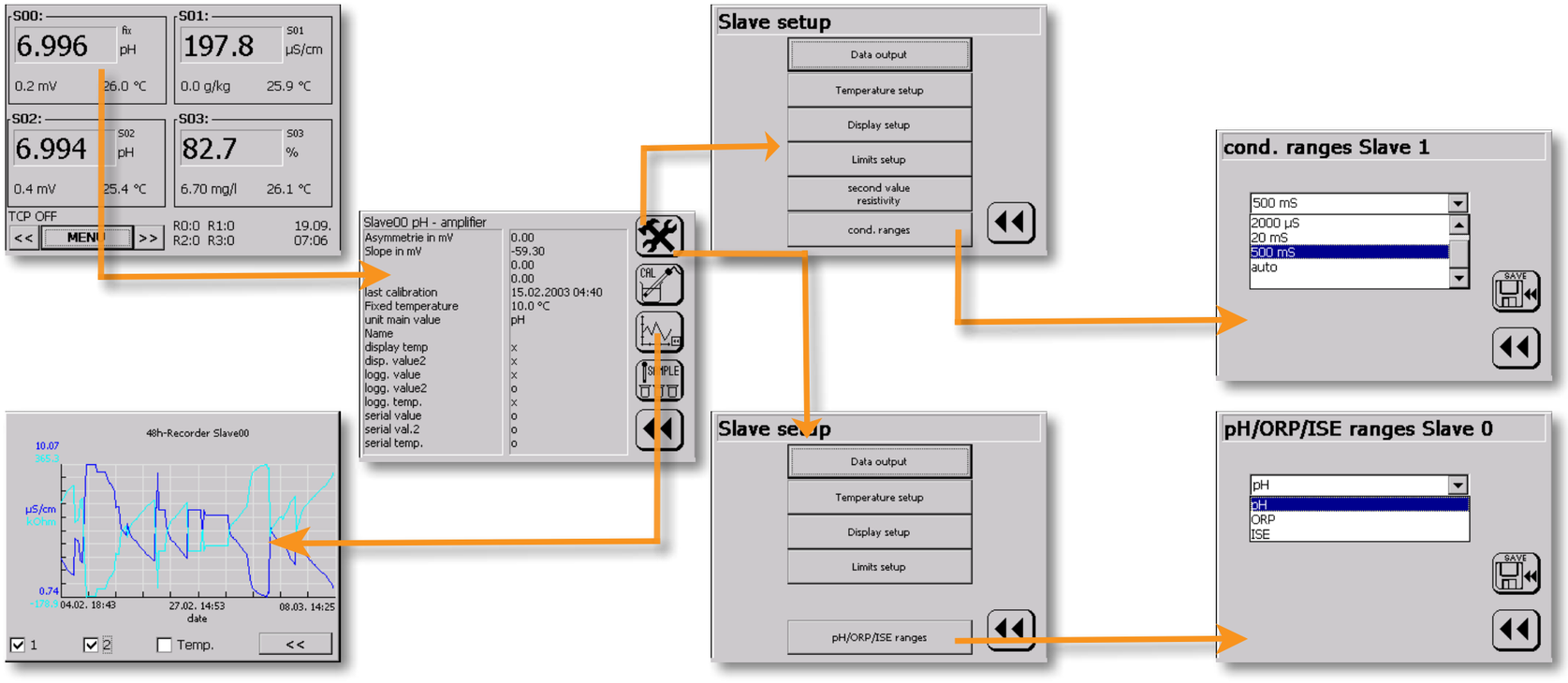
Komponenten des ProLab 5000

The ProLab 5000 multiparameter measuring instrument is based on a modular system structure that links the measurement modules to the central unit and to each other via a bus connection. It is the complete solution for measurement, control, and regulation in laboratory and technical centers. Choose up to four measurement modules can determine any combination of pH, conductivity, dissolved oxygen, ORP/redox potential, temperature and other parameters.

The main components of the multiparameter laboratory measurement system ProLab 5000 are:

- ProLab 5000 with power supply, touch screen display, internal modules, data logger and logbook, various digital interfaces such as RS232, USB and ethernet
- PC visualization program
- Measurement modules
- Sensors
- Optional samplers, depending on type, up to 72 samples (i.e. TW Alpha plus)
- Optional dosing system (TITRONIC® 500)
- Optional stirrer

Setting options



Color graphical touchscreen display

The distinguishing outward feature of the ProLab 5000 is the color touchscreen graphical display, which significantly simplifies operation, configuration, and calibration. Up to four measured values with their units, temperature values, a possible second value as well as an individual name can be presented simultaneously on a display page.

Four integrated threshold relays

Four integrated threshold relays for simple control, regulation, or alarm tasks are standard. Two PID-regulators that work independently of each other are available for complex regulation tasks. The regulators can be assigned to any parameter and function as analog, pulse width or pulse frequency regulators using the analog current outputs and the relay outputs of the measuring instrument.

ProLab 5000 Pilot visualization program

All values can be cyclically output and displayed graphically via the USB interface or ethernet connected to the PC visualization program ProLab 5000 Pilot. The visualization program ProLab 5000 Pilot simultaneously contains all functions for reading the data logger. The data logger can be used via the USB interface and the data can be transferred directly to a USB without the program ProLab 5000 Pilot.

Data recorder

The data recorder graphically displays the measured value curve of the parameters of each measurement module over the past 48 hours on the touch screen. This representation gives the operator a quick overview of the measurement progress, indicating the average, maximum, and minimum readings.

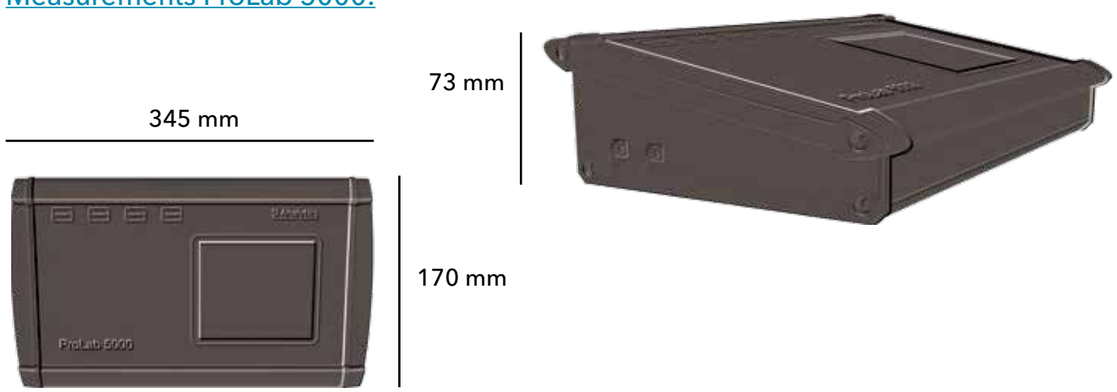
1.1.4.1 Ordering information - ProLab 5000

Type No.	Order No.	Product hierarchy No.	Description	Number of modules			
				pH/mV/ISE	Cond.	DO	Digital-analog converter
PL5000 0D 1pH 0LF 0OX	285206010	07	Multiparameter measuring instrument ProLab 5000 with one pH/mV/ISE module	1	0	0	0
PL5000 0D 1pH 1LF 0OX	285206020	07	Multiparameter measuring instrument ProLab 5000 with one each pH/mV/ISE and conductivity module	1	1	0	0
PL5000 0D 1pH 1LF 1OX	285206030	07	Multiparameter measuring instrument ProLab 5000 with one each pH/mV/ISE, conductivity and dissolved oxygen module	1	1	1	0
PL5000 0D 1pH 2LF 1OX	285206040	07	Multiparameter measuring instrument ProLab 5000 with one each pH/mV/ISE and dissolved oxygen as well as two conductivity modules	1	2	1	0
PL5000 0D 2pH 0LF 0OX	285206050	07	Multiparameter measuring instrument ProLab 5000 with two pH/mV/ISE modules	2	0	0	0
PL5000 0D 2pH 1LF 0OX	285206060	07	Multiparameter measuring instrument ProLab 5000 with two pH/mV/ISE and one conductivity modules	2	1	0	0
PL5000 0D 2pH 2LF 0OX	285206070	07	Multiparameter measuring instrument ProLab 5000 with each two pH/mV/ISE and conductivity modules	2	2	0	0
PL5000 0D 2pH 1LF 1OX	285206080	07	Multiparameter measuring instrument ProLab 5000 with one each conductivity, dissolved oxygen and two pH/mV/ISE modules	2	1	1	0
PL5000 0D 3pH 0LF 0OX	285206090	07	Multiparameter measuring instrument ProLab 5000 with three pH/mV/ISE modules	3	0	0	0
PL5000 0D 3pH 1LF 0OX	285206100	07	Multiparameter measuring instrument ProLab 5000 with three pH/mV/ISE and one conductivity modules	3	1	0	0
PL5000 0D 3pH 0LF 1OX	285206110	07	Multiparameter measuring instrument ProLab 5000 with three pH/mV/ISE and one dissolved oxygen modules	3	0	1	0
PL5000 0D 4pH 0LF 0OX	285206120	07	Multiparameter measuring instrument ProLab 5000 with four pH/mV/ISE modules	4	0	0	0
PL5000 1D 1pH 0LF 0OX	285206130	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter and one pH/mV/ISE module	1	0	0	1
PL5000 1D 1pH 1LF 0OX	285206140	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter as well as one each pH/mV/ISE and conductivity module	1	1	0	1
PL5000 1D 1pH 1LF 1OX	285206150	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter as well as one each pH/mV/ISE, conductivity and dissolved oxygen module	1	1	1	1
PL5000 1D 1pH 2LF 1OX	285206160	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter as well as one each pH/mV/ISE, dissolved oxygen and two conductivity modules	1	2	1	1
PL5000 1D 2pH 0LF 0OX	285206170	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter and two pH/mV/ISE-modules	2	0	0	1
PL5000 1D 2pH 1LF 0OX	285206180	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, two pH/mV/ISE- and one conductivity-modules	2	1	0	1
PL5000 1D 2pH 2LF 0OX	285206190	07	Multiparameter measuring instrument ProLab 5000 with digital-analog-converter, each two pH/mV/ISE- and conductivity-modules	2	2	0	1
PL5000 1D 2pH 1LF 1OX	285206200	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter, one each conductivity and dissolved oxygen as well as two pH/mV/ISE modules	2	1	1	1
PL5000 1D 3pH 0LF 0OX	285206210	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter and three pH/mV/ISE modules	3	0	0	1
PL5000 1D 3pH 1LF 0OX	285206220	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter, three pH/mV/ISE and one conductivity modules	3	1	0	1
PL5000 1D 3pH 0LF 1OX	285206230	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter, three pH/mV/ISE and one dissolved oxygen modules	3	0	1	1
PL5000 1D 4pH 0LF 0OX	285206240	07	Multiparameter measuring instrument ProLab 5000 with digital-analog converter and four pH/mV/ISE modules	4	0	0	1
Z570	285206250	04	USB cable for ProLab 5000				
Z573	285206260	04	Cable for connecting the ProLab 5000 to sample changer				
Z575	285206270	04	Wall mount for ProLab 5000				

1.1.4.2 Technical data ProLab 5000

Auxiliary energy	24 V DC desktop power supply, voltage disconnect via the unit switch
Ambient temperature	0 ... + 40 °C
Display	Touch screen graphic display 320 x 240 pixel, 256-color, back lit
Menu languages	German, English
Data transmission	Serial interface RS-232, ethernet port, USB port for PC Connection
Control outputs	4 potential-free relay outputs; resistive load I ≤ 1 A, U ≤ 24 V DC for threshold or alarm function; including a relay with timer function (wash contact; adjustable time interval 1 ... 9,999 hours)
Data storage	Integrated data logger for approx. 100,000 values including date and time, 48 hour data recorder
Logbook	Approx. 200 activities including date and time
Housing	Aluminum housing IP 40/DIN EN 60529; Dimensions see dimensional drawings, wall-mount kit available
Connections	BNC, banana, 8-pin Din, BK, USB, ethernet
Electromagnetic compatibility	89/336/EEC, EN 61326 Class B
Measurement modules	Four internal measurement modules; in any combination; inputs galvanically separated; calibration data storage; sensor monitoring via adjustable threshold bands; manual and automatic temperature compensation
Regulator module	Optional regulator module PL5000DAC: Standard signal module 4 x 0(4) ... 20 mA
Safety	Protection class III, EC Directive 73/23 EN 61010-1: 2001
GLP	GLP functions (data recording)

Measurements ProLab 5000:



Multifunctional connections:

Back panel connections

Lateral connections

Measurement modules:

Internal modules	Main parameter measuring range/resolution	Secondary parameters/ resolution	Temperature measurement measuring range/ resolution	Electrodes/sensors
PL5000 pH; ORP, ISE	pH value pH 0 ... 14 / 0.001 pH Accuracy: 0.005 pH	Chain voltage 0.1 mV	-10…130 °C / 0.1 °C	pH single rod measuring cell, separated measuring chain, Pt 1000 temperature sensor
	Redox potential -2000… +2000 mV > 0.1 mV	Redox voltage relative to the standard hydrogen electrode 0.1 mV	-10…130 °C / 0.1 °C	Redox single rod measuring cell, separate measuring chain, Pt 1000 temperature sensor
	Ion concentration corr. sensor specification (ISE) and calibration	Chain voltage 0.1 mV	-10…130 °C / 0.1 °C	Ion-selective electrode (ISE), separate measuring chain, Pt 1000 temperature sensor
PL5000LF	Conductivity 0…200 µS/cm 0.1 µS/cm (4-pol) 0…2 mS/cm 1 µS/cm 0…20 mS/cm 0.01 mS/cm 0…500 mS/cm 0.1 mS/cm automatic switching	Salinity 2 ... 42 g/kg	-10…130 °C / 0.1 °C	4-electrode conductivity measurement cell, NTC30kOhm temperature sensor
PL5000OX	O_2 saturation 0…120% / 0.1%	O_2 concentration 0…20 mg/l / 0.1	-10…130 °C / 0.1 °C	Membrane-covered amperometric O_2 sensor, NTC30kOhm temperature sensor

1.2 HandyLab MKII

Our 2nd generation of Handylab devices offers analog or digital options for the measurement of pH, ORP, dissolved oxygen and conductivity in the lab and in the field.

While our Handylab 100 pH and Handylab 200 Cond offer a single traditional analog channel, our IDS series Handylab 600 and 680 devices take full advantage of our new digital technologies. The digital HandyLab 600 concentrates on the pH measurement as a one-channel device, whereas the HandyLab 680 allows you to measure any two parameters simultaneously; pH, ORP, conductivity or oxygen.
IDS stands for "intelligent, digital sensors" and means that the analog measuring signal is converted into a digital measuring value in the sensor. This protects the signal from external interferences, such as moisture, electro-magnetic fields or pulses. The higher measuring accuracy raises confidence in your readings to a whole new level. IDS sensors send their type designation and serial number, i.e. they identify themselves to the meter automatically. This information is always part of the documentation. Calibration values are stored in the IDS sensor and transferred to the measuring device avoiding unnecessary recalibration as would be needed for traditional analog devices.Especially with field devices, the increased comfort is considerable as the IDS sensors can be calibrated in the laboratory under optimal conditions and simply need to be connected in the field.

- The advanced speed and precision of our benchtops in a portable and durable design.
- Specifically designed for mobile use
  - Handy, battery-operated
  - Keypad made from a continuous silicone mat and therefore waterproof with noticeable key click, even when used with gloves.
- P67
- Reproducible results due to active automatic AutoRead function with independent detection of stabile measuring values.
- CMC (Continuous Measurement Control) makes sure that the pH measuring values and the calibration area remain in sight and that the measurement is conducted in the optimal range.
- Generous data storage in all devices
- Backlit graphics display in all versions
- A case for the safe storage and transport is always included with these devices.

Benefits
HandyLab MKII

HandyLab 680

Selection chart

HandyLab	100	200	600	680
Analog	■	■		
IDS (Intelligent Digital Sensor)			■	■
One channel	■	■	■	
Two channel				■
pH/ORP	■		■	■
Temperature	■	■	■	■
Conductivity		■		■
DO				■
CMC-Function	■		■	■
1- to 5-point calibration with 22 stored buffer sets	■		■	■
QSC intelligent sensor evaluation			■	■
User administration				■
Autoread	■	■	■	■
Data memory	■	■	■	■
Interface Mini USB-B			■	■
Interface USB-A				■
Info display	■	■	■	■
Backlit B/W graphical display	■	■	■	
Backlit colored graphical display				■
Battery (Typ AA)	■	■	■	
Rechargable AA from included power supply.				■
Watertight housing and keypad (built of one piece of silicone mat)	■	■	■	■
IP67 certified	■	■	■	■

1.2.1 HandyLab 100

The portable allrounder for pH/mV measurements

The HandyLab 100 increases the measuring speed and accuracy thanks to the AutoRead and the CMC function. AutoRead displays when the measuring value is stable and eliminates the risk of a premature reading of the faulty measuring value. CMC (Continuous Measurement Control) visualizes whether the measuring value is still within the calibration limits. Having storage capacity for up to 200 data sets, stored data can be viewed.

The HandyLab 100 is ready for 1- to 5-point calibrations and offers 22 pre-stored buffer sets

Technical data

Measuring range/ resolution/ accuracy (all values +/-1 digit)	pH	-2.0 ... 20.0 +/-0.1 pH
		-2.00 ... 20.00 +/-0.01 pH
		-2.000 ... 19.999 +/-0,005 pH
	mV	+/- 1200.0 mV +/- 0.3 mV
		+/- 2500 +/-1 mV
	Temperature	-5.0 ... 105.0 °C +/- 0.1 °C
Calibration	Calibration points	1-, 2-, 3-, 4-, 5-Points
	Stored buffers	22 preloaded buffer sets
	Calibration memory	Latest calibration
Handling	AutoRead	Automatic/manual
	Celsius/Fahrenheit	Yes
	CMC	Yes
	Display	LCD B/W Graphic backlit
	Data memory	Manual 200 data sets
	Logger	Manual
	Power supply	4 x 1.5 V AA or 4 x 1.2 V NiMH rechargeable battery
	Continious operating time	Up to 1000 h without/ 150 h with lighting
	Sensor connector	Waterproof DIN/ 4mm banana
	Waterproof	IP67

- Designed for mobile use
- Reproducible results due to active automatic AutoRead function
- CMC function to visualize the optimal measuring range
- 1 to 5 point calibration with 22 stored buffer sets
- Data storage with output on display
- Backlit graphic display with clear text menu

Benefits
HandyLab 100

1.2.2 HandyLab 200

The portable Allrounder for conductivity measurements

Due to the wide selection of 2 and 4 pole measuring cells made by SI Analytics, the system consisting of a sensor and HandyLab 200 can be used for a variety of purposes such as conductivity, salinity, TDS and specific gravity. Autoread provides a stabile, precise measuring value. The backlit display and waterproof design make it especially ideal for field use.
For easy reference, the HandyLab 200 has a storage capacity for up to 200 data sets, which can be put out on the display.

Technical data

Measuring range/ resolution/ accuracy (all values +/-1 digit)	Conductivity	0.0 ... 1000 mS/cm +/- 0.5 % from average
		0.000 ... 1.999 µS/cm, K= 0.01 cm^{-1} +/- 0,5 % of the mean value
		0.00 ... 19.99 µS/cm, K= 0.010 cm^{-1}; K=0.100 cm^{-1} +/- 0,5 % of the mean value
	Specific resistance	1.000 Ohm cm ... 199.9 MOhm cm +/- 0,5 % of the mean value
	Salinity	0.0 ... 70.0 (IOT)
	TDS	0 ... 1999 mg/l, 0 bis 199.9 g/l
	Temperature	-5.0 ... 105.0 °C +/- 0.1 °C
Cell constant	Fixed	0.475 cm^{-1}, 0.100 cm^{-1}, 0.010 cm^{-1}
	Calibratable (1 point)	0.450 to 0.500 cm^{-1}, 0.585 ... 0.715 cm^{-1}, 0.800 ... 0.880 cm^{-1}, Standard: 0.01 mol/L KCl
	Adjustable:	0.250 ... 25.000 cm^{-1}; 0.090 ... 0.110 cm^{-1}
Temperature compensation	Adjustment	Automatic/manual
	Temperature coefficent	nLF: none linear function according to EN 27 888 and ultrapure water function
		Linear compensation 0.000 ... 3.000 %/K
		No Compensation
Handling	AutoRead	Automatic/manual
	Celsius/Fahrenheit	Yes
	Display	LCD B/W Graphic backlit
	Data memory	Manual 200 data sets
	Logger	Manual
	Power supply	4 x 1.5 V AA or 4 x 1.2 V NiMH rechargeable battery
	Continious operating time	Up to 800 h without/ 100 h with backlight
	Sensor connector	8 Pole
	Waterproof	IP67

- Designed for mobile use
- Reproducible results due to active automatic AutoRead function
- Data storage with output on display
- Backlit graphic display with clear text menu
- Waterproof IP67

Benefits
HandyLab 200

1.2.3 HandyLab 600

The portable pH IDS measuring device for the safest measuring and high operator comfort

The HandyLab 600 increases the measuring accuracy via:

IDS technology (Intelligent Digital Sensor) - The digitalization of the measuring signal eliminates interferences.

