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EN 02

Operation & Maintenance Instructions

Read these operation and maintenance instructions before start up!
To be held for future reference.

In modern industrial measuring systems, potentiometric measurement of the pH value and redox value is standard practice for precise measurement and control of aqueous and non-aqueous solutions.

pH value

The pH value indicates the acid or alkali content of a solution and normally ranges from pH 0 to pH 14. Pure water has a pH value of 7 and is defined as being neutral. The pH value of a solution can be increased by adding alkali and reduced by adding acid. Two electrodes are always needed in order to measure the pH value: a measuring electrode and a reference electrode. An electrical potential proportional to the pH value is generated when these two electrodes are immersed in a solution and can then be measured with the aid of appropriate amplifiers. If both electrodes are accommodated in a single shaft, this is known as a combined electrode. They are now used almost exclusively today, since combined electrodes are very much easier to handle than separate electrodes.
In such combined electrodes, the glass electrode is centrally immersed in the reference electrolyte.

The correct electrode must be selected first so that the pH value can be optimally measured.
The following criteria must be taken into account:
- Chemical composition of the solution to be measured
- Homogeneity
- Temperature
- pH range

Choosing the correct electrode is a particularly important matter when dealing with non-aqueous, high-protein or viscous samples and samples with low conductivity.
Standard electrodes **cannot** be used to measure the pH value of such solutions. Special combined electrodes or individual electrodes must be used instead in such cases.

The pH electrode is defined by its zero point and slope. Its response is determined by NERNST's equation and its change about a pH value (slope of the electrode) indicated by the NERNST voltage. The ideal slope equals 59.16 mV/pH at 25 °C.

Measurement of the slope provides information on the condition of the electrode system. The measuring system is worn and must be replaced if the slope drops below 50 mV (85%) or the deviation at the zero point exceeds $\pm$ 30 mV. If the electrode is to be used for further measurement, it must be calibrated at shorter intervals in order to ensure accurate measurement of the pH value.

Measurement of the pH value in water
Two extreme situations can arise when measuring the pH value in water. One refers to pure water (e.g. boiler water), the other to waste water. In the first case, there are few ions in the medium and its conductivity is consequently low. In the second case, the medium is highly polluted and the diaphragm will become clogged. Special measuring electrodes must always be used here. Standard electrodes are used in *„normal“* water.

REDOX measurement

When a metal electrode is immersed in an aqueous solution, an electrical potential develops, depending on the type of solution concerned. This potential is a function of the relationship between the reducing and the oxidizing components in the solution. It is measured against a reference electrode. The REDOX value can be indicated in mV with the aid of a suitable measuring amplifier.
If both electrodes are contained in a single shaft, this is once again known as a combined (measuring and reference) electrode.

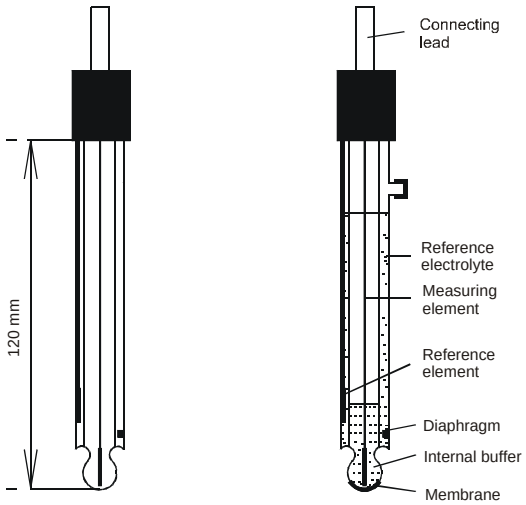
Improved changes are always reserved without notice.

Combined measuring and reference electrode

The basic design of a combined electrode is illustrated in Figure 1. The combined electrode comprises a shaft with a sensor element (glass membrane or electrode metal and diaphragm) at the bottom end. The upper end of the shaft forms the electrode head with transition to the connecting lead. It is either connected directly (permanently connected lead) or via a plug-and-socket connection. The electrode shaft may also be specially ground or include a screw thread so that it can be screwed into suitable vessels or fittings. The distance between the bottom end and the beginning of the electrode head is referred to as the installed length of a combined electrode.

Figure 1
Dimensional drawing and mechanical design of a combined measuring and reference electrode

Shaft diameter 12 mm



Information on electrodes

The presence of a so-called swelling layer on the glass membrane is essential for the glass electrode (measuring electrode) to operate correctly. If an electrode has been stored dry for a long time, it must be conditioned before used for measurement. For this purpose, combined electrodes must be immersed in an aqueous salt solution for 24 hours. If the measuring electrode is stored so that it is dry, potassium chloride will crystallize out on the outside of the diaphragm. Depending on the type of fouling concerned, impurities deposited on the glass membrane can be removed by various chemical methods, such as with a mild glass cleaning agent, alcohol or an acid solution, provided that it is not too strong, such as 0.1 mol hydrochloric acid.
Combined electrodes must be thoroughly rinsed in water before use. If the diaphragm is clogged (this is revealed by drifting of the measured value), the combined electrode must be immersed in 3 mol KCl solution for some time. In particularly stubborn cases, it is advisable to heat the electrode (place in a bath of water at approx. 40 °C).

The plug connectors must be kept absolutely clean and dry in order to avoid the occurrence of leakage currents.

Calibration
In the case of two-point calibration, the measuring amplifier is calibrated to the zero point and slope of the electrode system. Deviations may occur on account of a non-ideal response by the various sources of potential in the electrode system. The zero point and slope must be calibrated in order to compensate this deviation from the ideal state.

