Potentiostat

Contents

1. General

The water sampling station PM 01 is used in swimming pools, water works and many industrial water treatment plants to determine such water parameters as free chlorine, pH value and redox potential.
An electronic controller of type TOPAX, for example, can be installed directly on the wall panel, thus providing a compact measurement and control unit for driving such correcting elements as a control valve or metering pump.
The routing of the water to be sampled is of decisive importance for obtaining a perfect result. For this reason, the information on hydraulic installation should be read through with particular care before installing the equipment.

2. Scope of delivery

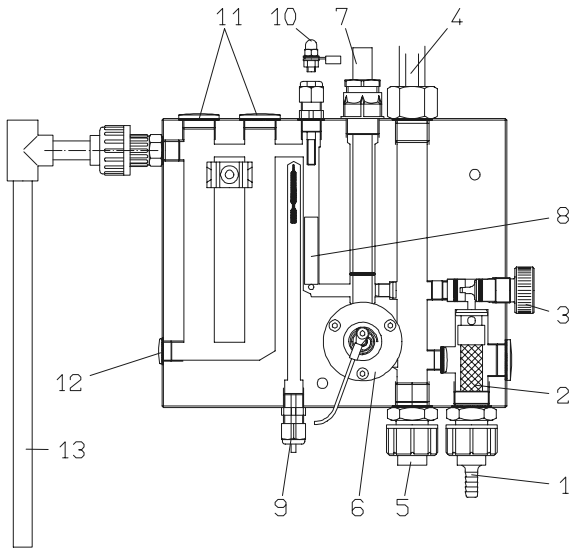
Depending on the configuration ordered, the water sampling station is supplied with various installation materials as accessories. The items delivered must therefore be compared immediately with those specified on the delivery note when unpacking the equipment.

3. Functions

All the following functional units of the water sampling station are accommodated in a transparent multi-function instrument panel:

- Potentiostatic chlorine sensor
  with electrode cleaning
  without zero calibration
- pH and redox measurement
  via combined measuring and reference electrode
- Hydrostatic flow control
  with gas bubble separator
  to ensure a uniform flow of gas through the measuring cell
- Sample water filter
  to protect the measuring cell from coarse dirt
- Precision adjusting valve
  for adjusting the water flow
- Flow monitor
  switches off the control system when the sample water level drops too low
- Equipotential bonding pin
  to discharge interfering imported potentials
- Sampling
  for manual sampling of the water during calibration

A detailed description of the various functions can be found in MB 4 37 20.



Legend:

1	Inflow of sample water
2	Filter
3	Needle valve ND 2.5
4	Central drain pipe in the overflow
5	Connection for overflow
6	Chlorine sensor
7	Reference electrode for chlorine measuring cell
8	Float with bar solenoid
9	Reed contact
10	Equipotential bonding pin
11	Mounting holes for combined pH and redox measuring and reference electrode
12	Mounting hole for temperature probe pT100
13	Water drain from sensor with transparent piping for sampling

4. Installation

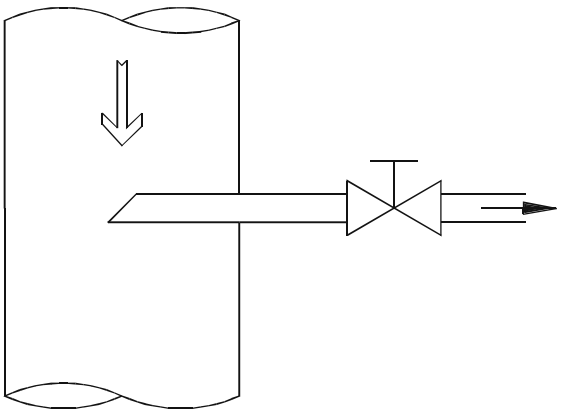
The water sampling station is mounted on the wall at eye level so that the electronic controller can be read and operated by personnel without difficulty. The enclosed screws and washers should be used to mount the station on the wall. The material and size of these parts are specially designed for this application.

4.1 Hydraulic connection

The sample water is delivered to the water sampling station via PVC or PE pipes or hoses. Metal pipes must not be used under any circumstances, as they may lead to incorrect results due to chlorine consumption!

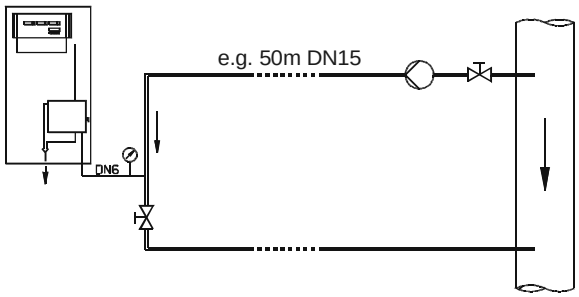
The sample water must be delivered to the water sampling station with as little delay as possible in order to ensure effective control of the water quality. The sampling line should therefore be kept as short as possible and have a small cross-section. A length of 25 metres and a cross-section of ND6 is sufficient to produce a delay of approx. 1 minute. The delay is increased to approx. 5 minutes if the same line is produced with a cross-section of ND15 in order to avoid high pressure losses.

The applicable regulations must be observed when sampling the water. German standard DIN 19643, for example, stipulates that the water in swimming pools must be sampled directly from the pool in order to eliminate measurement errors due to chlorine consumption in the overflow channel. When sampling water from a pipe, it must be taken from the middle of the pipe as illustrated below.



The installation of an 80 µm prefilter is often advisable, particularly in the case of outdoor swimming pools in which the water is sampled directly from the pool. Without such a prefilter, the dirt trap in the acrylic block may be clogged by leaves and flowers floating on the water, for example. (Refer to the installation diagrams in MB 4 37 20). The inserts in the dirt trap and 80 µm filter must be cleaned at regular intervals and replaced so that the measured value is not falsified by chlorine consumption in these filters.