AutoRead function - Autoread provides a stabile, precise measuring value.

CMC (Continuous Measurement Control) - Visualizes whether the measuring value is within the calibration range.

QSC (Quality Sensor Control) - Informs about the actual condition of the electrode and therefore increases operation safety.

The HandyLab 600 increases the operator comfort via:

IDS Technology - The secure allocation of the calibration data to the sensor eliminates any uncertainty about the date and results of its last calibration. This saves time and money while assuring the highest confidence in your measurements.

Traceability of the measuring values - By the digital and automatic capture of all sensor data.

Transmission of all data in *.csv format - Via USB interface to the PC. Or as an alternative, formatted transfer into Excel via MultiLabImporter (included in the delivery).

Technical data

Measuring range/ resolution/ accuracy (all values +/-1 digit) depending on the kind of IDS sensor	pH	0.000 ... 14.000 +/-0.004 pH
	mV	+/- 1200.0 mV +/- 0.2 mV
	Temperature	-5.0 ... 105.0 °C +/- 0.2 °C
Calibration	Calibration points	1-, 2-, 3-, 4-, 5-Points
	Stored buffers	22 preloaded buffer sets
	Calibration memory	10 last calibrations
	Timer	1 - 999 Days
Handling	Digital: IDS Sensor	Yes for pH and ORP
	AutoRead	Automatic/manual
	Celsius/Fahrenheit	Yes
	CMC	Yes
	QSC	Yes
	Traceability of results	Yes
	Display	LCD B/W graphic backlit
	Data storage	Manually 500/automatic 5.000 data sets
	Logger	Manually/time triggered
	Interface	Mini USB-B
	Data transfer	In *.csv format via USB interface to the PC. Alternatively also transfer into Excel via MultiLab Importer (scope of delivery).
	Power supply	4 x 1.5 V AA or 4 x 1.2 V NiMH rechargeable battery
	Continious operating time	up to 1,000 h without/ 150 h with backlight
	Sensor connector	1 x IDS
	Waterproof	IP67 (including battery compartment, USB ports and channels)

- IDS pH measuring device
- Waterproof design. Sealed keypad (IP67).
- 1 to 5 point calibration with 22 stored buffer sets
- Data storage with output on display and the USB interface
- Backlit graphic display with clear text menu
- Versatile application-oriented sets offered

Benefits
HandyLab 600

1.2.4 HandyLab 680

The portable pH IDS meter with two connectors for simultaneously measurement of pH, LF and DO

The HandyLab 680 increases the measuring accuracy via:

IDS technology - The digitalization of the measuring signal eliminates interferences.

AutoRead function - Autoread provides a stabile, precise measuring value.

CMC (Continuous Measurement Control) - Vsualizes whether the measuring value is within the calibration range.

QSC (Quality Sensor Control) - Informs about the actual condition of the electrode and therefore increases operation safety.

The HandyLab 680 increases the operator comfort via:

IDS Technology - the secure allocation of the calibration data to the sensor eliminates any uncertainty about the date and results of its last calibration. This saves time and money while assuring the highest confidence in your measurements.

Traceability of the measuring values - By the digital and automatic capture of all sensor data.

User administration - Can be activated to allow tiered access and capabilities ensuring security and confidence of your data.

Transmission of all data in *.csv format - Via USB interface to the PC or the USB memory stick, or, as an alternative, formatted transfer to Excel by means of MultiLabImporter (included in the delivery).

Color graphic display - with clear text menu control. The display color corresponds with the color of the sensor plug which prevents the user from unplugging the wrong sensor from the device.

- Two-channel IDS measuring device for pH/mV, conductivity and DO
- Waterproof design. Sealed keypad. (IP67)
- 1 to 5 point calibration with 22 stored buffer sets
- Huge data storage with output on display and to the USB interface as well to the USB memory stick
- Color backlit graphic display with clear text menu control
- Versatile application-oriented sets offered

Benefits
HandyLab 680

Technical data

Measuring range/ resolution/ accuracy (all values +/-1 digit) depending on the kind of IDS sensor	pH	0.000 ... 14.000 +/-0.004 pH
	mV	+/- 1200.0 mV +/- 0.2 mV
	Temperature	-5.0 ... 105.0 °C +/- 0.2 °C
	Conductivity	0.00 ... 2000 mS/cm +/- 0.5 % of mean value
	Specific resistance	0.00 Ohm cm ... 100 MOhm cm +/- 0.5 % of mean value
	Salinity	0.0 ... 70.0 (IOT) +/- 0.5 % of mean value
	TDS	0 ... 1999 mg/l, 0 bis 199.9 g/l +/- 0.5 % of mean value
	DO concentration	0.00 ... 20.00 mg/l +/- 0.5 % of value
	DO saturation	0.0 ...200.0 % +/- 0.5 % of value
	DO partial pressure	0 ... 400 hPa +/- 0.5 % of value
Calibration pH	Calibration points	1-, 2-, 3-, 4-, 5-Point
	Stored buffers	22 preprogrammed buffer sets
	Calibration memory	10 last calibrations
	Timer	1 - 999 Days
Calibration cell constant conductivity	Fixed	0.475 cm^{-1}, 0.100 cm^{-1}, 0.010 cm^{-1}
	Calibratable (1 point)	0.450 to 0.500 cm^{-1}, 0.800 ... 0.880 cm^{-1}, Standard: 0.01 mol/L KCl
	Adjustable	0.250 ... 25.000 cm^{-1}; 0,090 ... 0.110 cm^{-1}
Temperature compensation conductivity	Adjustable	Automatic/manual
	Temperature coefficient	nLF: none linear function according to EN 27 888 and ultrapure water function
		Linear compensation 0.000 ... 10.000 %/K
		No compensation
Calibration DO	Calibration point	1 point in FDO check vessel
Handling	Digital: IDS Sensor	Yes for pH, ORP, DO and conductivity
	AutoRead	Automatic/manual
	Celsius/Fahrenheit	Yes
	CMC	Yes
	QSC	Yes
	User administration	Yes
	Traceability of results	Yes
	Display	Colored graphic backlit
	Data storage	Manually 500/automatic 10,000 data sets
	Logger	Manually/time triggered
	Interface	USB-A and Mini USB-B
	Data transfer	In *.csv format via USB interface to the PC or USB-Memorystick. Alternatively also transfer into Excel via MultiLab Importer (scope of delivery).
	Power supply	4 x 1.2 V NiMH-rechargeable battery
	Continious operating time	150h (dependent on connected sensor)
	Sensor connector	2 x IDS (any combination)
	Waterproof	IP67

1.2.5 Ordering information - HandyLab MKII

Type Number	Order No.	Short Description	Detailed description
HL100Field	285204510	PH-METER Set HandyLab 100 Field	pH-Meter Set HandyLab 100 with pHT-combination electrode BlueLine 24 pH and protective armouring Z389 for field applications *
HL100Routine	285204500	PH-METER Set HandyLab 100 Routine	pH-Meter Set HandyLab 100 with pHT-combination electrode BlueLine 14 pH for routine applications *
HL100Versatile	285204520	PH-METER Set HandyLab 100 Versatile	pH-Meter Set HandyLab 100 with pHT-combination electrode A7780-NTC30-DIN-N for versatile applications *
HL200PureWater	285204550	COND-METER HandyLab 200 Pure Water	Cond-meter set HandyLab 200 with conductivity cell LF313T for measurements in purified water *
HL200Routine	285204530	COND-METER HandyLab 200 Routine	Cond-meter set HandyLab 200 with conductivity cell LF613T for routine applications *
HL200Versatile	285204540	COND-METER HandyLab 200 Versatile	Cond-meter set HandyLab 200 with conductivity cell LF413T for versatile applications *
HL600Field	285204570	PH-METER Set HandyLab 600 Field	pH-Meter Set HandyLab 600 with pHT-combination electrode BlueLine 24 pH IDS for field applications *
HL600Food	285204630	PH-METER Set HandyLab 600 Food	pH-Meter Set HandyLab 600 with pH-combination electrode with armoring BlueLine 21 pH IDS for cut-in measurements in food applications *
HL600LifeScience	285204600	PH-METER Set HandyLab 600 Life Science	pH-Meter Set HandyLab 600 with pHT-combination electrode A157 IDS for life science applications *
HL600Routine	285204560	PH-Meter Set HandyLab 600 Routine	pH-Meter Set HandyLab 600 with pHT-combination electrode BlueLine 14 pH IDS for routine applications *
HL600Science	285204590	PH-METER Set HandyLab 600 Science	pH-Meter Set HandyLab 600 with pHT-combination electrode A162 IDS for demanding applications *
HL600Surface	285204610	PH-METER Set HandyLab 600 Surface	pH-Meter Set HandyLab 600 with pHT-combination electrode BlueLine 27 pH IDS for measurement on surfaces *
HL600Tip	285204620	PH-METER Set HandyLab 600 Tip	pH-Meter Set HandyLab 600 with pHT-combination electrode A6880 IDS for cut-in measurements *
HL600Tris	285204640	PH-METER Set HandyLab 600 Tris	pH-Meter Set HandyLab 600 with pHT-combination electrode IL-pHT-A170MF-IDS for measurement in tris puffer *
HL600TrisMicro	285204650	PH-METER Set HandyLab 600 Tris Micro	pH-Meter Set HandyLab 600 with pHT-combination electrode IL-Micro-pHT-IDS for measurement in tris puffer with smaller sample volume *
HL600Versatile	285204580	PH-METER Set HandyLab 600 Versatile	pH-Meter Set HandyLab 600 with pHT-combination electrode A7780 IDS for versatile applications *
HL680 CondVersatile	285204760	Cond-METER Set HandyLab 680 Versatile	Cond-meter set HandyLab 680 with conductivity cell LF413T IDS and Z389 armoring for versatile applications *
HL680OxVersatile	285204770	OX-METER Set HandyLab 680 Versatile	OX-meter set HandyLab 680 with oxygen measuring cell FDO1100 IDS and Z389 amoring for versatile applications *

Type Number	Order No.	Short Description	Detailed description
HL680pH/Cond/OxVer	285204810	pH/Cond/OX-METER Set HandyLab 680 Versatile	pH/Cond/OX-meter set HandyLab 680 with oxygen measuring cell FDO1100 IDS, conductivity measuring cell LF413T IDS, pHT-combination electrode A7780 IDS, Z530 and Z389 for versatile applications **
HL680pH/CondPW	285204780	pH/Cond-METER Set HandyLab 680 Pure Water	pH/Cond-meter set HandyLab 680 with conductivity cell LF313T IDS, pHT-combination electrode A161 IDS, Z530 and Z389 for measurements in purified water *
HL680pH/CondVersat	285204790	pH/Cond-METER Set HandyLab 680 Versatile	pH/Cond-meter set HandyLab 680 with conductivity cell LF413T IDS, pHT-combination electrode A7780 IDS, Z530 and Z389 for versatile applications **
HL680pH/OxVersat	285204800	pH/OX-METER Set HandyLab 680 Versatile	pH/OX-meter set HandyLab 680 with oxygen measuring cell FDO1100 IDS, pHT-combination electrode A7780 IDS, Z530 and Z389 for versatile applications **
HL680pHField	285204670	PH-METER Set HandyLab 680 Field	pH-Meter Set HandyLab 680 with pHT-combination electrode BlueLine 24 pH IDS and Z389 amoring for field applications *
HL680pHFood	285204730	PH-METER Set HandyLab 680 Food	pH-Meter Set HandyLab 680 with pH-combination electrode with armoring BlueLine 21 pH IDS and Z389 for cut-in measurements in food applications *
HL680pH LifeScience	285204700	PH-METER Set HandyLab 680 Life Science	pH-Meter Set HandyLab 680 with pHT-combination electrode A157 IDS and Z389 amoring for life science applications *
HL680pHRoutine	285204660	PH-Meter Set HandyLab 680 Routine	pH-Meter Set HandyLab 680 with pHT-combination electrode BlueLine 14 pH IDS and Z389 amoring for routine applications *
HL680pHScience	285204690	PH-METER Set HandyLab 680 Science	pH-Meter Set HandyLab 680 with pHT-combination electrode A162 IDS and Z389 amoring for demanding applications *
HL680pHSurface	285204710	PH-METER Set HandyLab 680 Surface	pH-Meter Set HandyLab 680 with pHT-combination electrode BlueLine 27 pH IDS and Z389 for measurement on surfaces *
HL680pHTip	285204720	PH-METER Set HandyLab 680 Tip	pH-Meter Set HandyLab 680 with pHT-combination electrode A6880 IDS and Z389 amoring for cut-in measurements *
HL680pHTris	285204740	PH-METER Set HandyLab 680 Tris	pH-Meter Set HandyLab 680 with pHT-combination electrode IL-pHT-A170MF-IDS and Z389 for measurement in tris puffer *
HL680pHTrisMicro	285204750	PH-METER Set HandyLab 680 Tris Micro	pH-Meter Set HandyLab 680 with pHT-combination electrode IL-Micro-pHT-IDS and Z389 amoring for measurement in tris puffer with smaller sample volume *
HL680pHVersatile	285204680	PH-METER Set HandyLab 680 Versatile	pH-Meter Set HandyLab 680 with pHT-combination electrode A7780 IDS and Z389 for versatile applications **
Z389	285202470	Protective armouring Z389	Protective armouring Z389 for HandyLab 100/200/600/680
Z530	285202480	Case for multi electrode storing for HL680	Case Z530 incl. Z389, buffer and conductivity testing solutions for storing several electrodes and the multi parameter instrument HandyLab 680

Note:
All sets include a practical case. There are two different cases available, depending on the set.
* Standard case
** Extra large case with the possibility to transport even more electrodes (Z530)

2. Electrodes

The perfect match for reliable measuring results:

SI Analytics sensors and meters

Content

大久生物科技股份有限公司 GRANDEVER BIOTECHNOLOGY CO., LTD.

2.1 Our laboratory sensors - application orientated and perfectly matched

The standards for pH measurement are very high regarding precision, reproducibility, speed, handling and reliability. Every measurement is different. Different compositions, temperatures, conductivities and viscosities of samples and different measured conditions make for a million of different applications. Only application orientated and perfectly matched systems of electrodes, meters and buffer solutions can meet these standards. At SI Analytics we supply such systems.

The pH electrode is a very important part of the system as it comes in direct contact with the sample and provides the measurement signal. For more than 80 years our focus has been set on the electrode and we have dedicated ourselves to the development and manufacturing of glass electrodes. For a long time our electrodes have been used for the most demanding tasks in labs throughout the world where quality matters, and our customers benefit from this expertise.

It all started with a patent on pH electrodes – today it is a range of several hundred different sensors. Our electrode line includes three product families BlueLine, ScienceLine and TopLine to meet your applications. Whether for ultrapure water, jam, wine, creme or drinking water, SI Analytics offers the right electrode for every application.

Even today glass blowing talent is still indispensable.

Our first instruction booklet appeared in 1938. In those days the electrochemical pH measuring and the potentiometric titration still needed to be explained.

2.1.1 BlueLine – Elektroden in attractive form

Reliable function

Our compact BlueLine range is a basic series including electrodes for the typical laboratory applications which simplifies the user's choice.

The BlueLine family includes robust electrodes with gel electrolyte and plastic shaft for general use, liquid-electrolyte sensors for more critical measurements and special sensors. These special electrodes range includes pH electrode for surface measurements, for small sample amounts, for ultrapure water and emulsions or measurements in semi-solid samples (insert measurements).

- Basic series simplifies choice of the electrode for specific application
- Gel electrolyte, liquid electrolyte and special sensors with universal membrane glass
- Liquid electrolyte electrodes with unique platinum junction and refill port slider for easier refilling of the electrolyte
- Each electrode with individual serial number for clear documentation

Benefits *BlueLine*

2.1.2 ScienceLine Electrodes

The proven high-end laboratory electrodes

In research and development, manufacturing and quality control, our ScienceLine electrodes have become standard for the most demanding measurement tasks. Each electrode has an individual serial number and pH- and metal combination electrodes are supplied with a quality certificate, better making documentation simple and better traceable.

We have kept on improving the glass membrane shapes and types to make the electrodes even more robust, durable and easier to clean. Furthermore, they achieve stable measurement values even faster.

Our ScienceLine electrodes ensure high measurement accuracy and stability and long service life, but are highly adaptable to your measurement tasks. We can offer you a range of electrodes with unmatched versatility and quality.

A perfect all-rounder for basically any application is the platinum diaphragm. A plurality of platinum wires are twisted and fused together. The outflow channels between the wires have constant dimensions. This provides, e.g. compared to the ceramic diaphragm, a pulsation-free discharge and therefore reliable measured values as well as even better self-cleaning.

Platinum diaphragm

- Proven high-end electrodes for demanding measurement tasks
- Double junction Silamid® reference system for fast and stable acquiring of measured values and for longer electrode life.
- Utmost versatility of pH electrodes is achieved by a large selection of junctions, membrane glass types and shapes, shaft lengths and diameters, ground joints, plug connections and integrated temperature sensors.
- Each pH and metal combination electrode comes with individual serial number and quality certificate.
- Large selection of separate glass and reference electrodes, metal combination electrodes, conductivity sensors, ion selective electrodes and ammonia, sodium and oxygen sensors.

Benefits *ScienceLine*

Typical examples:

- pH electrodes with a length of up to 600 mm for measurements in very deep vessels
- The N 6003 electrode allows pH measurements even in NMR tubes or other small sample vessels. The A 157 is a micro electrode with an integrated temperature sensor with a 5 mm in diameter.
- For more demanding media, choose among different junctions and membrane glasses. For measurements in samples of low ionic strength there is a choice between e.g. the N 64 and the types A 164. Those feature a ground joint junction, and the A 164 offers a temperature sensor.
- A wide selection of separate reference and glass electrodes completes the offering.

The more stable display of the measured value with Science Line electrodes, as well as their longer life are due to their Silamid reference system. In contrast to the silver/silver chloride reference system of the BlueLine series, the ScienceLine employs. The ScienceLine employs a double junction design where the inner tube is coated with silver which provides for a very stable electrode. Hence, the stability of the potential is much higher.

Silamid derivation

- The silamid reference is a closed dissipating element in which a glass tube is coated with silver and filled with silver.
- Compared to a silver chlorinated silver wire, the potential setting area is significantly increased.
- The watt plug is an inner second diaphragm.
- Electrodes with a silamide reference therefore have an even longer lifetime compared to electrodes with Ag / AgCl wire as well as an even more stable and reliable measurement.

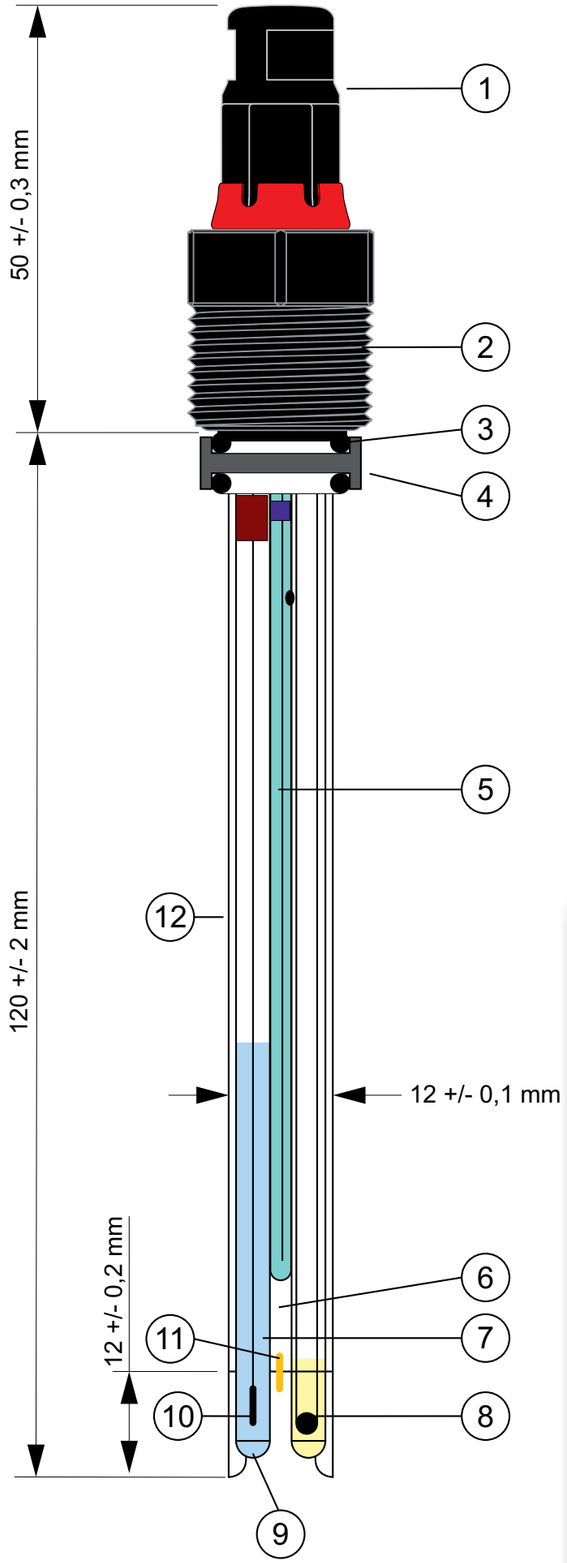
Benefits *Silamid*

2.1.3 TopLine - pH and ORP electrodes with Peek shaft for Lab, Feld and Process

TopLine electrodes were developed for a wide range of applications in the lab, field and processing of wastewater via emulsions, solutions with proteins, suspensions all the way to purely aqueous samples. This is achieved by the special mechanical and chemical resistance of the peek shaft as well as the proven process components of the measuring and reference electrode.