The calibration accuracy can be influenced by the following factors:
- Correct nature of the buffer solution
- Temperature balance between electrode and buffer solution
- Condition of the diaphragm and reference system (fouling)
- Resolution and reproducibility of the pH amplifier
- Technique (human factor)

Buffer solutions
Buffer solutions are mixtures with stable proton activity. They contain equilibrium systems delivering the appropriate type of ion when lost. Buffer solutions will keep for many months in the unopened original bottles. Once opened, their shelf life is limited due to the influence of atmospheric carbon dioxide (contamination).
Redox buffer solutions are ready-made solutions for calibrating REDOX electrodes. Although the zero point and slope of metal electrodes do not change, testing the electrode with the buffer solution can provide information on defects and impurities, as well as any shift in the zero point of the reference electrode.

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Temperature compensation

When measuring the pH value or conductivity, the electrode signal changes with temperature.
These temperature changes influence the accuracy of the reading. If the temperature of a sample when measuring the pH value differs from the calibration temperature by more than 10 °C, this may lead to a measurement error of approx. 0.15 pH units (between pH 3 and 11).
The temperature error when measuring the pH value depends on several different factors which will not be discussed in further detail here. In order to minimize the temperature error, the temperature can be compensated in the measuring amplifiers. For this purpose, the temperature of the measured medium must be measured and transmitted to the pH meter. A resistance thermometer of type Pt 100 is used for automatic temperature compensation.

Technical data:

Type: Resistance thermometer Pt100

Design	Shaft material	: Glass	Shaft material	: Metal
	Installed length	: 120 mm	Installed length	: 50 mm
	Diameter	: 12 mm	Diameter	: 6 mm
Connection	N-type slip-on screw head		2.50 m connecting lead (2-wire)	
Part No.	**41100021**		**41100022**	

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Electrodes for pH and Redox

Combined pH measuring and reference electrodes, type: PE 110

pH measuring range		pH 2...12		
Service temperature (°C)	80	130	40	50
Max. pressure (bar)	6.0	6.0	0.4	0.6
Measuring membrane	Ball	Ball	Tip	Tip
Electrolyte	GEL	GEL	KCl	GEL
Shaft material	Glass	Glass	Plastic	Plastic
Installed length max. (mm)	120	120	120	120
Connecting lead (Special lead 1.50m)			x	x
N-type slip-on screw head	x			
Screw thread with N-type slip-on screw head		x		
Part No.	41100001	41100002	41100006	41100007

Combined REDOX measuring and reference electrodes, type: RE 110

REDOX measuring range		0-1000 mV		
Service temperature (°C)	80	80	50	50
Max. pressure (bar)	6.0	6.0	6.0	0.6
Electrode metal	Platinum	Platinum	Platinum	Platinum
Electrolyte	GEL	GEL	KCl	GEL
Shaft material	Glass	Glass	Glass	Plastic
Installed length max. (mm)	120	120	180	120
Connecting lead (Special lead 1.50m)			x	x
N-type slip-on screw head	x			
Screw thread with N-type slip-on screw head		x		
Part No.	41100011	41100012	41100014	41100015

Accessories

Buffer solution			
-pH value	pH 3.06		Part No.: 78061
	pH 4.65		Part No.: 78062
	pH 6.80	250 ml	Part No.: 78063
	pH 9.27		Part No.: 78064
-Redox	468 mV		Part No.: 78065
Cleaning agent		250 ml	Part No.: 78071
Connecting lead 1.50m with N-type cable bushing and BNC plug connector			Part No.: 78075

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Warranty

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Please copy and send with the device.

If the device breaks down within the period of warranty,
please return it in a cleaned condition with the complete warranty application, filled out.

Sender

Company:..... Phone:..... Date:.....

Address:.....

Contact person: .....

Manufacturer order-no.: ..... Delivery date:.....

Device type:..... Serial no.: .....

Nominal capacitynominal pressure: .....

Description of fault:.....

.....

.....

Type of fault:

1. Mechanical fault
- o premature wear
- o wear parts
- o breakage/other damage
- o damage in transit

2. Electrical fault
- o loose connections such as plug connector or cable
- o operating elements (e.g.. switches/buttons)
- o electronics - corrosion

3. Leaks
- o connections
- o dosing head

4. No or inadequate function
- o defective diaphragm
- o other

Service conditions of the device

Point of use / system designation:.....

Accessories used (Suction line, etc.):.....

.....

.....

Commissioning (date):.....

Duty peroid (approx. operating hours): .....

Please describe the specifics of the installation and provide a simple diagram with details of the material, diameter, length and levels.

Declaration of harmlessness

Please copy and send in with your device!
Please display anon the outer packaging!

Declaration of harmlessness

(please fill out a separate form for each appliance)

We forward the following device for repairs:

Type of device: _____

Part-no.: _____

Order-no.: _____

Delivery date: _____

Reason for repair: _____

_____

Medium used: _____ Properties: irritant: yes/no
corrosive: yes/no

We hereby certify that the machine has been thoroughly cleaned inside and out before its dispatch and that it is free from health risk chemical, biological and radioactive materials as well as having been drained of oil. *)

If the manufacturer find it necessary to carry out further cleaning work, we accept the charge will be made to us.

We certify that the aforementioned information is correct and complete and that the unit is dispatched in compliance with legal requirements.

Company / address:

Phone:
Fax:
E-Mail:

Customer-number:
Contact person:

_____ _____
Date Signature / stamp

*) If not applicable please cross out!