The reference electrode has a double diaphragm system with an external fiber wick hole and an interior labyrinth-like reference element (LoopRef). This design makes it very difficult for damaging substances to permeate the electrode.
The maximum saturation with microdispersed KCl of the solidified DuraLid reference electrolyte is another reason for the good zero point stability and hence long dwelling time of the TopLine electrode. The fiber wick reduces the loss of KCl and allows a very quick collection of pH and ORP data.

TopLine electrode



No.	Description TopLine 83-120 NMSN
1	Screw plug head with Memosens® connection (Alternatively analogue electrodes with VP- or coax- plug head (for versions without integrated temperature sensor))
2	Screw-in thread Pg 13.5 (Material: PPS)
3	O-Ring 11-2.5 (Material: Viton®)
4	HD joint ring 18.8/12.7/6.5 (Material stainless steel 1.4571)
5	Reference element (LoopRef)
6	DuraLid electrolyte (KCl saturated) of the reference electrode
7	Inner buffer of the pH glass electrode
8	Temperature sensor (NTC 30 kOhm)
9	Glass membrane (H-glass)
10	Internal conduction element of the pH glass electrode
11	Junction (fiber packing hole)
12	Peek shaft

Benefits TopLine

- Peek shaft for the highest mechanical and chemical resistance
- Most precise measurements thanks to proven process membrane glasses and reference system
- Maximum dwell time by means of a reference electrode with microdispersed KCl solid electrodes (DuraLid) as well as a multi-diaphragm system with external fiber wick hole and internal labyrinth reference element (LoopRef)
- Wide selection of electrodes for the lab, field and process, even as digital electrodes with IDS and Memosens® head

2.1.4 Application recommendations for pH and ORP electrodes...

The table provides an orientation to the large variety of our electrodes. The listed electrodes give an example for similar measuring models, i.e. variation only regarding the connection system or the integrated temperature sensor. The electrode BlueLine 11 pH for instance also represents the versions 12 pH, 14 pH, 15 pH, 17 pH, 18 pH and 19 pH. These models are also available with longer shaft lengths: ScienceLine pH electrodes N 62 and H 62. An extension of length under the same application conditions delivers faster and more stable measuring results; additionally it enables a longer life of the electrode. The higher electrolyte along with the increased electrolyte outflow reduces unwanted diffusion potentials on the junction and rinses it free.

Some applications may require other electrode recommendations due to certain conditions, as identical applications can differ fundamentally with varying concentrations and temperatures. Please also note the material resistance of the sensor towards the measuring media. The recommended and additional sensors with the corresponding technical data are stated on the following pages and the highlighted last section.

...and conductivity cells

Area of use	Sensor example	pH: TopLine 22	pH: A 7780	pH: H 62	pH: H 64	pH: L 32	pH: L 8280	pH: N 62	pH: N 64	pH BlueLine: 11 pH	pH BlueLine: 22 pH	pH BlueLine: 13 pH	ORP ScienceLine: Ag 6280	ORP ScienceLine: Pt 62	ORP ScienceLine: Pt 8280	ORP BlueLine: 31 RX	ORP BlueLine: 32 RX	ORP TL*: TopLine 32 RX	Conductivity ScienceLine: LF 313 T NFTC	Conductivity ScienceLine: LF 413 T	Conductivity ScienceLine: LF 613 T	Conductivity ScienceLine: LF 713 T
	Application																					
Chemisrty	Etching and degreasing baths			■	■			■	■	■		■		■		■						■
	Bleach and dyeing solutions	■		■	■			■	■	■		■		■		■		■				■
	Cutting oil emulsions	■					■	■	■	■		■		■		■		■				■
	Cyanide detoxification			■	■			■	■	■		■		■		■						■
	Dispersion paint			■	■			■	■			■		■		■						■
	Emulsions, water-based	■		■	■		■	■	■	■		■		■		■		■	■			■
	Emulsions, partly water-based	■						■	■	■		■		■		■		■	■			■
	paint/varnish, water-soluble	■		■	■			■	■	■		■		■		■			■			■
	Fixing bath			■	■			■	■	■		■	■					■	■			■
	Varnish, water-based	■		■	■			■	■	■		■		■		■			■			■
	Varnish, partly water-based							■	■	■		■		■		■			■			■
	Lye, extreme			■	■									■		■		■		■		■
	Oil/water-emulsions	■						■	■	■		■		■		■				■		■
	Organic percentile high							■	■			■		■		■			■			■
	Paper extract			■	■			■	■	■		■		■		■			■			■
	Acid, extreme			■	■			■	■	■		■		■		■						■
	Sulphide containing liquid							■	■					■		■		■	■			■
	Suspension, water-based	■		■	■		■	■	■			■		■		■			■	■		■
	Ink			■	■			■	■			■		■		■			■			■
	Viscose samples				■				■			■		■		■				■		
Field measurements	Stream	■	■			■	■	■	■	■	■	■		■	■	■	■	■		■	■	
	Ground water	■	■			■	■	■	■	■	■	■		■	■	■	■	■		■	■	
	Lake water	■	■			■	■	■	■	■	■	■		■	■	■	■	■		■	■	
	Seawater	■	■			■	■	■	■	■	■	■		■	■	■	■	■		■	■	
	Rain water	■	■			■	■	■	■	■	■	■		■	■	■		■	■	■	■	
Drinks production	Beer	■	■			■	■	■	■	■	■	■		■	■	■		■		■	■	
	Fruit juice	■	■			■	■	■	■	■		■		■	■	■		■		■	■	
	Vegetable juice	■	■			■	■	■	■	■		■		■	■	■		■		■	■	
	Lemonades/soda	■	■			■	■	■	■	■	■	■		■	■	■		■		■	■	
	Mineral water	■	■			■	■	■	■	■	■	■		■	■	■		■		■	■	
	Juice	■	■			■	■	■	■	■		■		■	■	■		■		■	■	
	Spirits	■	■				■	■	■	■		■		■		■		■		■	■	
	Wine	■	■				■	■	■	■		■		■	■	■		■		■	■	
		TopLine 22	A 7780	H 62	H 64	L 32	L 8280	N 62	N 64	11 pH	22 pH	13 pH	Ag 6280	Pt 62	Pt 8280	31 RX	32 RX	TopLine 32 RX	LF 313 T NFTC	LF 413 T	LF 613 T	LF 713 T

* TL = TopLine

Further application recommendations

Area of use	Application	TL* TopLine 22	pH ScienceLine A 7780	N 1048 A	L 32	L 39	L 6880	L 8280	N 62	N 64	pH BlueLine 11 pH	22 pH	13 pH	21 pH	27 pH	ORP ScienceLine Pt 62	Pt 6140	Pt 8280	ORP BlueLine 31 RX	32 RX	TL* TopLine 32 RX	Conductivity ScienceLine LF 313 T NFTC	LF 413 T	LF 613 T	LF 713 T
Cosmetics	Creme	■		■		■	■		■	■	■		■	■	■	■			■		■	■	■		
	Hair dye	■							■	■	■		■			■			■		■	■	■		
	Hair gel	■		■		■	■			■				■	■	■			■		■	■			
	Hair mousse	■							■	■	■		■			■			■		■	■	■		
	Lotions	■							■	■	■		■			■			■		■	■	■		
	Make-up	■							■	■	■		■		■	■			■		■		■		
	Mouth wash	■							■	■	■		■			■			■		■	■	■		
	Shaving cream	■							■	■	■		■			■			■		■	■	■		
	Sun lotion	■							■	■	■		■			■			■		■	■	■		
	Tooth paste	■		■		■	■			■	■		■	■	■	■			■		■	■	■		
Agriculture	Ground (extract/slug)	■	■		■			■	■	■	■		■			■		■	■	■	■		■		
	Fertilizer solution	■	■		■			■	■	■	■	■	■			■		■	■	■	■		■		
	Vegetables	■		■		■	■							■	■		■				■				
	Liquid manure	■	■		■			■	■	■	■		■			■		■	■	■	■		■		
	Fruit	■		■			■							■			■				■				
Food production	Bread/dough/pastry			■			■							■			■								
	Vinegar	■	■						■	■	■	■	■			■		■	■		■		■		■
	Grease								■	■	■		■			■			■				■		
	Fish			■			■							■			■								
	Meat			■			■							■			■								
	Honey			■			■						■	■		■			■				■		
	Margarine								■	■	■		■			■			■				■		
	Coffee extract								■	■	■		■			■		■	■				■	■	
	Jam/marmelade								■	■	■		■			■			■				■		
	Mayonnaise								■	■			■			■		■	■				■		
	Sausage			■		■	■							■	■		■								
Dairy	Butter	■							■	■				■		■			■		■		■		
	Yoghurt	■	■		■				■	■	■		■			■			■		■		■		
	Cheese			■		■	■		■	■				■	■	■			■						
	Milk	■	■		■				■	■	■		■			■			■		■		■		
	Cream	■							■	■	■		■			■			■		■		■		
Surface	Skin					■									■										
	Leather					■									■										
	Paper					■									■										
	Textiles					■									■										
		TopLine 22	A 7780	N 1048 A	L 32	L 39	L 6880	L 8280	N 62	N 64	11 pH	22 pH	13 pH	21 pH	27 pH	Pt 62	Pt 6140	Pt 8280	31 RX	32 RX	TopLine 32 RX	LF 313 T NFTC	LF 413 T	LF 613 T	LF 713 T

... for pH and ORP electrodes and conductivity cells

Area of use	Application	TL* TopLine 22	pH ScienceLine A 157	A 7780	H 62	H 64	N 1048 A	L 32	L 39	L 6880	L 8280	N 62	N 64	N 6000 A	N 6003	pH BlueLine 11 pH	22 pH	13 pH	16 pH	21 pH	27 pH	ORP ScienceLine Pt 62	Pt 6140	Pt 8280	Pt 5900 A	BL* 31 RX	32 RX	TL* TopLine 32 RX	Conductivity ScienceLine LF 213 T	LF 313 T	LF 313 T NFTC	LF 413 T	LF 613 T	LF 713 T
Pharmazie, Biologie, Biotechnologie, Medizin, Mikrobiologie	Agar-agar gel						■		■	■										■	■		■											
	Enzym solution	■														■		■				■			■	■		■						■
	Infusion solutions											■	■			■		■				■				■								■
	Small vessels/sample quantity		■											■	■				■						■									
	Bacteria cultures	■	■	■								■	■	■	■	■		■	■			■				■		■						■
	Gastric juice	■										■	■			■		■				■				■		■						■
	NMR tubes														■																			
	Precision measurement											■	■									■				■								
	Protein containing liquid	■										■	■									■				■		■						
	Serum		■									■	■	■	■				■			■			■	■								■
	Tris puffer																																	■
	Urine	■										■	■			■		■				■				■		■						■
	Vials		■											■					■						■								
Technical	Cooling water	■		■								■	■			■		■				■				■		■		■				
	Lye, hot				■	■																■				■								■
	Acid, hot				■	■																■				■								■
Washing agents	Detergents	■										■	■			■		■				■				■		■			■	■	■	■
	Disinfectant	■										■	■			■		■				■				■		■				■		■
	Cleaning agent	■										■	■			■		■				■				■		■			■	■		
	Soap solution	■										■	■			■		■				■				■		■			■	■		
	Dishwashing liquid	■										■	■			■		■				■				■		■			■	■		
	Surfactant solution	■										■	■			■		■				■				■		■			■	■		
Water	Waste water, general	■		■	■			■			■	■	■			■	■	■				■		■		■	■						■	
	Aquarium water	■		■				■				■	■			■	■	■				■		■		■	■						■	
	Demineralization/ion exchanger											■	■			■		■				■				■					■	■		
	pH values, extreme				■	■												■				■				■								■
	Media containing low ions			■								■	■			■		■				■				■					■	■		
	Boiler feed water			■								■	■			■		■				■				■			■	■	■			
	Condensate			■								■	■			■		■				■				■			■	■	■			
	Purity water												■			■		■				■				■			■					
	Salt solution	■		■	■			■			■					■		■				■		■		■	■						■	
	Drinking water	■		■								■	■			■		■				■		■		■	■				■	■	■	
	Drops							■												■														
		TopLine 22	A 157	A 7780	H 62	H 64	N 1048 A	L 32	L 39	L 6880	L 8280	N 62	N 64	N 6000 A	N 6003	11 pH	22 pH	13 pH	16 pH	21 pH	27 pH	Pt 62	Pt 6140	Pt 8280	Pt 5900 A	31 RX	32 RX	TopLine 32 RX	LF 213 T	LF 313 T	LF 313 T NFTC	LF 413 T	LF 613 T	LF 713 T

* BL = BlueLine
* TL = TopLine

2.2.1 IDS

New features

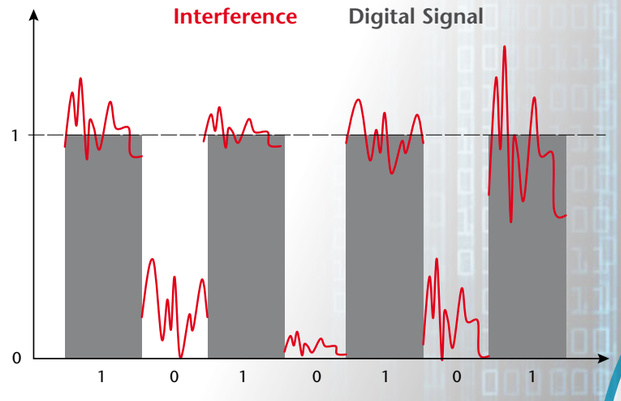
INTELLIGENT
DIGITAL
SENSORS

SI Anayltics' IDS: Intelligent, Digital Sensors technology for the standard parameters pH, conductivity and dissolved oxygen consists of two components, Digital sensors and matching field or benchtop meters. This new processing of the measured values no longer takes place in the device, exclusively in the sensor so that every sensor has it's own data base when connected.

Built on the basic sensor of the BlueLine and ScienceLine series that have proven themselves tens of thousands of times over, the IDS sensors have added precision and reliability and cover almost any application.

I intelligent:
IDS sensors are intelligent. They log into the device automatically, submit their name, serial number, calibration status and history as well as all parameters.

D digital:
IDS sensors transform the sensitive measuring signals in the sensor head into digital signals and transmit them to the output device without interference and errors.



S sensor:
IDS sensors are based on proven and continuously developed sensors by SI Analytics. They cover almost any lab application, like pH, conductivity or dissolved oxygen measurements.

SI Analytics also offers titrators with IDS:
TitroLine® 7800

Cond
O_2
pH

SI Analytics also offers Field meters with IDS:
HandyLab 680

Cond
O_2
pH

IDS Sensors

Unique.

IDS combines proven measuring technology with new advantages. Based on established electrochemical SI Analytics sensors, but equipped with state-of-the-art measuring electronics IDS save the serial number and calibration data in the sensor. However, IDS also process measuring signals directly and thus improve the data quality. This also allows a current evaluation of the sensor quality by means of the QSC (Quality Sensor Control) function.

IDS combine proven technology with new advantages.

- High-quality, highly developed sensor technology combined with state-of-the-art measuring electronics.
- IDS have saved the serial number and calibration history – error-free and therefore immediately ready for use.
- Current evaluation of the sensor quality for IDS pH electrodes thanks to QSC (Quality Sensor Control).
- IDS conductivity measurement: Two sensors to cover all applications.

IDS sensors

IDS types

Type	Measuring function	Application range
A 157 IDS	pH micro cylinder + temp.	-5..100 °C pH 0-14
A 161/162 IDS	pH sphere + temp.	-5..100 °C pH 0-14
A 6880 IDS	pH spear + temp.	-5..100 °C pH 0-14
A 7780 IDS	pH sphere + temp.	-5..80 °C pH 0-14
BL 14 pH IDS	pH cone + temp.	-5..100 °C pH 0-14
BL 21 pH IDS	pH spear	-5..80 °C pH 2-13
BL 24/24-3 pH IDS	pH cylinder	-5..80 °C pH 0-14
BL 27 pH IDS	pH flat	-5..50 °C pH 2-13
BL 31 RX IDS	ORP platinum disk, 4 mm Ø + temp.	-5..100 °C
BL 32/32-3 RX IDS	ORP platinum pin, 1 mm Ø + temp.	-5..80 °C
FDO 1100/1100 3M IDS	Oxygen optical (photoluminiscence) + temp.	0.. 50 °C 0 ... 20 mg/l O_2
IL-Micro-pHT-IDS	pH micro cylinder + temp.	-5..100 °C pH 0..14
IL-pHT-A120/ 170 MF-IDS	pH sphere + temp.	-5..100 °C pH 0..14
IL-Sp-pHT-IDS	pH spear + temp.	-5..100 °C pH 0..14
LF313T IDS	Conductivity stainless steel + temp.	-5..100 °C 0,01..200 µS/cm
LF 413T/413T 3M IDS	Conductivity graphite + temp.	-5..80 °C 1 µS/cm..2000 mS/cm

INTELLIGENT DIGITAL SENSORS

- Resistant against environmental influences
- QSC takes the guess work out of the determining the health of your sensor
- Effortless capture and storage of your sensors latest calibration data
- Highest possible operator comfort and measuring precision

Benefits
IDS Electrodes

2.2.2 ScienceLine pH combination electrodes

pH combination electrodes with plug head and fixed cable

Reference system: Silamid®
Shaft material: glass
Zero point: pH = 7.0 ± 0.3
Electrolyte: KCl 3 mol/l (except N 6250: KCl 4.2 mol/l, A 7780 and L 7780: gel electrolyte, L 8280: Referid® electrolyte)
Membrane shape: sphere
pH range: 0 to 14
Connection cable for plug head: e.g. L 1 A (See also page with connection cables)
fixed cable: 1 m long, with plug A acc. to DIN 19262 or with BNC plug

H 61 *H 62 H 63 N 61 N 62 H 6180 H 6280 H 6380 N 6180 N 6250 N 6280 N 42 A N 42 BNC N 50 A N 52 A N 52 BNC N 61 eis H 61-500 H 61-600*

H 64 *H 64 1M-DIN-ID H 64 1M-BNC-ID N 64 N 6480 eis N 6480 eth*

N 65 *H 65 H 6580 N 6580*

L 32

A 7780 *L 7780*

N 6980

L 8280

Order No.	Type No.	Length L [mm]	Ø [mm]	Junction	pH-glass	Temp. range [°C]	Connection	Remarks
285101260	A 7780	120	12	3 x ceramic	A	–5 to + 80	plug head	gel electrolyte
285100207	H 61	170	12	platinum	H	+ 10 to + 100	plug head	
285092583	H 61-500	500	12	platinum	H	0 to + 100	plug head	
285092591	H 61-600	600	12	platinum	H	0 to + 100	plug head	
285102524	H 6180	170	12	ceramic	H	+ 10 to + 100	plug head	
285100215	H 62	120	12	platinum	H	+ 10 to + 100	plug head	
285102532	H 6280	120	12	ceramic	H	+ 10 to + 100	plug head	
285100223	H 63	320	12	platinum	H	+ 10 to + 100	plug head	
285102549	H 6380	320	12	ceramic	H	+ 10 to + 100	plug head	
285100231	H 64	170	12	ground joint	H	+ 10 to + 100	plug head	
285130220	H 64 1M-DIN-ID	170	12	ground joint	H	+ 10 to + 100	DIN plug[2)]	ID function
285130230	H 64 1M-BNC-ID	170	12	ground joint	H	+ 10 to + 100	BNC plug[2)]	ID function
285100248	H 65	103[1)]	10	platinum	H	+ 10 to + 100	plug head	standard taper NS 14.5
285102565	H 6580	103[1)]	10	ceramic	H	+ 10 to + 100	plug head	standard taper NS 14.5
1061093	L 32	120	12	fibre	A	–5 to + 50	plug head	plastic shaft
285101252	L 7780	120	12	ceramic	A	–5 to + 80	plug head	gel electrolyte
285101277	L 8280	120	12	KPG®	A	–5 to + 80	plug head	Referid® electrolyte
285100437	N 42 A	120	12	ceramic	A	–5 to + 100	DIN plug[2)]	
285101544	N 42 BNC	120	12	ceramic	A	–5 to + 100	BNC plug[2)]	
285100453	N 50 A	108	12	ceramic	A	–5 to + 100	DIN plug[2)]	for portable Knick pH meters
285100494	N 52 A	120	12	platinum	A	–5 to + 100	DIN plug[2)]	
285105451	N 52 BNC	120	12	platinum	A	–5 to + 100	BNC plug[2)]	
285100001	N 61	170	12	platinum	A	–5 to + 100	plug head	
285100018	N 6180	170	12	ceramic	A	–5 to + 100	plug head	
285100034	N 62	120	12	platinum	A	–5 to + 100	plug head	
285100112	N 6250	120	12	ceramic	A	+ 15 to + 40	plug head	calomel ref., for TRIS buffers
285100042	N 6280	120	12	ceramic	A	–5 to + 100	plug head	
285100059	N 64	170	12	ground joint	A	–5 to + 100	plug head	
285100067	N 65	103[1)]	10	platinum	A	–5 to + 100	plug head	standard taper NS 14.5
285102516	N 6580	103[1)]	10	ceramic	A	–5 to + 100	plug head	standard taper NS 14.5
285101709	N 6980	103[1)]	10	ground joint	A	–5 to + 100	plug head	standard taper NS 14.5
285092661	N 61eis	170	12	3 x platinum	A	+ 10 to + 40	plug head	electrolyte L 5014, Ag / AgCl ref.
285092337	N 6480 eis	170	12	ground joint	A	+ 10 to + 40	plug head	electrolyte L 5014, Ag / AgCl ref.
285092329	N 6480 eth	170	12	ground joint	A	0 to + 40	plug head	electrolyte L 5014, Ag / AgCl ref.

[1)] Length from upper end of standard taper
[2)] with 1 m fixed cable

2.2.2.1 ScienceLine pH combination electrodes with temperature sensor

pH combination electrodes with temperature sensor

Reference system:	Silamid®
Shaft material:	glass
Diameter:	12 mm
Zero point:	pH = 7.0 ± 0.3
Electrolyte:	KCl 3 mol/l
Temperature sensor:	Pt 1000
Membrane shape:	sphere
pH range:	0 to 14
Connection cable:	
for SMEK-plug head:	e.g. LS 1 ANN (See also page with connection cables)
fixed cable:	1 m long, with plug A acc. to DIN 19262 or with BNC plug, as well as plug for temperature sensor

N 1042 A
N 1041 A
N 1041BNC
N 1042 BNC
N 1050 A
N 1051 A
N 1051 BNC
N 1052 A
N 1052 BNC
N 2041 A
N 2042 A
N 1041 A - 600
N 1043 A

A 161 1M DIN ID
A 161 1M BNC ID
A 161 IDS
A 162 IDS
H 161 1M DIN ID
H 161 1M BNC ID

A 164 1M DIN ID
A 164 1M BNC ID

A 7780 1M DIN ID
A 7780 1M BNC ID
A 7780 IDS

electrodes with temperature sensor

Order No.	Type No.	Length L [mm]	Junction	pH-glass	Temp.-range [°C]	Connection	Remarks
85100090	A 161 IDS	170	platinum	A	–5 to +100	IDS plug	IDS function
285130240	A 161 1M-DIN-ID	170	platinum	A	–5 to +100	DIN[1]- + 4-mm plug	ID function
285130250	A 161 1M-BNC-ID	170	platinum	A	–5 to +100	BNC[1]- + 4-mm plug	ID function
285100120	A 162 IDS	120	platinum	A	–5 to +100	IDS plug	IDS function
285130280	A 164 1M-DIN-ID	170	ground joint	A	–5 to +100	DIN[1]- + 4-mm plug	ID function
285130290	A 164 1M-BNC-ID	170	ground joint	A	–5 to +100	BNC[1]- + 4-mm plug	ID function
285101080	A 7780 IDS	120	3 x ceramic	A	–5 to +80	IDS plug	IDS function
285130200	A 7780 1M-DIN-ID	120	3 x ceramic	A	–5 to +80	DIN-[1] + 4-mm plug	ID function
285130210	A 7780 1M-BNC-ID	120	3 x ceramic	A	–5 to +80	BNC-[1] + 4-mm plug	ID function
285130260	H 161 1M-DIN-ID	170	platinum	H	+10 to +100	DIN[1]- + 4-mm plug	ID function
285130270	H 161 1M-BNC-ID	170	platinum	H	+10 to +100	BNC[1]- + 4-mm plug	ID function
285100486	N 1041 A	170	ceramic	A	–5 to +100	DIN-[1] + 4-mm plug	
285093111	N 1041 A-600	600	ceramic	A	–5 to +100	DIN-[1] + 4-mm plug	Ag/AgCl ref.
285100531	N 1041 BNC	170	ceramic	A	–5 to +100	BNC-[1] + 4-mm plug	
285104541	N 1042 A	120	ceramic	A	–5 to +100	DIN-[1] + 4-mm plug	
285105476	N 1042 BNC	120	ceramic	A	–5 to +100	BNC-[1] + 4-mm plug	
285093009	N 1043 A	320	ceramic	A	–5 to +100	DIN-[1] + 4-mm plug	
285100375	N 1050 A	108	ceramic	A	–5 to +100	DIN-[1] + 4-mm plug	for portable Knick pH Meter
285100510	N 1051 A	170	platinum	A	–5 to +100	DIN-[1] + 4-mm plug	
285100500	N 1051 BNC	170	platinum	A	–5 to +100	BNC-[1] + 4-mm plug	
1054512	N 1052 A	120	platinum	A	–5 to +100	DIN-[1] + 4-mm plug	
285100380	N 1052 BNC	120	platinum	A	–5 to +100	BNC-[1] + 4-mm plug	
285100342	N 2041 A	170	ceramic	A	–5 to +100	DIN-[1] + 2-mm plug	
285100359	N 2042 A	120	ceramic	A	–5 to +100	DIN-[1] + 2-mm plug	

[1] with 1 m fixed cable

2.2.2.2 ScienceLine micro, spear tip

pH combination electrodes with temperature sensor

Reference system: Silamid®
Shaft material: glass
Diameter: 12 mm
Zero point: pH = 7.0 ± 0.3
Electrolyte: KCl 3 mol/l
Temperature sensor: Pt 1000
Membrane shape: sphere
pH range: 0 to 14
Connection cable:
for SMEK-plug head: e.g. LS 1 ANN (See also page with connection cables)
fixed cable: 1 m long, with plug A acc. to DIN 19262 or with BNC plug, as well as plug for temperature sensor

A 157 1M BNC ID	N 5800 A	N 6000 1M DIN ID	N 6003	A 6880 IDS	N 1048 A	L 39
A 157	*N 5800 BNC*	*N 6000 1M BNC ID*		*L 6880*	*N 1048 1M BNC ID*	*L 39 1M DIN ID*
A 157 1M DIN ID	*N 5900 A*	*N 6000 A*		*L 6880 1M-DIN-ID*	*N 1048 1M DIN ID*	*L 39 1M DIN ID*
A 157 IDS		*N 6000 BNC*		*L 6880 1M-BNC-ID*	*N 48 A*	
				L 8880	*N 48 BNC*	

and surface combination electrodes

Order No.	Type No.	Length L [mm]	Ø [mm]	Junction	pH-glass	Membrane shape	Temp.-range [°C]	Range [pH]	Connection	Remarks
Micro										
285100080	A 157 IDS	70/130	12/5	platinum	A	cylindrical	–5 to +100	0 to 14	IDS plug	IDS function
285130160	A 157 1M-DIN-ID[1]	70/130	12/5	platinum	A	cylindrical	–5 to +100	0 to 14	DIN plug[3]	ID function
285130170	A 157 1M-BNC-ID[1]	70/130	12/5	platinum	A	cylindrical	–5 to +100	0 to 14	BNC plug[3]	ID function
285105127	N 5800 A	96[2]	5	3 x platinum	A	spear	–5 to +100	0 to 14	DIN plug[3]	Ag/AgCl ref.
285105579	N 5800 BNC	96[2]	5	3 x platinum	A	spear	–5 to +100	0 to 14	BNC plug[3]	Ag/AgCl ref.
285105135	N 5900 A	96[2]	5	platinum	A	sphere	–5 to +100	0 to 14	DIN plug[3]	Ag/AgCl ref.
285105151	N 6000 A	96[2]	3	platinum	A	cylindrical	–5 to +100	0 to 14	DIN plug[3]	Ag/AgCl ref.
285105632	N 6000 BNC	96[2]	3	platinum	A	cylindrical	–5 to +100	0 to 14	BNC plug[3]	Ag/AgCl ref.
285130180	N 6000 1M-DIN-ID	96[2]	3	platinum	A	cylindrical	–5 to +100	0 to 14	DIN plug[3]	ID function, Ag/AgCl ref.
285130190	N 6000 1M-BNC-ID	96[2]	3	platinum	A	cylindrical	–5 to +100	0 to 14	BNC plug[3]	ID function, Ag/AgCl ref.
285105176	N 6003	70/180	12/3	ceramic	A	cylindrical	–5 to +100	0 to 14	plug head	Ag/AgCl ref.
Spear tip										
285100100	A 6880 IDS	70/50	12/8	3 x ceramic	A	spear	–5 to +100	0 to 14	IDS plug	IDS function
285101211	L 6880	70/50	12/8	3 x ceramic	A	spear	–5 to +100	0 to 14	plug head	
285130100	L 6880 1M-DIN-ID	70/50	12/8	3 x ceramic	A	spear	–5 to +100	0 to 14	DIN plug[3]	ID function
285130110	L 6880 1M-BNC-ID	70/50	12/8	3 x ceramic	A	spear	–5 to +100	0 to 14	BNC plug[3]	ID function
285101285	L 8880	70/50	12/8	hole	A	spear	–5 to +80	2 to 13	plug head	
285104611	N 1048 A[1]	120	12	ceramic	A	spear	–5 to +100	0 to 14	DIN-[3] + 4-mm plug	
285130120	N 1048 1M-DIN-ID[1]	120	12	ceramic	A	spear	–5 to +100	0 to 14	DIN-[3] + 4-mm plug	ID function
285130130	N 1048 1M-BNC-ID[1]	120	12	ceramic	A	spear	–5 to +100	0 to 14	BNC-[3] + 4-mm plug	ID function
285100445	N 48 A	120	12	ceramic	A	spear	–5 to +100	0 to 14	DIN plug[3]	
285101569	N 48 BNC	120	12	ceramic	A	spear	–5 to +100	0 to 14	BNC plug[3]	
Surface										
1061094	L 39	120	12	fibre	A	flat	–5 to +50	1 to 13	plug head	
285130140	L 39 1M-DIN-ID	120	12	fibre	A	flat	–5 to +50	1 to 13	DIN plug[3]	ID function
285130150	L 39 1M-BNC-ID	120	12	fibre	A	flat	–5 to +50	1 to 13	BNC plug[3]	ID function

[1] with integrated temperature sensor Pt 1000
[2] Length from upper end of standard taper (Standard taper NS 7.5)
[3] with 1 m fixed cable

2.2.2.3 ScienceLine

Metal combination electrodes with Silver/Silverchloride reference system, plug head and connection cable

Temperature range: –5 to + 100 °C (except Pt 6140: + 10 to + 40 °C)
Reference system: Silamid®
Shaft material: glass
Electrolyte: KCl 3 mol/l (See also remarks)
Connection cable for plug head: e.g. L 1 A (See also page with connection cables)
fixed cable: 1 m long, with plug A acc. to DIN 19262 or with BNC plug

Metal-Reference electrodes with pH glass membrane reference system and plug head for titrations

Temperature range: -5 to + 100 °C
Reference system: pH glass membrane Type A
Shaft material: glass
Length: 120 mm
Diameter: 12 mm
Connection cable for plug head: z.B. L 1 A
(please refer to the page “connection cables”)

AgCl 62
AgCl 65
Ag 42 A
Ag 6180
Ag 6280
Ag 6580
AgCl 6280
Au 6280

Pt 61
Pt 62
Pt 6180
Pt 6280
Pt 6580
Pt 42 A

Pt 6880
Pt 6980
Pt 48 A

Pt 6140

Pt 8280

Pt 5900 A
Pt 5900 BNC
Pt 5901

Pt 62 RG
Ag 62 RG
AgCl 62 RG
AgS 62 RG

Metal combination electrodes

Order No.	Type No.	Length L [mm]	Junction	Ø [mm]	Sensor Metal, shape	Connection	Remarks
285102051	Ag 42 A	120	ceramic	12	Ag, cap, 5 mm Ø	DIN plug[4]	electrolyte L 2114, Ag/AgCl ref.
285102208	Ag 6180	170	ceramic	12	Ag, cap, 5 mm Ø	plug head	electrolyte L 2114, Ag/AgCl ref.
285102343	Ag 6280	120	ceramic	12	Ag, cap, 5 mm Ø	plug head	electrolyte L 2114, Ag/AgCl ref.
285102216	Ag 6580	103[1]	ceramic	10	Ag, cap, 5 mm Ø	plug head	electrolyte L 2114, Ag/AgCl ref.
285102351	AgCl 6280[3]	120	ceramic	12	Ag, cap, 5 mm Ø	plug head	electrolyte L 2114, Ag/AgCl ref.
285102413	AgCl 62[3]	120	platinum	12	Ag, cap, 5 mm Ø	plug head	electrolyte L 2114, Ag/AgCl ref.
1061051	AgCl 65[3]	103[1]	platinum	12	Ag, cap, 5 mm Ø	plug head	electrolyte L 2114, Ag/AgCl ref.
285102121	Au 6280	120	ceramic	12	Au, pole, 2 mm Ø	plug head	
285102302	Pt 42 A	120	ceramic	12	Pt, pole, 1 mm Ø	DIN plug[4]	
285102224	Pt 48 A	120	ceramic	12	Pt, ring, 6 mm Ø	DIN plug[4]	Ag/AgCl ref.
285105192	Pt 5900 A	96[2]	platinum	5	Pt, pole, 1 mm Ø	DIN plug[4]	Ag/AgCl ref.
285105702	Pt 5900 BNC	96[2]	platinum	5	Pt, pole, 1 mm Ø	BNC plug[4]	Ag/AgCl ref.
285105065	Pt 5901	160[2]	platinum	5	Pt, pole, 1 mm Ø	plug head	
285102002	Pt 61	170	platinum	12	Pt, pole, 1 mm Ø	plug head	
285102019	Pt 62	120	platinum	12	Pt, pole, 1 mm Ø	plug head	
285097162	Pt 6140	150/20	platinum	12/5	Pt, pole, 1 mm Ø	plug head	for spear tip, electrolyte L420
285102232	Pt 6180	170	ceramic	12	Pt, pole, 1 mm Ø	plug head	
285102249	Pt 6280	120	ceramic	12	Pt, pole, 1 mm Ø	plug head	
285102257	Pt 6580	103[1]	ceramic	10	Pt, pole, 1 mm Ø	plug head	
285100075	Pt 6880	120	ceramic	12	Pt, ring, 6 mm Ø	plug head	
285102265	Pt 6980	170	ceramic	12	Pt, ring, 6 mm Ø	plug head	
285102281	Pt 8280	120	KPG®	12	Pt, round, 6 mm Ø	plug head	electrolyte Referid®
285102090	Ag 62 RG	120	–	12	Pt bearing – silver coated, ring, 6 mm Ø	plug head	
285102100	AgCl 62 RG	120	–	12	Pt-bearing – silver coated, chlorinated, ring, 6 mm Ø	plug head	
285102110	AgS 62 RG	120	–	12	Pt bearing – silver coated, sulfidized, ring, 6 mm Ø	plug head	
285102070	Pt 62 RG	120	–	12	Pt, ring, 6 mm Ø	plug head	

[1] Length from upper end of standard taper; standard taper NS 14.5
[2] Length from upper end of standard taper; standard taper NS 7.5
[3] Sensor coated with AgCl
[4] with 1 m fixed cable

2.2.2.4 ScienceLine Single electrodes:

ScienceLine single electrodes

pH glass electrodes

Reference system: Silamid®
Shaft material: glass, 12 mm Ø
Zero point: pH = 7.0 ± 0.3
Membrane shape: sphere
Connection cable: e.g. L 1 A

Metal electrodes

Shaft material: glass, 12 mm Ø
(See remarks)

A 1180
H 1180

Ag 1100

KF 1100

Pt 1400
Pt 1200

Pt 1800

pH glass and metal electrodes

Order No.	Type No.	Length L [mm]	pH Glass	Range [pH]	Temp.-range [°C]	Remarks
1057997	A 1180[1]	120	H	0 to 14	0 to + 80	plug head
285103212	H 1180	120	H	0 to 14	10 to + 100	plug head

Order No.	Type No.	Length L [mm]	Sensor Metal	Sensor shape	Temp. range [°C]	Remarks
285103607	Ag 1100	120	Ag	cap, 4 mm Ø	– 5 to + 100	plug head, cable e.g. L 1 A
285102030	KF 1100	96[1]	Pt[2]	2 pole, 1 mm Ø	– 30 to + 135	shaft 5 mm Ø, standard taper NS 7.5, fixed cable, 2 x 4-mm plug
285103512	Pt 1200	120	Pt[2]	2 pole, 1 mm Ø	– 30 to + 135	plug head, cable e.g. L 1 NN
285103537	Pt 1400	103[1]	Pt[2]	2 pole, 1 mm Ø	– 30 to + 135	shaft 10 mm Ø, standard taper NS 14.5, cable e.g. L 1 NN
285103553	Pt 1800	120	Pt	ring, 6 mm Ø	– 30 to + 135	plug head, cable e.g. L 1 A

[1] Length from upper end of standard taper
[2] Double platinum electrode

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2.2.2.5 ScienceLine Single electrodes:

Reference electrodes

Shaft material: glass
Electrolyte depending on reference system:
Ag/AgCl: KCl 3 mol/l, e.g. L 300
Calomel: KCl 4.2 mol/l, e.g. L 420
Hg/Hg_2SO_4: K_2SO_4 0.6 mol/l, e.g. L 1254
pH range: 0 to 14
Connection cable: e.g. L 1 N

B 2220+ | B 2420+ | B 2810+ *B 2820+ B 2910+ B 2920+* | B 3420+ *B 3410+ B 3510+ B 3520+ B 3610+* | B 3920+

Reference electrodes

Order No.	Type No.	Length L [mm]	Ø [mm]	Temp. range [°C]	Junction	Reference system	Remarks
1069994	B 2220+	120	12	–5 to +100	platinum	Ag/AgCl	double electrolyte system
1070028	B 2420+	120	12	–5 to +100	ground joint	Ag/AgCl	
1070029	B 2810+	120	12	+15 to +40	ceramic	Calomel	
1070044	B 2820+	120	12	–5 to +100	ceramic	Ag/AgCl	
1070077	B 2910+	120	12	+15 to +40	platinum	Calomel	
1070046	B 2920+	120	12	–5 to +100	platinum	Ag/AgCl	
1070048	B 3410+	103[1)]	10	+15 to +40	ceramic	Calomel	standard taper NS 14.5
1070070	B 3420+	103[1)]	10	–5 to +100	ceramic	Ag/AgCl	standard taper NS 14.5
1070100	B 3510+	103[1)]	10	+15 to +40	platinum	Calomel	standard taper NS 14.5
1070073	B 3520+	103[1)]	10	–5 to +100	platinum	Ag/AgCl	standard taper NS 14.5
1070074	B 3610+	103[1)]	10	+15 to +40	ceramic	Hg/Hg_2SO_4	standard taper NS 14.5
1070075	B 3920+	103[1)]	10	–5 to +100	ground joint	Ag/AgCl	double electrolyte system, standard taper NS 14.5

[1)] Length from upper end of standard taper

2.2.2.6 ScienceLine

Conductivity measuring cells with fixed cable and 8-pole plug

Temperature sensor: NTC 30 kΩ

LF 213 T	LF 313 T NTFC	LF 413 T-3	LF 513 T	LF 713 T	LF 913 T	LFOX 1400	LF 413T 3M Fork	LF 435 T
LF 213 T ID	*LF 313 T* *LF 313 T ID* *LF 313 T IDS*	*LF 413 T* *LF 413 T ID* *LF 413 T IDS* *LF 413 T3M IDS*	*LF 613 T* *LF 813 T*	*LF 713 T-250*	*LF 913 T ID*	*LFOX 1400 ID*	*LF 413T 3M Fork IDS*	

conductivity cells with cable

Order No.	Type No.	Length L [mm]	Ø [mm]	Sensor	Cell const. ~ [cm^{-1}]	Temp. range [°C]	Meas. range[1)] [µS/cm]. . .[mS/cm]	Remarks
285106150	LF 213 T	120	12	Stainless steel	0.01	0 to + 100	0 to 0.03	Trace conductivity cell with integrated flow-through vessel, stainless steel, 1.5 m cable
285106160	LF 213 T ID	120	12	Stainless steel	0.01	0 to + 100	0 to 0.03	Trace conductivity cell with integrated flow-through vessel, stainless steel, 1.5 m cable, ID function
285414360	LF 313 T	120	12	Stainless steel	0.1	0 to + 100	0 to 0.2	Ultrapure water conductivity cell with flow-through vessel, stainless steel shaft, fixed cable 1.5 m
285130300	LF 313 T-ID	120	12	Stainless steel	0.1	0 to + 100	0 to 0.2	Ultrapure water conductivity cell with flow-through vessel, stainless steel shaft, cable 1.5 m, ID function
285414351	LF 313 T NFTC	120	12	Stainless steel	0.1	0 to + 100	0 to 0.2	Ultrapure water conductivity cell without flow-through vessel, stainless steel shaft, fixed cable 1.5 m
285202430	LF 313 T IDS	120	12	Stainless steel	0.1	–5 to + 100	0 to 0.2	Ultrapure water conductivity cell with flow-through vessel, stainless steel shaft, cable 1.5 m, IDS function
285106172	LF 413 T	120	15.3	4 x Graphite	0.475	–5 to + 80	1 to 2,000	Plastic shaft, 1.5 m cable
285130310	LF 413 T-ID	120	15.3	4 x Graphite	0.475	–5 to + 80	1 to 2,000	Plastic shaft, 1.5 m cable, ID function
2852024410	LF 413 T-IDS	120	15.3	4 x Graphite	0.475	–5 to + 80	1 to 2,000	Plastic shaft, 1.5 m cable, IDS function
285106148	LF 413 T-3	120	15.3	4 x Graphite	0.475	–5 to + 80	1 to 2,000	Plastic shaft, fixed cable 3 m
285106280	LF 413 T 3M FORK	120	15.3	4 x Graphite	0.47	–5 to + 80	1 to 2,000	Plastic shaft, fixed cable 3 m
285106290	LF 413 T 3M FORK IDS	120	15,3	4 x Graphite	0.47	–5 to + 80	1 to 2,000	Plastic shaft, 3 m cable
285206420	LF 435 T	120	15.3	Graphite	0.33	–5 to + 80	1 to 500	Plastic shaft, 3 m cable
285106037	LF 513 T	120	12	2 Pt rings	1.0	–5 to + 80	1 to 200	Plastic shaft, 1 m cable
285106131	LF 613 T	120	12	4 Pt rings	1.0	–5 to + 80	1 to 2,000	Plastic shaft, 1 m cable
285106189	LF 713 T	120	12	4 Pt rings	1.0	–30 to + 135	1 to 2,000	Glass shaft, 1 m cable
285106190	LF 713 T-250	250	12	4 Pt rings	1.0	–30 to + 135	1 to 2,000	Glass shaft, 1 m cable
285106250	LF 813 T	120	12	5 Pt rings	0.650	–5 to + 80	1 to 2,000	Plastic shaft, 1 m cable
285106260	LF 913 T	120	12	5 Pt rings	0.650	–30 to + 135	1 to 2,000	Glass shaft, 1 m cable
285130320	LF 913 T-ID	120	12	5 Pt rings	0.650	–30 to + 135	1 to 2,000	glass shaft, 1 m cable, ID function
285104630	LFOX 1400	145	15.3	Graphite	0.475	0 to + 50	1 to 2,000	Combined 4-pole conductivity cell and galvanic D.O. sensor LFOX 1400 ID, plastic shaft, fixed cable 3 m
285130330	LFOX 1400 ID	145	15.3	Graphite	0.475	0 to + 50	1 to 2,000	Combined 4-pole conductivity cell and galvanic D.O. sensor LFOX 1400 ID, plastic shaft, fixed cable 3 m, ID function

[1)] Outside the recommended ranges measuring errors > 10 % can occur with these conductivity measuring cells.

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2.2.2.7 ScienceLine Sensors for

Ammonia combination electrode with plug head

Shaft material: plastic, 12 mm Ø
Connection cable: e.g. L 1 A

Sodium combination electrode with plug head

Reference system: Silamid®
Shaft material: glass, 12 mm Ø
Zero point: pNa = 2.0
Membrane shape: sphere
Connection cable: e.g. L 1 A

ISE measuring cells

Shaft material: plastic
Length: 120 mm
Fixed cable: 1 m long, with DIN plug

ISE combination electrodes with plug head

Shaft material: plastic
Length: 120 mm

NH 1100 | Na 61 | 9009/61 | Cu 1100 A *Ca 1100 A F 1100 A Pb 1100 A* | F 60 *Cl 60 NO 60 K 60 CA 60 CN 60 AG-S 60 I 60 BR 60 CU 60 PB 60* | OX 1113T

ammonia, sodium, oxygen,ion-selective indicator electrodes

Order No.	Type No.	Length L [mm]	Temp. range [°C]	Meas. range [mg/l]	Remarks
285102808	NH 1100	120	0 to + 50	0.1 to 1,000	membrane module replaceable

Order No.	Type No.	Length L [mm]	Junction	Membrane Glass	Temp. range [°C]	Meas. range [pNa]	Remarks
285100026	Na 61	170	platinum	Na	-10 to +80	0 to 6	electrolyte KCl 3 mol/l, aqueous solution NaCl 0.1 mol/l

Order No.	Type No.	Length L [mm]	Temp. range [°C]	Meas. range [mg/l]	Remarks
285111664	9009/61	145	0 to + 50	0 to 50	amperometric sensor, Au cathode, Pb anode, fixed cable 1.5 m[1)] with 8-pole plug, IMT temperature compensation, shaft 15.25 mm Ø, membrane FEP, 13 µm thick, accuracy 1% at 18 cm/s flow rate.
285206410	OX 1113 T	120	-5 to +45	0 to 20	Membrane covered amperometric sensor, plastic shaft, with temperature compensation, 1 m fixed cable with 8-pole plu
285202440	FDO 1100 IDS	150	0 to + 50	0 to 20	IDS optical oxygen sensor (photoluminescence), plastic shaft, temperature sensor NTC30kOhm, 1.5 m fixed cable with digital plug
285202450	FDO 1100 3M IDS	150	0 to + 50	0 to 20	IDS optical oxygen sensor (photoluminescence), plastic shaft, temperature sensor NTC30kOhm, 3 m fixed cable with digital plug

Order No.	Type No.	Parameter	Temp. range [°C]	pH-range	Measuring range [mg/l]
285216314	Ca 1100 A	Calcium	0 to + 40	2.5 to 11	0.02 to 40,000
285216312	Cu 1100 A	Copper	0 to + 80	2 to 6	0.0006 to 6,400
285216313	F 1100 A	Fluoride	0 to + 80	5 to 7	0.02 to saturated
285216315	Pb 1100 A	Lead	0 to + 80	4 to 7	0.1 to 20,000

Order No.	Type No.	Parameter	Temp. range [°C]	pH-range	Measuring range [mg/l]
285130340	F 60	Fluoride	0 to + 80	5 to 7	0.02 to saturated
285130350	Cl 60	Chloride	0 to + 80	2 to 12	2 to 35,000
285130360	NO 60	Nitrate	0 to + 40	2.5 to 11	0.4 to 62,000
285130370	K 60	Potassium	0 to + 40	2 to 12	0.04 to 39,000
285130380	CA 60	Calcium	0 to + 40	2.5 to 11	0.02 to 40,000
285130390	CN 60	Cyanide	0 to + 80	0 to 14	0.2 to 260
285130400	AG-S 60	Sulfide / silver	0 to + 80	2 to 12	0.003 to 32,000 / 0,01 to 108.000
285130410	I 60	Iodide	0 to + 80	0 to 14	0.006 to 127,000
285130420	BR 60	Bromide	0 to + 80	1 to 12	0.4 to 79,000
285130430	CU 60	Copper	0 to + 80	2 to 6	0.0006 to 6400
285130440	PB 60	Lead	0 to + 80	4 to 7	0.2 to 20,000

[1)] Other cable lengths available on request

2.2.3 Resistance thermometers

Resistance thermometers
with 1 m fixed cable

Resistance thermometer
with coaxial plug head

W 5780 NN | W 5790 NN *W 5790 PP W 5791 NN* | W 5980 NN | W 2180-KOAX

Resistance thermometers with SMEK plug head

Resistance thermometers with 1 m fixed cable

Order No.	Type No.	Lenght L [mm]	Ø [mm]	Sensor	Temp. range [°C]	Shaft material	Connection plug
285105221	W 5780 NN	120	6	Pt 1,000	–30 to +135	glass	2 x 4 mm Ø
285105254	W 5790 NN	120	4	Pt 1,000	–30 to +135	stainless steel	2 x 4 mm Ø
285105776	W 5790 PP	120	4	Pt 1,000	–30 to +135	stainless steel	2 x 4 mm Ø
285105262	W 5791 NN	170	4	Pt 1,000	–30 to +135	stainless steel	2 x 4 mm Ø
285105287	W 5980 NN	96[1)]	5 NS 7.5	Pt 1,000	–30 to +135	glass	2 x 4 mm Ø

Resistance thermometer with coaxial plug head

Order No.	Type No.	Length L [mm]	Ø [mm]	Sensor	Temp. range [°C]	Shaft material
285119030	W 2180-KOAX	120	12	Pt 1,000	–30 to +135	glass

[1)] length from upper end of standard taper

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2.2.4 TopLine electrodes

TopLine electrodes
with Memosens® plug head

TopLine electrodes
with fixed cable

TopLine electrodes
with coaxial plug head

TopLine electrodes
with IDS head

TopLine 22 pH
TopLine 23 pH
TopLine 24 pH
TopLine 24 pH IDS
TopLine 25 pH
TopLine 26 pH
TopLine 26 pH Cinch
TopLine 28 pH
TopLine 29 pH
TopLine 32 RX
TopLine 32 RX IDS
TopLine 80-120 pH
TopLine 81-120 pHT VP
TopLine 83-120 NMSN
TopLine 89-120 NMSN
TopLine 89-120 Pt

pH range:	0 … 14
Zero point [pH]:	7
Elektrolyt:	Duralid polymer elektrolyte with oversaturated dispersed KCl
Outer junction:	Fiber packing hole
Reference system:	LoopRef labyrinth
Response time (98% between pH 4 … 7):	< 20 sec.
Shaft material:	PEEK
Shaft diameter [mm]:	12
Shaft length [mm]:	120

Type No.	Order No.	Measuring parameter	Electrode type	Connection	Temperature sensor	Temperature range [°C]	Sensor element	Membrane impedance [MΩ]
TopLine 22 pH	285111135	pH	Analogue	plug head	N.A.	-5…+100	A glass	400
TopLine 23 pH	285111140	pH	Analogue	1 m fixed cable with DIN plug	N.A.	-5…+100	A glass	400
TopLine 24 pH	285111145	pH + Temp	Analogue	1 m fixed cable with DIN- +4-mm banana plug	NTC 30 kOhm	-5…+100	A glass	400
TopLine 24 pH IDS	285111150	pH + Temp	Digital IDS	1.5 m fixed cable with digital plug	NTC 30 kOhm	-5…+100	A glass	400
TopLine 25 pH	285111155	pH	Analogue	1 m fixed cable with BNC plug	N.A.	-5…+100	A glass	400
TopLine 26 pH	285111160	pH + Temp	Analogue	1 m fixed cable with BNC- +4-mm banana plug	NTC 30 kOhm	-5…+100	A glass	400
TopLine 26 pH Cinch	285111165	pH + Temp	Analogue	1 m fixed cable with BNC- +cinch plug	NTC 30 kOhm	-5…+100	A glass	400
TopLine 28 pH	285111170	pH + Temp	Analogue	1 m fixed cable with DIN- +4-mm banana plug	Pt 1000	-5…+100	A glass	400
TopLine 29 pH	285111175	pH + Temp	Analogue	1 m fixed cable with DIN- +4-mm banana plug	Pt 1000	-5…+100	A glass	400
TopLine 32 RX	285111180	ORP	Analogue	Plug head	N.A.	-5…+100	Pt pin	N.A.
TopLine 32 RX IDS	285111185	ORP + Temp	Digital IDS	1.5 m fixed cable with digital plug	NTC 30 kOhm	-5…+100	Pt pin	N.A.
TopLine 80-120 pH	285111190	pH	Analogue	plug head with Pg13.5 thread	N.A.	0…+110	H glass	550
TopLine 81-120 pHT VP	285111195	pH + Temp	Analogue	VP plug head with Pg13.5 thread	Pt 1000	0…+110	H glass	550
TopLine 83-120 NMSN	285111200	pH + Temp	Digital MEMOSENS®	MEMOSENS® plug head with Pg13.5 thread	NTC 30 kOhm	0…+110	H glass	550
TopLine 89-120 NMSN	285111205	ORP + Temp	Digital MEMOSENS®	MEMOSENS® plug head with Pg13.5 thread	NTC 30 kOhm	0…+110	Pt pin	N.A.
TopLine 89-120 Pt	285111210	ORP	Analogue	coax plug head with Pg13.5 thread	N.A.	0…+110	Pt pin	N.A.

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2.2.5.1 BlueLine

The robust electrodes for general applications

pH range	0 to 14
Temperature range	-5 to +80 °C
Shaft	Noryl, 12 mm Ø
Shaft length L	120 mm
Zero point	pH = 7.0 ± 0.3
Junction	fibre
Reference system	Ag/AgCl
Reference electrolyte	gel (KCl), low maintenance, not refillable
Shape of glass membrane	cylindrical
Resistance of glass membrane (25 °C)	400 MΩ
Type of membrane glass	A

The liquid electrolyte electrodes for demanding measurements

pH range	0 to 14
Temperature range	-5 to +100 °C
Shaft	glass, 12 mm Ø
Shaft length L L	120 mm
Zero point	pH = 7.0 ± 0.3
Junction	platinum
Reference system	Ag/AgCl
Reference electrolyte	KCl 3 mol/l
Shape of glass membrane	conical
Resistance of glass membrane (25 °C)	200 MΩ
Type of membrane glass	A

BlueLine 28 pH
22 pH
23 pH
23-2 pH
23-5 pH-S
24 pH
24-3 pH
24 pH IDS
24-3 pH IDS
25 pH
25-2 pH
25-5 pH
26 pH
26 pH-Cinch
28 pH-P
28-5 pH
29 pH
29 pH-P

BlueLine 18 pH
11 pH
12 pH
14 pH
14 pH ID
14 pH IDS
15 pH
15 pH ID
15 pH Cinch
17 pH
17 pH-R
19 pH

pH single-rod measuring cells

Order No.	BlueLine Type No.	Temperature sensor integrated	Connection
285129225	22 pH	no	plug head, recommended cable: e.g. LB1A
285129233	23 pH	no	1 m fixed cable with DIN plug 19 262
1063462	23-2 pH	no	2 m fixed cable with DIN plug
1066411	23-5 pH-S	no	5 m fixed cable with S plug
285129241	24 pH	NTC 30 kΩ	1 m fixed cable with DIN plug 19 262 + banana plug
285129533	24-3 pH	NTC 30 kΩ	3 m fixed cable with DIN plug 19 262 + banana plug
285128240	24 pH IDS	NTC 30 kΩ	1.5 m fixed cable with IDS plug
285429243	24-3 pH IDS	NTC 30 kΩ	3 m fixed cable with IDS plug
285129258	25 pH	no	1 m fixed cable with BNC plug
1063461	25-2 pH	no	2 m fixed cable with BNC plug
285129540	25-5 pH	no	5 m fixed cable with BNC plug
285129266	26 pH	NTC 30 kΩ	1 m fixed cable with BNC plug + banana plug
285095712	26 pH-Cinch	NTC 30 kΩ	1 m fixed cable with BNC plug + cinch plug
285129282	28 pH	Pt 1000	1 m fixed cable with DIN plug 19 262 + banana plug
1065896	28 pH-P	Pt 1000	1 m fixed cable with DIN plug 19 262 + 2-mm pole plug
285129570	28-5 pH	Pt 1000	5 m fixed cable with DIN plug 19 262 + banana plug
1065895	29 pH	Pt 1000	1 m fixed cable with BNC plug + banana plug
1065894	29 pH-P	Pt 1000	1 m fixed cable with BNC plug + 2-mm pole plug

Order No.	BlueLine Type No.	Temperature sensor integrated	Connection
285129114	11 pH	no	plug head, recommended cable: e.g. LB1A
285129122	12 pH	no	1 m fixed cable with DIN plug 19 262
285129147	14 pH	NTC 30 kΩ	1 m fixed cable with DIN plug 19 262 + banana plug
285129440	14 pH ID	NTC 30 kΩ	1 m fixed cable with DIN plug + banana plug, ID function
285129140	14 pH IDS	NTC 30 kΩ	1.5 m fixed cable with IDS plug
285129155	15 pH	NTC 30 kΩ	1 m fixed cable with BNC plug + banana plug
285129450	15 pH ID	NTC 30 kΩ	1 m fixed cable with BNC plug + banana plug, ID function
285095730	15 pH Cinch	NTC 30 kΩ	1 m fixed cable with BNC plug + cinch plug
285129171	17 pH	no	1 m fixed cable with BNC plug
1064746	17 pH-R	no	1 m fixed cable with Metrohm plug
285129188	18 pH	Pt 1000	1 m fixed cable with DIN plug 19 262 + banana plug
285129190	19 pH	Pt 1000	1 m fixed cable with BNC plug + banana plug

2.2.5.2 BlueLine - Special sensors

The specialists
for special applications

Zero point of
pH electrodes
pH = 7.0 ± 0.3

Connection cable
for pH/Redox
electrodes
e.g. LB 1 A

BlueLine 13 pH	BlueLine 16 pH	BlueLine 21 pH	BlueLine 27 pH	BlueLine 54 pH	BlueLine 31 Rx	BlueLine 32 Rx	BlueLine 48 LF
		21 pH 1M DIN ID	*27 pH 1M DIN ID*	*BlueLine 56 pH*	*31 Rx IDS*	*32 Rx IDS*	
		21 pH 1M BNC ID	*27 pH 1M BNC ID*	*BlueLine 56 pH Cinch*		*32-3 Rx IDS*	
		21 pH IDS	*27 pH IDS*				

Precision electrode **BlueLine 13 pH**	Glass shaft, screw ground joint junction, electrolyte KCl 3 mol/l, Ag/AgCl reference system, spherical membrane, A-glass, plug head, length 170 mm, 12 mm Ø, –5 to +100 °C, 0 to 14 pH, Order No. 285129139
Micro electrode **BlueLine 16 pH**	Glass shaft, platinum junction, electrolyte KCl 3 mol/l, Ag/AgCl reference system, spherical membrane, A-glass, plug head, length 40/80 mm, 12/5 mm Ø, –5 to +100 °C, 0 to 14 pH, Order No. 285129163
Spear tip electrode **BlueLine 21 pH**	Glass shaft, hole junction, Referid® electrolyte, Ag/AgCl reference system, Spear membrane, A-glass, plug head, length 65/25 mm, 12/5 mm Ø, –5 to +80 °C, 2 to 13 pH, Order No. 285129217
Spear tip electrode with sensor recognition **BlueLine 21 pH 1M-DIN-ID**	Like BlueLine 21 pH but with 1 m fixed cable with DIN plug and sensor recognition Order No. 285129930
Spear tip electrode with sensor recognition **BlueLine 21 pH 1M-BNC-ID**	Like BlueLine 21 pH but with 1 m fixed cable with BNC plug and sensor recognition Order No. 285129940
Spea tip electrode with IDS function **BlueLine 21 pH IDS**	Plastic shaft, hole-junction, Referid® electrolyte, Ag/AgCl-reference system, temp. sensor NTC 30 kOhm, spear membrane, A-glass, 1.5 m fixed cable with digital plug, length 90 (65/25) mm, 12/5 mm Ø, -5...+80 °C, 2...13 pH Order No. 285129210
Surface electrode **BlueLine 27 pH**	Glass shaft, KPG® annular gap junction, Referid® electrolyte, Ag/AgCl reference system, flat membrane, A-glass, plug head, length 120 mm, 12 mm Ø, –5 to +50 °C, 2 to 13 pH, Order No. 285129274
Surface electrode with sensor recognition **BlueLine 27 pH 1M-DIN-ID**	Like BlueLine 27 pH but with 1 m fixed cable with DIN plug and sensor recognition Order No. 285129950
Surface electrode with sensor recognition **BlueLine 27 pH 1M-BNC-ID**	Like BlueLine 27 pH but with 1 m fixed cable with BNC plug and sensor recognition Order No. 285129960
Surface electrode with IDS function **BlueLine 27 pH IDS**	Glass shaft, KPG-annular-gap-junction, Referid® electrolyte, Ag/AgCl-reference system, temp.-sensor NTC 30 kOhm, flat membrane, L glass, 1.5 m fixed cable with digital plug, length120 mm, 12 mm Ø, -5...+50 °C, 2...13 pH Order No. 285129270
Combination electrode with plastic shaft **BlueLine 54 pH**	Ceramic junction, electrolyte KCl 3 mol/l, Ag/AgCl-reference system, temp.-sensor NTC 30 kW, cylinder membrane, A glass, 1 m fixed cable with BNC- +4-mm banana plug, length 120 mm, 12 mm Ø, –5 to +80 °C, 0 to 14 pH Order No. 285129460
Combination electrode with plastic shaft **BlueLine 56 pH**	Like BlueLine 54 pH but with BNC plug Order No. 285129640
Combination electrode with plactic shaft **Blueline 56 pH cinch**	Like BlueLine 54 pH but with BNC and cinch plug Order No. 285129650
Redox electrode **BlueLine 31 Rx**	Glass shaft, ceramic junction, electrolyte KCl 3 mol/l, Ag/AgCl reference system, sensor platinum disk 4 mm Ø, plug head, length 120 mm, 12 mm Ø, –5 to +100 °C, Order No. 285129311
Redox electrode with IDS function **BlueLine 31 Rx IDS**	Glass shaft, ceramic junction, electrolyte KCl 3 mol/l, Ag/AgCl-reference system, temp.-sensor NTC 30 kOhm, sensor platinum disk 4 mm Ø, 1.5 m fixed cable with digital plug, length 120 mm, 12 mm Ø, -5...+100 °C Order No. 285129310
Redox electrode **BlueLine 32 Rx**	Plastic shaft, fibre junction, gel electrolyte, Ag/AgCl reference system, sensor platinum pin 1 mm Ø, plug head, length 120 mm, 12 mm Ø, –5 to +80 °C, Order No. 285129320
Redox electrode with IDS function **BlueLine 32 Rx IDS**	Plastic shaft, fibre junction, gel electrolyte, Ag/AgCl-reference system, temp.-sensor NTC 30 kOhm, sensor platinum pin 1 mm Ø, 1.5 m fixed cable with digital plug, length 120 mm, 12 mm Ø, -5...+80 °C Order No. 285129321
Redox electrode with IDS function **Blue Line 32-3 Rx IDS**	Plastic shaft, fibre-junction, gel electrolyte, Ag/AgCl-reference system, temp.-sensor NTC 30 kOhm, sensor platinum pin 1 mm Ø, 3 m fixed cable with digital plug, length 120 mm, 12 mm Ø, -5...+80 °C Order No. 285129323
Conductivity cell for low ionic media **BlueLine 48 LF**	Stainless steel shaft, 2-pin cell, 1 m fixed cable with 8-pole plug, sensor stainless steel, cell constant 0.1 cm–1, temperature sensor NTC 30 kW, length 120 mm, 12 mm Ø, –5 to +100 °C, measuring range 0 to 300 µS/cm, Order No. 285129488

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2.2.6 Puncture knife

The determination of the pH value is one of the most important analyzes in the quality control of food. SI Analytics® offers special puncture electrodes, such as the variants of the BlueLine 21 pH. These are also available with an integrated temperature sensor, which contributes greatly to the measurement safety in the measurement in chilled foods.

The pH measurement in semi-solid and solid foods such as meat, sausage and cheese is optimized by our puncture knife (Z503). This is especially designed for electrodes of type BlueLine 21 pH. In addition to extending the lifetime of the electrode, the Z503 puncture knife significantly increases safety and comfort during measurement:

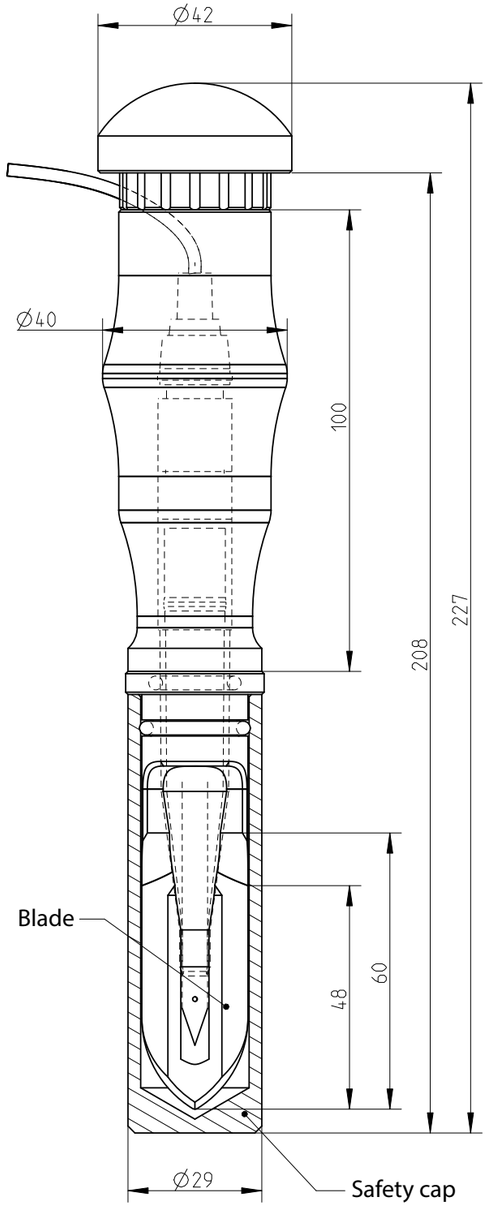
- The blade of the puncture knife is slightly rounded at the tip, so that it can slip off the bone if it accidentally hits one.
- Low risk of slipping due to ergonomic handle contour.
- The extraordinary cable lead below the "head", the so-called ball knob, prevents kinking of the electrode cable.
- The ball knob can also be used for exerting pressure for the punctuation.

Technical data

Blade	Shaft	O-ring
DIN 1.4108, stainless steel, CRONIDUR 30	PBT (natural)	EPDM

Ordering information

Type No.	Order No.	Description
Z503	285122940	Puncture knife for BlueLine 21 pH variants



All measurements are mm

- Facilitates measurement even in stronger material.
- Increases the security of the measurement.
- Extends the life of the electrode.
- Reduces the cost per measurement.

Benefits
Puncture knife

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2.2.7 Connection cables

1 Electrode socket/plug

Coaxial plug for pH, redox, ammonia and sodium combination electrodes, pH and redox single electrodes as well as reference electrodes in *Plus* series. The L and LB series plugs are compatible. The LB sockets are matching colors with the BlueLine electrodes.

plug L
plug LB

VP-6-pin plug for pH combination electrodes with temperature sensor as well as conductivity measuring cells with VP plug head and integrated temperature sensor

plug VP

Electrode plug for reference electrodes from the predecessor series, i.e. *"non-Plus"* versions

plug B

Plug for resistance thermometers in conductivity measuring cells without temperature sensor, for older models

plug 9907/00

Plug for conductivity measuring cells with temperature sensor and oxygen cells, for older models

plug 9909/00

2 Instrument connector/plug

A (DIN 19 262)

BNC

EE (Radiometer)

R (Metrohm)

S (UK socket without extension)

N (4-mm banana plug)

P (2-mm pole plug)

8-pole (for Handylab and Lab and ProLab conductometer)

9910/00

Not illustrated:

X (without instrument plug, meaning free cable end)

The connecting cables are available in various combinations of electrode socket, instrument plug and cable length. Should you i.e. require a coaxial cable for connecting a pH electrode to a meter, please select i.e.a cable type L 1 A. The "L" as part of the type description stands for the coaxial plug (please refer to page 86) of the electrode, the middle number stands for the cable length and the "A" for the instrument connection (in this example for a DIN plug).

In case you do not find your desired cable combination listed below, please contact us.

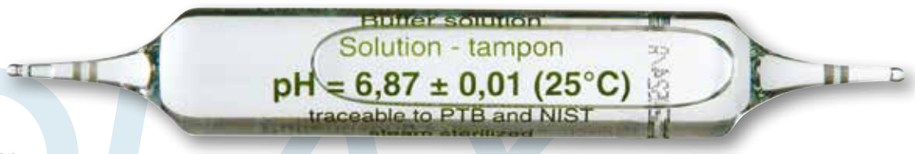
Order No.	Type No.	1 Electrode socket/plug	2 Instrument connector/plug	Cable length and type
285122904	A 1 A	DIN instrument plug (A)	DIN instrument plug (A)	1 m coax. cable
285123793	A 1 BNC	DIN instrument plug (A)	BNC instrument plug	1 m coax. cable
285121916	B 1 N	reference electrode plug (B)	Banana plug (N)	1 m single conductor cable
285122012	B 1 P	reference electrode plug (B)	2 mm Pole plug (P)	1 m single conductor cable
285121813	B 1 X	reference electrode plug (B)	free end (X)	1 m single conductor cable
285122456	L 1 A	electrode plug (L)	DIN instrument plug (A)	1 m coax. cable
285122497	L 1 BNC	electrode plug (L)	BNC instrument plug	1 m coax. cable
285122501	L 1 EE	electrode plug (L)	Radiometer instrument plug (EE)	1 m coax. cable
285122457	L 1 N	electrode plug (L)	Banana plug (N)	1 m coax. cable
285122489	L 1 NN	electrode plug (L)	2 x banana plug (N)	1 m coax. cable
285122534	L 1 R	electrode plug (L)	Metrohm instrument plug (R)	1 m coax. cable
285122407	L 1 X	electrode plug (L)	free end (X)	1 m coax. cable
285122464	L 2 A	electrode plug (L)	DIN instrument plug (A)	2 m coax. cable
285122448	L 2 NN	electrode plug (L)	2 x 4 mm banana plug (N)	2 m coax. cable
285122653	LB 1 A	electrode plug (LB)	DIN instrument plug (A)	1 m coax. cable
285122661	LB 1 BNC	electrode plug (LB)	BNC instrument plug	1 m coax. cable
285122678	LB 3 A	electrode plug (LB)	DIN instrument plug (A)	3 m coax. cable
285124716	9907/21	electrode plug (9907/00)	2 x 4-mm plug (N) for LF cells	1 m two-conductor cable
285125618	9909/31	electrode plug (9907/00)	2 x 4-mm plug (N)	1 m two-conductor cable
285125515	9910/11	electrode plug (9909/00)	9910	1 m four-conductor cable
285125215	9910/21	electrode plug (9909/00)	9910	1 m four-conductor cable, shielded
285125523	9919/21	electrode plug (9907/00)	8-pole instrument plug	1 m two-conductor cable
285125548	9919/41	electrode plug (9909/00)	8-pole instrument plug	1 m four-conductor cable
285122820	LVP 1 ANN	VP 6-pin	DIN and 2 x banana plug	1 m KA19
285122830	LVP 1 BNCNN	VP 6-pin	BNC and 2 x banana plug	1 m KA19
285122840	LVP 3 ANN	VP 6-pin	DIN and 2 x banana plug	3 m KA19
285122860	LVP 5 BNCNN	VP 6-pin	BNC and 2 x banana plug	5 m KA19
285122810	LVP 1 ST4 S	VP 6-pin	4-pin step connector	1 m KA19

Cable

Other plug/cable combinations available on request

2.2.8 Solutions

Buffer solutions in the unique double-end ampoules offer a particularly high degree of reliability and measuring accuracy.



The exactness of the pH measurement is mainly dependent on the accuracy of calibration. This again highly depends on the reliability of the buffer.

Hermetically sealed in the glass ampoule and sterilized with hot steam, same as a pharmaceutical product, the buffer solutions free of preservation agent have an extremely long shelf life and guarantee continuously error-free characteristics.

The ampoules can be easily opened at the breaking point. Tools are not required. Since refilling is not possible, you are always ensured of maximum calibration reliability.

- Highest measurement reliability
- Extremely long storage times, thanks to hot-steam sterilization
- No preservative agents
- Maximize calibration reliability

Benefits *Ampoules*

Standard buffer solutions according to DIN 19 266
Hot steam sterilized for longer stability, no preservation agents used.

Order No.	Type No.	pH value at 25 °C	Contents
285137977	L 4791	1.68	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138246	L 4794	4.01	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138254	L 4796	6.87	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138262	L 4799	9.18	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138402	L 4790	4.01 / 6.87	2 x 30 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285137985	L 4797	1.68 / 6.87 / 9.18	3 x 20 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138238	L 4798	4.01 / 6.87 / 9.18	3 x 20 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138279	L 4893 / Set	4.01 / 6.87	2 x 9 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate, with electrolyte solution L 3008

Order No.	Type No.	pH value at 25 °C	Contents
285137841	L 168	1.68	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285137677	L 1684	1.68	250 ml in DURAN® glass bottle, with manufacturer's certificate
285138098	L 401	4.01	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285138008	L 4014	4.01	250 ml in DURAN® glass bottle, with manufacturer's certificate
285138102	L 687	6.87	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285138016	L 6874	6.87	250 ml in DURAN® glass bottle, with manufacturer's certificate
285138119	L 918	9.18	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285138024	L 9184	9.18	250 ml in DURAN® glass bottle, with manufacturer's certificate

* 20 ml volume = ~17 ml content

Technical buffer solutions
Hot steam sterilized for longer stability, no preservation agents used.

Order No.	Type No.	pH value at 25 °C	Contents
285138213	L 4694	4.00	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138221	L 4697	7.00	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138205	L 4691	10.01	60 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138398	L 4690	4.00 / 7.00	2 x 30 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138192	L 4698	4.00 / 7.00 / 10.01	3 x 20 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate
285138632	L 4895 / Set	4.00 / 7.00	2 x 9 FIOLAX® ampoules à 20 ml*, with manufacturer's certificate, with electrolyte solution L 3008,

Order No.	Type No.	pH value at 25 °C	Contents
285138727	L 400	4.00	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285138032	L 4004	4.00	250 ml in DURAN® glass bottle, with manufacturer's certificate
285138735	L 700	7.00	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285138049	L 7004	7.00	250 ml in DURAN® glass bottle, with manufacturer's certificate
285138719	L 100	10.01	1,000 ml in DURAN® glass bottle, with manufacturer's certificate
285138057	L 1004	10.01	250 ml in DURAN® glass bottle, with manufacturer's certificate

* 20 ml volume = ~17 ml content

Solutions

Color-coded technical buffer solutions in plastic bottles

Order No.	Type No.	pH value at 25 °C	Contents
285139156	LC 4004 K	4.01	250 ml in PE bottle
285139189	LC 7004 K	7.00	250 ml in PE bottle
285139218	LC 1004 K	10.01	250 ml in PE bottle

Electrolyte solutions, aqueous
for reference electrodes, as electrolyte bridges and for storage

Order No.	Type No.	Description	Contents
285136956	L 101	potassium chloride solution 1 mol/l	1,000 ml in DURAN® glass bottle, sterilized
285138649	L 1254	potassium sulfate solution 0.6 mol/l	250 ml in DURAN® glass bottle
285138151	L 200	low temperature electrolyte (–30 °C)	1,000 ml in DURAN® glass bottle
285138365	L 2004	low temperature electrolyte (–30 °C)	250 ml in DURAN® glass bottle
285138349	L 2114	2 mol/l KNO_3 + 0.001 mol/l KCl for Ag combination electrodes	250 ml in DURAN® glass bottle
285136923	L 2214	2 mol/l KNO_3 + 0.001 mol/l KCl for Ag combination electrodes, thickened	250 ml in DURAN® glass bottle
285138332	L 2224	potassium chloride solution 2 mol/l	250 ml in DURAN® glass bottle
285138554	L 300	potassium chloride solution 3 mol/l	1,000 ml in DURAN® glass bottle, sterilized
285138427	L 3004	potassium chloride solution 3 mol/l	250 ml in DURAN® glass bottle, sterilized
285138505	L 3008	potassium chloride solution 3 mol/l	50 ml in PE bottle
285138419	L 3014	potassium chloride solution 3 mol/l, Ag/AgCl saturated	250 ml in DURAN® glass bottle
285138468	L 310	potassium chloride solution 2 mol/l, gel for sterilizable electrodes	1,000 ml in DURAN® glass bottle
285138484	L 3104	potassium chloride solution 2 mol/l, gel for sterilizable electrodes	250 ml in DURAN® glass bottle
285138702	L 320 K	potassium chloride solution 2 mol/l, gel for Ag_2S electrodes	1,000 ml in DURAN® glass bottle
285138143	L 350	potassium chloride solution 3.5 mol/l	1,000 ml in DURAN® glass bottle, sterilized
285138127	L 3504	potassium chloride solution 3.5 mol/l	250 ml in DURAN® glass bottle, sterilized
285138587	L 420	potassium chloride solution 4.2 mol/l	1,000 ml in DURAN® glass bottle
285138608	L 4204	potassium chloride solution 4.2 mol/l	250 ml in DURAN® glass bottle
285138590	L 911	storage electrolyte solution, sterilized	1,000 ml in DURAN® glass bottle
285138560	L 9114	storage electrolyte solution, sterilized	250 ml in DURAN® glass bottle

Electrolyte solutions, organic
for measurements in organic solutions for reference electrodes and as electrolyte bridges

Order No.	Type No.	Description	Contents
285138324	L 5014	LiCl saturated in glacial acetic acid	250 ml in DURAN® glass bottle
285138308	L 5034	LiCl 1,5 mol/l in ethanol	250 ml in DURAN® glass bottle

Solutions for oxygen measurements

Order No.	Type No.	Description	Contents
285138513	L 6708	electrolyte for oxygen electrodes OX 1100/OX 1100+/OX 1101	50 ml in PE bottle
285126606	OX 920	electrolyte for oxygen electrodes 9009/61	50 ml in PE bottle
285126614	OX 921	cleaning solution for oxygen electrodes 9009/61	30 ml in PE bottle
285138287	OX 060	zero point solution for oxygen electrodes OX 1100/OX 1100+	60 FIOLAX® ampoules à 20 ml volume = ~17 ml content

Solutions for ammonia measurements

Order No.	Type No.	Description	Contents
285137344	L 6408	electrolyte for ammonia combination electrodes	50 ml in PE bottle

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Solutions

Solutions and accessories for conductivity measurements

Order No.	Type No.	Description	Contents
285126503	LF 990	test solution KCl 0.001 mol/l (147 µS/cm)	3 x 6 FIOLAX® ampoules à 20 ml*, with manufacturer certificate
285126511	LF 991	test solution KCl 0.01 mol/l (1.41 mS/cm)	3 x 6 FIOLAX® ampoules à 20 ml*, with manufacturer certificate
285126528	LF 992	test solution KCl 0.1 mol/l (12.9 mS/cm)	3 x 6 FIOLAX® ampoules à 20 ml*, with manufacturer certificate
285126293	LF 995	test solutions KCl 0.01 / 0.1 / 1 mol/l (1.41 / 12.9 / 112 mS/cm)	3 x 6 FIOLAX® ampoules à 20 ml*, with manufacturer certificate
285126166	LF 1000 / Set	same as LF 999 / set, in addition platinizing vessel and cable B 1 N	3 x 6 FIOLAX® ampoules à 20 ml*, with manufacturer certificate
285136907	LF 1024	test solution KCl 0.01 mol/l (1.41 mS/cm)	250 ml in PE bottle
285126530	LF CSKC13	test solution KCl 1.3 µS/cm (maximum shelf life: unopened three months, opened six hours)	250 ml in PE bottle
285126540	LF CSKC5	test solution KCl 5.0 µS/cm, (maximum shelf life: six months)	500 ml in PE bottle

ORP electrode solutions

Order No.	Type No.	Redox voltage Pt/Calomel (KCl sat.)	Pt/Ag/AgCl (KCl 3 mol/l)	Contents
285138373	L 4619	180 mV	220 mV	60 FIOLAX® ampoules à 20 ml*, acc. to DIN 38 404-C6
285138357	L 4643	430 mV	470 mV	60 FIOLAX® ampoules à 20 ml*,
285138381	L 4660	600 mV	640 mV	60 FIOLAX® ampoules à 20 ml*
285138784	L 4648	180, 430, 600 mV	220, 470, 640 mV	3 x 20 FIOLAX® ampoules à 20 ml*
285138184	L 430	430 mV	470 mV	1,000 ml in DURAN® glass bottle
285138168	L 4304	430 mV	470 mV	250 ml in DURAN® glass bottle

Cleaning solutions for combination electrodes and reference electrodes

Order No.	Type No.	Description	Contents
285138538	L 510	pepsin / hydrochloric acid solution	1,000 ml in DURAN® glass bottle
285138295	L 5104	pepsin / hydrochloric acid solution	250 ml in DURAN® glass bottle

Solutions

* 20 ml volume = ~17 ml content

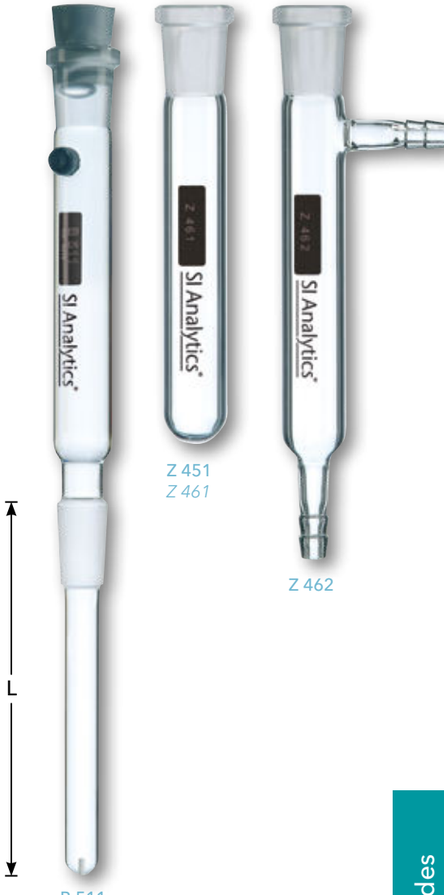
2.2.9 Electrolyte bridges, Accessories

Accessories

Electrolyte bridges
Shaft:glass, 12 mm Ø

Order No.	Type No.	Length L [mm]	Junction	Description
285104209	B 511	103[1]	ceramic	standard taper NS 14.5 and sleeve NS 14.5 for electrode installation
285104217	B 521	120	ceramic	plastic sleeve and sleeve NS 14.5 for electrode installation
285104225	B 522	120	Pt lateral	plastic sleeve and sleeve NS 14.5 for electrode installation
285104233	B 524	120	ground joint	plastic sleeve and sleeve NS 14.5 for electrode installation

[1] Length from upper end of standard taper



Z 451
Z 461

Z 462

B 511

Accessories for electrodes

Order No.	Type No.	Description
285123806	BXX	plug for reference electrodes, single pole
285123703	KXX	coaxial plug for combination electrodes and indicator electrodes
285126482	NH 928	electrolyte for ammonia electrodes in 50 ml plastic bottle, 3 membrane modules
285126499	NH 995	membrane module set: 3 membrane modules, 3 caps
285126639	OX 923	3 spare membrane heads for oxygen electrodes 9009 / 61
285126655	OX 925	maintenance set (OX 920, OX 921, OX 923 and SF 300) for oxygen electrodes 9009 / 61
285126277	OX 929	5 spare membrane heads for oxygen electrodes OX 1100 / OX 1100 + / OX 1101
285126647	OxiCal® SL	calibrating vessel for oxygen electrodes 9009 / 61
285126622	SF 300	grinding foil for oxygen electrodes 9009 / 61
285123728	SXX	coaxial plug for extension cable and for UK socket
285215229	TZ 1520	taper adapter NS 14.5 of PTFE for electrodes with Ø 12 mm shaft
285123103	Z 341	stainless steel clamp for NS 7.5 / 16
285123136	Z 451	measuring and storage vessel with sleeve NS 7.5 / 16
285123170	Z 453	electrode vessel for storing electrodes with Ø 12 mm shaft
285123152	Z 461	measuring and storage vessel with sleeve NS 14.5 / 23
285123169	Z 462	flow-through measuring vessel with sleeve NS 14.5 / 23
285123185	Z 472	watering cap for electrodes with Ø 12 mm shaft
285122961	Z 50	Knick electrode adapter
285123193	Z 501	O-Ring seal 10.5 / 1.5 for electrode plug head
285123214	Z 506	plug head sealing cap with male thread for KXX and BXX plugs
285129509	Z 512	plug head sealing cap with female thread for BlueLine electrodes

Z 453

2.2.10 Tips for successful measurement with pH and ORP electrodes

Chapter 1: How are pH single-rod measuring cells constructed?

Content

Problem

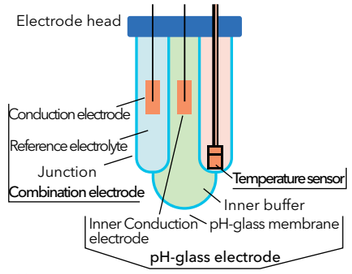
The users can select from a variety of different electrodes for the pH measurement. When first selecting, the selection is often the problem. It is therefore important to describe the components of the pH electrodes including their features, so that the best electrode can be found for the application.

Question

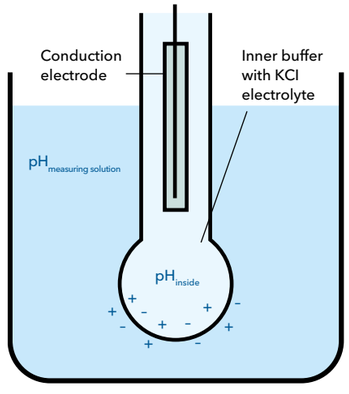
Which components make up a single-rod pH measuring cell and what functions do they have?

Answer

The basic structure of pH electrodes is very simple: As potentiometric measuring chains, they consist of a measuring electrode and a reference electrode. For many years, it has been the state of the art to integrate both in a shaft as single rod measuring cell. In addition, a large proportion of pH electrodes available on the market today have already an installed temperature sensor to automatically compensate the temperature dependence of the electrode slope in the pH meter. The construction of such pH-electrodes is described in DIN 19261 and clearly schematically shown in Figure 1 1.



1 *Structure of a single rod measuring cell*



2 *The processes on the junction of the ' single-rod measuring*

Why does the user need a reference electrode for the pH measurement?

The pH glass electrode is the measuring electrode. The pH signal is generated by it in mV, which is directly proportional to the pH value of the measurement solution. However, the measurement signal can only be measured against a reference electrode, since only differences in potential and therefore voltages can be measured. The reference electrode ideally has a stable, constant potential independent of the pH value and the composition of the medium at all temperatures.

What happens on the glass junction?

The glass junction changes due to the pH value 2. Under the effect of water, alkali ions dissolve from the glass surface and the oxide bridges of the silicate framework partially become OH-groups based on the absorption of water. This is how a "gel layer" develops. This gel layer acts on hydrogen ions as an ion exchanger.

How does the exchange process work?

In the special pH junction glasses, a reproducible balance develops between the solution and the glass surface, which only depends on the hydrogen ion concentration in the solution and in the gel layer.

Finally, the question remains, how the user recognizes the right choice of the measuring chain: The correct measurement chain provides the highest measurement reliability and longest service life in the application.

Conclusion

Only an electrode matching the application achieves the best measurement reliability and maximum service life. It is especially important to pay attention to the type of junction in the selection of the electrode. This is established by the connection between the electrode and the measuring medium. For example, the platinum junction, which provides a fast and stable measurement setting with its defined electrolyte flow and at the same time protects itself against the penetration of the measurement medium, is generally usable.

Chapter 2: Reference systems of pH electrodes

Problem

Besides glass membranes and junctions, pH-electrodes differ in reference systems and junction types (junction). The desired application makes the choice between pH electrode reference systems and junctions easier.

Question

What is a pH electrode reference system and why do I need it? What kind of reference systems are there for pH electrodes and what features can they provide 3?

Answer

The most common method to obtain a pH measurement is by measuring a voltage. To measure a voltage the pH electrode must be able to measure the difference between two points with different electrical potential values. For a pH electrode to provide a voltage measurement of a solution's ion concentration a reference electrode is necessary because its potential essentially remains constant and independent of the solution and temperature relative to the solution being measured. The pH electrode can then use that reference electrode's potential to determine how the solution's ion concentration compares to the reference. The voltage developed from this comparison is then turned into the pH measurement.

The Standard Hydrogen Electrode (SHE) is used as the international reference system. Unfortunately due to its complicated handling requirements it is not typically used for standard applications. A common approved reference system is the Saturated calomel Electrode (SCE), however this electrode contains mercury and is toxic. The most common reference system is the silver/silver chloride reference system (Ag/AgCl). However, Ag/AgCl can precipitate silver when exposed to certain samples. An alternate configurations to the standard silver/silver chloride reference system is the double junction system. The double junction construction isolates the Ag/AgCl from the sample by means of a second chamber containg a simple electrolyte solution such as potassium chloride (KCl). A special type of double junction electrode is the Silamid double junction reference system which is a special construction of the Ag/AgCl reference system. Most electrodes having a Ag/AgCl system are built with an Ag wire coated with AgCl. Silamid reference systems have a glass tube with the inner part coated with Ag,

Reference System	Advantage	Disadvantage
Ag/AgCl	Well described, multifunctional, reproducible, wide temperature range, nontoxic → environmental sustainability	Reference potential depends on temperature and could deliver a different potential, if measured at a different temperature as calibrated
Hg/Hg_2Cl_2 (Calomel)	Stable reference potential	Toxic, low temperature application range 59 to 104 °F (15 to 40 °C)
Tl,Hg/TlCl (Thalamide)	very low hysteresis, broad temperature range, low temperature coefficient	toxic, out of production
Iodine/Iodide	Low polarization, low temperature dependence, free of undesired heavy metal ions	formerly limited long-life-cycle

table 1 : Advantages and disadvantages of different reference systems

Chapter 3:
pH glass electrode types

then filled with AgCl, and plugged with a polyester fibre. This reference system creates greater contact surface area between Ag and AgCl compared to the standard Ag/AgCl wire system. This results in a reference system that is long lasting and very stable. A more recent reference system is the iodine/iodide system. The iodine/iodide reference system does not precipitate silver and can be used with Tris buffers. The advantages and disadvantages of different reference systems are displayed in table 1. Further characteristics of the reference electrode are defined by the junction.

Conclusion

The most important pH electrode reference system is the Ag/AgCl system because it is well described, reproducible, and nontoxic. In the few applications where this reference system does have problems the newer iodine/iodide reference system can be used instead. Due to an absence of silver ions or other contaminating metal ions the iodine/iodide reference system is an excellent alternative when working with applications requiring rapidly changing temperatures. Even with quick changing pH values such as titrations, the iodine/iodide reference system is beneficial.

Problem

There are many different pH glass electrodes on the market. Each pH glass electrode has particular qualities so they should be chosen carefully to suit the measurement application.

Question

What different kinds of pH glass electrodes are available? What are the main characteristics of these electrodes and which membrane glass is recommended for which measurement application?

Answer

Over time the glass membrane of a pH glass electrode changes due to the process of taking pH measurements. Because of exposure to water, alkali ions dissolve from the glass surface and oxide groups of the silicate become OH groups which causes a source layer. This source layer appears to hydrogen ions as an ion exchanger. Using a special pH glass electrode membrane there is a reproducible balance between the sample solution and glass surface, which is only dependent on the hydrogen ion concentration in the solution and the source layer 4.

Because pH glass electrodes have numerous different capabilities many different kinds of membrane glasses are needed to make accurate and reliable pH measurements for all applications. SI Analytics offers five different types: L-, H-, S-, A- and N-glass. The main characteristics of these pH glasses are:

- L: Wide application range, very low impedance resulting in accurate and rapid response times over a large temperature range 3
- H: Optimized for higher temperatures up to 275 °F (135 °C) and extreme pH-values, high accuracy in stronger alkaline range (Na^+)
- S: Tolerates sudden temperature changes, provides constant measurement values with fast response time in hot alkali solutions
- A: Fast response time in drinking water, surface water, sewage, and general applications
- N: At normal temperatures usable for the full pH-range and almost all kinds of samples.

The following examples illustrate the use of different pH glass electrodes: With a strong alkaline media the so called "alkaline measuring error" appears. This error is triggered by the confusion of sodium with hydrogen ions (cross sensitivity) and causes a measurement inaccuracy beginning at a pH value of 12 in presence of sodium ions. Under extreme conditions this inaccuracy could mean a difference up to 1 pH unit. In those cases the H type glass electrode should be used.

3 *Blue pH glass bulp of a pH electrode*

Applications with hot alkaline treatments or sterilization by superheated steam impose great demands on the consistency of the membrane glass. Under these conditions a pH glass electrode usually ages faster and corrodes. In this case the right choice would be a S type pH glass electrode.

In common applications or drinking water measurements the challenge is the variety of applications and the low conductivity of the pH glass electrodes. This could lead to slow response times and unstable or unreliable data. For these demands the A type glass has been developed. It features rapid response times and extended use.

Conclusion

The characteristics of the membrane glass determine the quallity of the characteristics of the pH glass electrodes. Only the right choice of pH glass electrode will provide you with the highest accuracy and reliability.

Chapter 4:
pH calibration and pH solutions

Problem

To calibrate pH measuring systems you must use a solution with a known pH value, also known as pH reference or buffer pH solution. The accuracy of your subsequent pH measurements is dependent on how accurately the pH measuring system is calibrated, so particular attention must be paid to this step. Because there are a great number of different buffer pH solutions available many people are uncertain about how many and what pH calibration solutions should be used.

Question

What is a buffer pH solution and how many pH calibration points are reasonable?

Answer

A buffer pH solution is composed of either a weak acid and the conjugated base or a weak base and the conjugated acid. The main characteristic of a buffer pH calibration solution is that the pH value of the solution will not alter when a small amount of acid or a base is added. Dependant to the used components and their concentration the pH value of the buffer solution can be set over nearly the complete pH range, e.g. with HCl and sodium citrate (pH 1–5), citric acid and sodium citrate (2.5–5.6), acetic acid and sodium acetate (3.7–5.6), Na_2HPO_4 and NaH_2HPO_4 (6–9) or borax sodium hydroxide (9.2–11). The pH value of the calibration solution does not only alter with its composition but with temperature changes. An exact specification of refer

Table 2 : Temperature behavior of reference pH buffer

Temperature in °C	pH		
10	3,997	6,923	9,332
20	4,001	6,881	9,225
25	4,005	6,865	9,180
40	4,027	6,838	9,068
50	4,050	6,833	9,011

ence pH calibration solutions is given by the DIN 19266. The thermal characteristics of these buffer pH calibration solutions have been determined by metrological institutes 5 (see Table 2).

In contrast to reference pH calibration solutions the composition of technical buffer pH solutions is not regulated. So it is important to note that the temperature reaction of those pH calibration solutions can be manufacturer-specific, even if the same nominal pH value is specified at 25 °C. In particular at a calibration temperature other than 25 °C considerable errors can occur with the pH measurement results. In addition to different kinds of buffer pH solutions the calibration procedure plays a major role in determining the accuracy of the pH measurement. The following pH calibration procedures are described in detail in DIN 19288.

- One-point-calibration: A one-point-calibration is accomplished using one reference pH calibration solution. Here only the zero point of the pH electrode is verified and it is assumed that its slope is close to theoretical Nernst slope. This method of pH electrode calibration is the fastest. It is recommended to use this calibration method for comparative only and not for absolute measurements.
- Two-point-calibration: This method is accomplished using two reference pH calibration solutions, with a minimum pH difference of two units. Here the maximum measurable pH value and zero point of the pH electrode are determined by a linear slope cutting through the measuring points (in the application of the measured mV against the nominal pH value of the buffer solution).

Chapter 5:
Accuracy of the pH measurement

- Multipoint-calibration: A multipoint calibration is accomplished with three or more reference pH calibration solutions. The difference between pH solutions should be greater than 0.5 pH units. The pH electrode calibration curve is determined by either linear regression through all measuring points or built from segments between neighbored buffers in which the zero point and slope can be calculated. To evaluate the certainty of the calibration procedure the stability index (R2) could be consulted. It shows whether the theory correlates with the results and should have a value around 1. Often alkaline buffer solutions are used to accomplish a multipoint calibration. These should be checked for freshness and percentage error effect has to be estimated.

Generally a two-point-calibration with DIN buffer pH calibration solutions 4.01 and 6.87 is sufficient, because they are very stable. Furthermore pH electrodes offer due to their high linearity a sufficient measuring security beyond the pH values of the used buffers. Even for additional coverage the two-point-calibration can be checked through an additional measuring of a buffer solution within the range of the estimated pH value.

Conclusion

The higher the required accuracy of the pH measurement, the higher the need for DIN-19266 buffer pH calibration solutions, which provide an accuracy of under 0.01 pH. Multipoint-calibrations should increase the accuracy and for most pH measurement applications a two-point-calibration will be satisfactory.

Problem

The question of the accuracy of pH measurement is not easy to answer because there are many factors that are often not or not precisely known to even the experts. However, one thing is certain: The pH value shown on the pH meter says nothing about its accuracy. The number of decimals is always deceptive in showing an excessively high accuracy.

Question

What are the key factors and how can the accuracy be determined?

Answer

In metrology, the uncertainty is likely selected as a standard for the measurement accuracy. The lower the uncertainty, the higher the measurement accuracy. This uncertainty is a part of every measured value. It is composed of the uncertainties of the individual contributions to the measured value. This difficult subject for the pH measurement is presented easily understandable for the user in standardDIN 19268 [6]. The important temperature effect is disregarded in the standard for the sake of simplicity, and adhering to the temperature constant is assumed. The following, however, must still be included:

- pH of the buffer solutions with uncertainty,
- Uncertainty of the measured values in buffer solutions and
- Uncertainty of the measured value in the sample solution.

In order to ensure a high measurement accuracy for the calibration, buffer solutions according to DIN 19266 are recommended, in which various manufacturers already specified the measurement uncertainty.

Now the question arises as to the uncertainty of the measurement values in these buffer solutions during calibration or adjusting. A dissolution of ±1 digit is assumed for the pH meter. This corresponds to 0.2 mV or 2 mV (depending on the dissolution of the pH meter and its digital display). Then the question of the uncertainty of the pH measuring chain voltage remains. Assuming that the pH glass electrode operates linearly up to pH < 12 prior to insertion of the "alkaline error", the reference electrode with the junction and the interference potential, the liquid junction potential (LJPs) remain as a critical point. The LJPs in buffer solutions according to DIN 19266 in reference/bridge electrolyte amount to about –2.5 mV at 3 – 4 mol/L KCl. If the measurement solution has approximately the same composition (if a buffer solution would be the sample), the LJP would also be in the same order of magnitude. If the composition of the sample solution is not the same, but similar, 0.2 mV is (arbitrarily) added to the uncertainty of the measured values during calibration. If the type and concentration of salts, acids or lyes in the solution significantly varies, the LJPs increase and can only be calculated or estimated according to elaborate equations (e.g. Henderson). The calculation of measurement uncertainties according to DIN 19268 are shown in Table [3] for three different cases. Now the user must decide which case is appropriate for his measurement.

Table [3]: Examples for measurement inaccuracies

Calculation in accordance with DIN 19268		Expanded inaccuracy ± U (k = 2)		
Measured value	value	Case 1	Case 2	Case 3
Puffer1	4.008	0.01	0.02	0.02
Puffer2	6.865	0.01	0.02	0.02
Measurement voltage 1 [mV]	174.6	0.2	0.2	2
Measurement voltage 2 [mV]	6.6	0.2	0.2	2
Measurement voltage x [mV]	-1.4	0.2	0.4	3
Measurement voltage x [pH]	7.001	0.023	0.045	0.131

Chapter 6:
Temperature effect – uncertainty in the pH measurement

Conclusion

At higher demands to the accuracy of the pH measurement for estimation of the overall measurement uncertainty, the knowledge of type and dimension of the measurement uncertainties in detail are required. This estimation can be eased by DIN 19268. The optimal choice of pH electrode and buffer solution helps reducing the uncertainty.

Problem

Varying temperatures affect the measurement of the pH value. These must therefore be included in the uncertainty of the measurement.

Question

What effect does the temperature have in the pH measurement? What are isotherms? How does the temperature compensation work? How does the pH value of buffer solution and the sample change with the temperature?

Answer

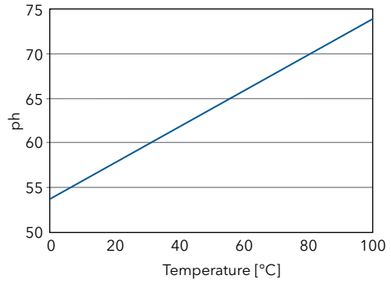
The voltage of the pH combination electrode changes with the temperature. This behavior can be described by the Nernst equation:

$U = U_{0^+}(R \times T/n \times F) \times \ln a_{H^+}$ with

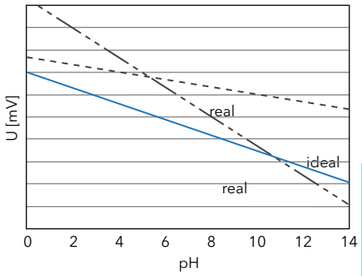
- a_{H^+}: Activity of the hydrogen ion
- U_0: Standard potential
- R: Gas constant 8.3144 J/K*mol
- T: Temperature
- F: Faraday constant 9,6485*10⁴ C/mol
- n: Number of electrons transferred

The Nernst factor (R*T/n*F) indicates the theoretical slope of the electrode. This factor is temperature dependent, it varies between 54.20 mV/pH at 0 °C and 74.04 mV/pH at 100 °C.

In real electrodes, the slope never exactly corresponds to the Nernst factor. In addition, the zero point of the measurement chain, especially in heavily aged electrodes, is temperature dependent. When recording the voltage of a real electrode at two different temperatures at different pH



[4] *Temperature dependency of the Nernst factor* [3]



[5] *Characteristics of a real and an ideal electrode*

values, a characteristic curve is obtained for each temperature. These characteristics, called isotherms, intersect in the isothermal intersection. This intersection can vary markedly from the zero point of the ideal characteristic [5]. When conducting measurements at many variable temperatures, you can even receive a field of isotherm intersections [2].

The temperature compensation of pH meters only takes into account the change of the theoretical slope in temperature changes. When calibrating the metering device at a certain temperature and measures at another temperature as the calibration temperature, the temperature compensation adjusts the slope according to the the-

oretical change of the Nernst factor. Non-ideal behavior of the slope and the zero point is not recorded here. This plays a minor role for less critical applications. However, in measurements with far deviating temperatures that required maximum accuracy, the measuring chain must be calibrated for each measuring temperature with buffers at the same temperature..

The temperature responses for buffer solutions were precisely studied by metrological institutes. DIN buffer solutions are precisely specified by DIN 19266. These buffers show a temperature behavior such as shown in Table 4 5.

Technical buffers display a different temperature behavior than DIN buffer solutions, and their compositions are not defined, i.e. each manufacturer can produce his own mixture. Incorrect measurements can result here due to the lack of knowledge of the temperature responses of the buffer solutions.

The specific temperature dependence of the hydrogen ion activity of the sample is almost never known and therefore can neither be compensated nor be converted to a reference temperetaure as at the conductivity measurement. Hence it is mandatory to note the temperature at which the pH value has been determined. A comparison of the pH values of the same sample at different temperatures is nearly impossible. This frequently results in great variations between operational pH measurements at elevated temperatures and the measurement of the sample in the laboratory at room temperature.

Conclusion

The electrode zero point and slope, in practice, can have deviations from the ideal behavior, which is described by the Nernst equation. The greater the difference in the temperature between the calibration and measurement, the greater the measurement deviations. Deviations from 0.05 to 0.25 pH are possible, depending on the difference between the calibration temperature and the measurement temperature 4 5.

The calibration and measurement should be performed at the same temperature for a possibly precise measurement. Based on the more precise specification, buffer solutions according to DIN 19266 should be applied for the calibration.

In order to evaluate the measurement results and for a complete documentation, the measurement temperature, the electrode used and the calibration conditions must always be specified with the result of the pH measurement. A conversion of the pH value of a sample from the measured temperature to another temperature is not possible.

Temperature in °C	pH		
10	3.997	6.923	9.332
20	4.001	6.881	9.225
25	4.005	6.865	9.180
40	4.027	6.838	9.068
50	4.050	6.833	9.011

Table 4 : Temperature behavior of various DIN 19266 buffer solutions

Chapter 7: Acid and alkaline errors in the pH measurement

Problem

What effects can occur during measurements in solutions with extreme pH values?

Question

What are acid and alkali errors? Under what conditions do they occur? What impact do they have?

Answer

Even measuring chains, which respond ideally over a wide pH range, i.e. linear, can display deviations in the very acidic (< pH 2) or basic (> pH 12) range 6 2.

The effect of these deviations is that too high pH values are displayed in the acid medium and too low pH values in an alkaline medium. In the first case, the acid error is stated and in the second case, the alkali error.

The acid error is generally lower than the alkali error. One cause of the acid error is the incorporation of acid molecules in the gel layer or the change of water activity, resulting in reduction of the H^+ ion activity 2. It is only observed under very extreme conditions in practice. In addition, high concentrations of acids dehydrate the source layer by osmotic pressure and accumulate the hydroxyl groups. Both results in apparently higher pH values 7.

The alkali error is much more relevant to the reliability of the measurement. It occurs when the measuring solution contains alkali ions (e.g. lithium or sodium) and has a pH value of greater than 12. Under these conditions, there is an exchange of alkali ions in the gel layer of the membrane glass and in the measuring solution. This cross sensitivity is also known as sodium error, since a sodium hydrozide solution is frequently used for setting very high pH values 3. Figuratively speaking, the alkali metal ions are detected in addition to the H^+ ions, simulating a lower pH value. Depending on the type of pH membrane glass, the pH value of the measurement solution, the temperature and the alkali ion concentration, the alkali error can amount up to one pH unit.

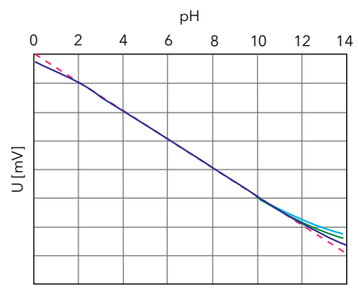
The alkaline error is slight in modern pH glasses. Results from the measurement of pH electrodes with various pH membrane glasses are compared in table 5. The measurements were each made in solutions of the same pH value (once with sodium ions and once without). The concentration of sodium ions equaled 1 mol/l. In order to obtain the maximum accuracy, a pH glass that possibly has a slight alkali error should be noted at this high pH value and high concentration of sodium ions.

Conclusion

In order to achieve the highest possible accuracy of pH measurements, even under extreme conditions, the electrode should be selected to suit the application. At high alkali concentrations and high pH values, a pH electrode with a minimum of alkali errors should be selected.

	pH value without sodium ions	pH value with sodium ions	Alkali error
Electrode 1	13,72	13,15	0,57
Electrode 2	13,77	13,45	0,32
Electrode 3	13,98	13,63	0,35
Electrode 4	13,78	13,21	0,57
Electrode 5	13,80	13,25	0,55

Table 5 : Measurements with different membrane glasses in a solution with pH 14 without and with an addition of sodium ions (concentration 1mol/l).



6 Exemplary mV curve of various electrode for different pH values.

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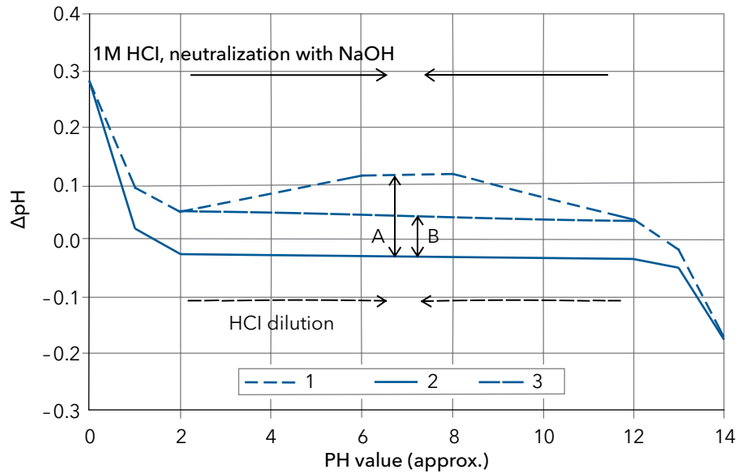
Chapter 8:
Diffusion potential as a error source



7 *Course of the measurement error of a pH electrode*

Problem

Diffusion potentials are often referred to as a disturbance variable in the pH measurement. However, their size and influence on the measurement accuracy are rarely known. Diffusion potentials were calculated for several examples and compared with practical measurements. In simple systems, the calculations were confirmed 8 9 .

Question

How great can diffusion potentials be and how do they affect the accuracy?

Answer

The Henderson equation is usually applied for calculating the diffusion potentials. This requires that concentration, the mobility and the charge of all the ions involved in a sample are known. This means that if only one parameter is unknown, the calculation cannot be performed. In most solutions, however, even the composition is not precisely known. A number of assumptions must therefore be applied when calculating the diffusion potentials, which then results in a rough estimate of the expected measurement errors. Therefore, the following deliberations must be applied:

As a reference or bridge electrolyte, a three molar KCl solution is usually used. It should also be the basis for the calculation of the diffusion potentials according to Henderson.

The size of the diffusion potentials is essentially determined by the differences in the mobility of all the types of ions. Therefore, the contact with hydrochloric acid and caustic soda is therefore observed here regarded as an adverse event.

Since errors in the pH measurement must be considered here, the calculated diffusion voltages are converted into ΔpH at 25 °C and presented against the pH value of the solution 7. The change of the pH values must again be achieved by a dilution (7 1) with water and once by neutralization (7 2). The figure shows the calculated variations in measurements ΔpH versus the pH value of the solutions for the mentioned cases. The following areas must be considered:

- Errors can greatly increase in extreme pH values.
- Extremely high values are measured in the acid range and extremely low values in the alkaline range.
- The error increases at great dilutions (purest water A). If the ion strength is higher, for example at a conductivity greater than 1mS/cm, the measurement errors from diffusion potentials are lower (3,B).

Conclusion

In solutions with conductivities greater 1 mS/cm and in the range of 2 < pH < 12, the effect of diffusion potentials on the uncertainty of the pH measurement is approximately ΔpH < 0.05. In the estimation of the measurement uncertainty, however, any additional sources of errors must be taken into account.

Chapter 9:
Selection of the pH electrode

Problem

It is crucial for the measurement reliability and the service life of a pH electrode to find the most suitable design for the application.

Question

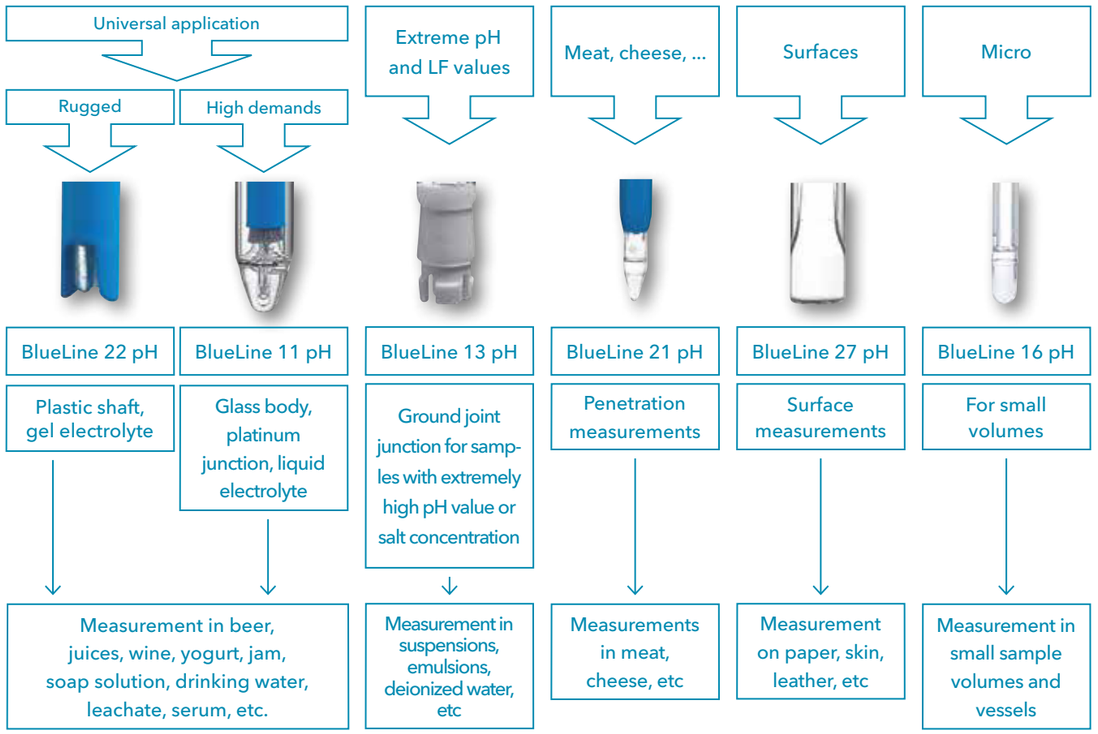
It is crucial for the measurement reliability and the service life of a pH electrode to find the most suitable design for the application.

Answer

As varied as the applications in which the pH value is measured, is the number of electrode types. These differ from one another in style and shape of the membrane glass, the reference system, the material and the length of the shaft up to the connection to the measuring device 8. In order to find a suitable electrode, it is easiest, to go through the following two checklists for the type of sample, and the design requirements of the electrode:

First, the user should deal with the type of sample and measurement conditions. The answer to the following questions helps here:

- At what temperature is measurement and calibration conducted? What is their pH application range? This information is important in the selection of the electrolytes (e.g., liquid or gel) and of the reference system and the membrane glass type.
- What conductivity of the sample solution is present? How high is the water content? Are solids or still undiluted components in the measuring solution? For samples with a low conductivity or a proportion of solids, for example, an electrode with liquid electrolyte and platinum or ground junctions provide for a stable electrolyte discharge and thus for accurate measurements.



8 *Choice of different electrode types and their applications*

Chapter 10: Care of the pH electrode

- What is the consistency of the measurement solution? It makes a difference, for example, whether a puncture measurement or a measurement is performed in the solution.
- Are sulfide, bromide, iodide or other unwanted electrode poisons present within the solution? The reactions in the electrode can be avoided by the selection of the reference system and the junction.
- Is the measurement performed in aggressive compounds (such as HF or hot sodium hydroxide solution)? This information helps in the selection of the shaft material and the membrane glass.

Once these issues have been resolved, the design requirements for the electrode must be determined:

- Which installation length and diameter is required? This information is required when e.g. measuring in special vessels.
- What accuracy of the electrode is necessary, which strength is required? This information is important to decide whether a gel electrode with a plastic shaft or a liquid electrolyte electrode with a glass body is used.
- Will a temperature sensor be integrated in the electrode or not? What connections does the measuring device have for the electrode? This is important, in order to provide the appropriate connection of the electrode to the measuring device.
- Is the application area of the pH measurement in the laboratory or process? When the electrode is used in the process, it is important to clarify what pressure is applied in the measurement and how the electrode is installed. When used in the process, the electrodes have a special built-in Pg13.5 thread to be permanently installed at the measuring station via a holder. If liquid electrolyte electrodes are used under such conditions, a pressurization of the electrolyte storage must also be provided.

Conclusion

When selecting the electrode, it is important to coordinate it to the respective application. The user can only then assume an optimal service life and accuracy of the measurement.

Problem

How do pH electrodes have to be maintained/cared for and stored?

Question

What influence does the maintenance and care have on the service life of the electrode and the accuracy of the measurement? How should the electrode be stored? What cleaning methods are there?

Answer

Careful handling and storage of the electrodes are elementary for reliable results. Furthermore, the durability is thereby increased. The following tips show an overview [10] [2] [3] :

- Storage:
  An electrode should never be stored dry, but always in watering solution. The watering cap should be filled with the following solutions depending on the type of electrode:

• Single-rod measuring cells and reference electrodes: In case of liquid electrolyte electrodes, the electrolyte solution in the reference electrode should also be used for watering. 3 mol/l KCl solution must be used in gel electrodes.

• Glass electrodes: In case of pure measurement electrodes, the watering cap can be filled with deionized water. For single-rod measuring cells and reference electrodes, this results in a reduction of the service life.

If the electrode has been stored incorrectly dry, it must be watered for at least 24 h in the above solutions before its first use. The functionality must be tested by calibrating prior to the measurement.

- Cleaning:
  Dirt deposits of any kind on the membrane surface or the junction may result in the reduction of the service life of the electrode and inaccurate measurements. The electrode should preferably be chemically and not mechanically cleaned. In the event of dirt deposits outside the electrode and the junction, the following cleaning processes can be performed:

• Inorganic adhesions: Put the electrode for a couple of minutes into 0.1 mol/l HCl or 0.1 mol/l NaOH. If the buildup is not resolved, the solution should be a cautiously heated up to 50 °C before the acid or alkali concentration are increased.

• Organic adhesions: Rinse the electrode with organic solvents. The membrane can be carefully and briefly wiped with a damp, lint-free, soft cloth . The resistance of the plastic shaft of the electrode to organic solvents should be noted in this treatment.

• Proteins: Placing the electrode in a pepsin/HCl solution for at least 1 h.

• Sulfides on the ceramic junction: Store the electrode in a thiourea/HCl solution (7.5 % in 0.1 mol/l HCl) until the discoloration on the junction has disappeared. After cleaning, the electrode is rinsed with deionized water and placed in the electrolyte solution for at least 1 h. In addition, the electrode must be recalibrated prior to the next measurement.

- Cleaning of the reference electrode with liquid electrolyte:

• In case of dirt/particles in the reference electrode: remove the old and refill with new electrolyte. If necessary, repeat until the dirt is removed. Some heated electrolyte (about 45 °C) can also be used. An internal chemical cleaning is not advised, since the reference system can be irreversibly damaged.

• KCl crystals in the interior: The crystals can be dissolved when heating the electrode in a water bath at 45 °C. Then the electrolyte must be completely replaced.

- General treatment recommendations:

• After the measurement, the electrode must be rinsed immediately with deionized/distilled water and stored in the recommended manner.

• The electrode is regularly inspected for dirt deposits on the membrane surface, the junction and the interior.

• Measurements in aggressive and/or hot media result in a reduction of the service life.

• When using electrodes with liquid electrolyte, the filling opening must be opened during the measurement/calibration, in order to prevent a back diffusion of the sample by the electrolyte flow. The refilling opening must be closed when storing and between the measurements.

• The use of deionized water as a storage solution for any electrode reduces their service life.

• Never store the electrode dry, use it as an agitator or clean it mechanically.

Conclusion

The general treatment recommendations contribute greatly to the service life extension of the electrode and thus to the accuracy of the measurement.

Chapter 11
Qualifications of the pH measurement

Problem

pH measurements are operated in GMP/GLP-related companies for quality control of both raw materials and finished products. The measured pH values therefore are highly relevant in determining whether the sample meets the requirements or not. Accordingly, measures must be taken to ensure the accuracy of the measurement.

Question

What measures are available to ensure the pH measurement, and how are they performed?

Answer

The qualification process consists of up to four consecutive test stages [9]. They include the following steps that must be documented accordingly:

- **DQ (Design Qualification)**: The user formulates the requirements for the components and operating conditions in the DQ prior to purchasing. Described are the purpose of use, environmental conditions, technical data, a description of the samples, as well as general and special requirements based on the application [11]. The DQ is therefore the documented evidence that the instrument is designed and manufactured in accordance with the requirements and the user receives exactly what he needs.
- **IQ (Installation Qualification)**: The IQ is conducted at the site of the installation. The completeness of the system and the environmental and application conditions are examined after delivery. The IQ provides evidence that the delivered instrument meets the specifications of the order (DQ), is properly set up at the intended work area and is properly installed for the environmental conditions there. A first test can already be included in the IQ. After this training, the system is ready for use.
- **OQ (Operational Qualification)**: The OQ is used to check whether the installed system complies with the general conditions of the technical and functional specifications. The test includes a test of the device at the point of use. A comparison with the technical data of the components or a test with a standard can be performed, which can be attributed to a national standard. For a pH measuring system, this means the determination of the pH value of DIN buffer solutions after the calibration of the device.
- **PQ (Performance Qualification)**: The PQ is used to demonstrate that the measurement system consistently provides a performance according to specifications under real operating conditions. During the IQ and OQ, which must be carried out once, which the suppliers often offer in the form of prefabricated documents up to the implementation of the qualifications, the PQ is usually performed by the user on a regular basis. The testing interval is determined according to the application of the measurement system [12].

Fig. [9]

Conclusion

The individual tests of the pH meter and electrode yield only a statement about the current functioning of the electrode and the pH meter as individual components, but no statement about the continuous validity of pH measurements of the entire system. The qualification beginning from the design qualification prior to the purchase, over the one-time installation (IQ) and Operational Qualification (OQ) at the corresponding work station up to the routine performance qualification (PQ) together provide verification that the complete measuring system (consisting of pH meter, pH electrode, buffer solutions) yield a consistent performance according to specifications under the specific conditions.

Chapter 12:
pH measurement in organic media

Problem

The requirements for the feasibility and accuracy of pH measurements and titrations in nonaqueous media for process and quality control increase steadily in the pharmaceutical industry.

It is therefore important to examine to what extent one can speak at all of a classic pH-measurement in such analyses and how the electrodes respond in such a medium.

Question

Under what conditions are pH measurements and titrations possible in non-aqueous media?

Answer

The pH value in accordance with DIN 19260 [13] is only defined in aqueous media. However, analog to the dissociation of the water:

$$2H_20 \leftrightarrow H_3O^+ + OH^-$$

similar observations for aqueous solvents can be employed and the following equation can be employed:

$$2HLy \leftrightarrow H_2Ly^+ + Ly^-$$

H_2Ly^+ is the protonated solvent molecule and is called Lyonium ion. Ly^- is the deprotonated solvent molecule and is called Lyat ion. Aprotic solvents such as DMSO or benzene do not dissociate from the equation. Only water-like solvents with a dissociation such as Ethanol allow the introduction of a pH scale. This results from the pKLy value of the solvent. Thus, the scale for water contains 14 units, 16.7 for methanol and 19.1 for ethanol.

With the creation of individual, that is solvent-dependent, pH scales, however, only the first step is accomplished. It requires then also individual reference buffer solutions to calibrate the electrode under these conditions. If the pH electrode is calibrated with aqueous buffer solutions and a pH measurement is then performed in an aqueous medium, this corresponds to the proverbial comparison of apples and oranges. The absence of reference buffer solutions based on the particular solvent may therefore not be followed with a conversion of the actual measured value mV, as delivered by pH-electrodes, into a pH-value.

In contrast to the pH measurement, the absolute pH value is not the relevant value for titrations, but the change of pH value. The consumption of titrant up to this pH jump is applied for the content calculation. Under such conditions, the conversion of the original mV measured value of the electrode into a pH-value is possible, but this conversion value is just as little reliable as an absolute measurement value.

In addition to the lack of individual reference buffer solutions and the associated lack of knowledge of the hydrogen ion activity in non-aqueous solvents, the challenge for the pH measurement in such samples, among others, is subject to the following two phenomena:

- The increased phase boundary voltage on the junction upon contact of the non-aqueous solvent with the reference electrolyte of the electrode complicates the pH measurement [14].
- The low conductivities of these solvents also result in problems. The effect of low conductivity is shown in very fluctuating measured values even at pH measurements in distilled water. Organic solvents even increase that effect.

The electrodes or their membrane should be conditioned or formed to the proper solvent even for recording the mV value. With immersing the electrode into the solvent the resistance of the glass membrane is reduced and a faster response time of the electrode is guaranteed [3].

Conclusion

No measurements to determine the absolute pH value in non-aqueous solvents (i.e., having a water content of less than 30 %) may be carried out, but only direct mV measurements.

With an increased setting period in these media, a pretreatment or formation of the electrode may also be anticipated [15].

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