Use of a sample water pump is also advisable if the sample water is not delivered with sufficient pressure (at least 0.2 bar at the port on the water sampling station). This system design also avoids long delays even when the sampling point is at a considerable distance from the water sampling station.



The pump conveys the water over this long distance in a loop line past the water sampling station and only part of the water flow is used for the actual measurement. Under no circumstances should the butterfly valve be fully closed, otherwise long delays can make control more difficult. Moreover, the water would heat up strongly in the pump, thus also leading to measurement errors. A pressure gauge in the loop line is useful for adjusting the butterfly valve.

The water drain in the water sampling station is without pressure. The water must be able to drain off freely. A pump must be installed if the sample water is returned to a pressurized system. A submergible pump is recommended in a collecting vessel for the sample water, for example. (Refer to the installation diagrams in MB 4 37 20).

4.2 Electrical connection

Local regulations (DIN, VDE standards and others) must be observed when carrying out general electrical installation work. Work on the electrical system should always be carried out by a qualified electrician.

The controller or measuring amplifier should be installed directly on the water sampling station or, if installed in a control cabinet, as close as possible to the water sampling station. Particularly the lines connecting the pH and redox sensors to the amplifier must not exceed 15 metres in length without special precautions. If greater distances have to be covered, an impedance converter must be installed at the electrode. Measurement leads must never be routed directly parallel to mains and control lines or the trunking for such lines. Crossings must be made at right angles.

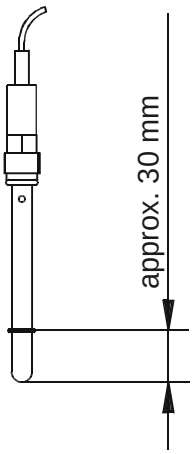
Equipotential bonding is required if imported voltages result in measurement errors, particularly during chlorine and pH measurement.

The combined pH and redox measuring and reference electrodes are connected to the measuring amplifier via BNC plugs. The chlorine sensor is connected to the potentiostat electronics via terminal blocks.

5. Commissioning

5.1 Installation of the sensors

During transport, a plastic bar is fitted in place of the reference electrode in order to prevent the glass balls dropping out of the sensor. This bar must be removed together with the heavy-duty Pg compression gland and the reference electrode screwed in. The enclosed O-ring is slipped over the reference electrode to a height of approx. 30 mm.



Note:
There must not be any flow of sample water when installing the reference electrode, otherwise the glass balls will be entrained from the chlorine sensor. The combined pH and redox measuring and reference electrodes are inserted in the acrylic block from above, together with the enclosed Pg13.5 compression glands. If applicable, the temperature probe is inserted at the bottom of the side with the Pg7 compression gland.
Note:
The caps on the glass electrodes should be kept in a safe place, as they will be required to keep the electrodes moist when the water sampling station is shut down.

5.2 Switching on the sample water

The needle valve on the acrylic block must be set so that water drains through the overflow pipe. If fluctuations must be expected in the system pressure (for instance when pumps are switched off overnight), the needle valve must be set to the lowest system pressure so that sufficient water always flows through the sensor. The glass balls in the chlorine sensor begin to rotate when sufficient sample water flows through; the float rises and the Reed contact makes, thus indicating to the electronic controller that a sufficient flow of sample water is present.

5.3 Calibration of the measuring amplifiers

The sample water should be allowed to flow for approx. one hour before calibrating the measuring amplifiers, since the chlorine sensor in particular requires a certain startup phase before it delivers reliable measured values. The measuring amplifiers are always calibrated in the same sequence of steps, regardless of make. Refer to the operating instructions of the measuring amplifiers and controllers for a detailed description of the procedure.

pH value

Two buffer solutions are required to calibrate the pH measuring amplifier. These solutions should define the range of values to be expected (e.g. buffer solutions with pH 6.8 and 9.28 for measured values of around pH 7.2).
Note:
Buffer solutions will only keep for approx. six weeks after being opened. Calibration is performed with flowing sample water. The combined pH measuring and reference electrode can be hooked into the holder at the front of the acrylic block during calibration.

Redox potential
Only one buffer solution (e.g. 468 mV) is required to calibrate the redox measuring amplifier. This buffer solution will likewise only keep for approx. six weeks after being opened.
Calibration is performed with flowing sample water. The redox electrode can be hooked into the holder at the front of the acrylic block during calibration.

Chlorine sensor
Since measurement of the free chlorine is strongly dependent on the pH value, the chlorine measuring amplifier may only be adjusted after pH calibration and when the pH value has stabilized.

Zero calibration is not required for sensor based on the potentiostatic principle. It must only be performed if the zero point of the measuring amplifier is maladjusted or zero calibration is an essential requirement for the measuring amplifier. The „zero" condition of the sensor is obtained by disconnecting the lead from the gold electrode. The lead is reconnected after calibrating the zero point. A very high reading is initially displayed. The slope must not be calibrated until this reading has gradually dropped to a stable value.

For calibration of the slope, water is sampled from the hose at the sensor outlet and the concentration of free chlorine determined by hand. A photometer based on the DPD method is normally used for this purpose. The operating instructions for the measuring instrument must be followed closely and care taken to ensure cleanliness. Soiled cuvettes and fingerprints on the cuvette can lead to considerable measurement errors. The value determined by hand is *immediately set on the chlorine measuring amplifier.*
When commissioning the system for the first time, the chlorine measuring amplifier must be recalibrated after one or two days, during which the surface of the electrodes adjusts to the chemical and mechanical service conditions.

6. Operation
During operation of the water sampling station, care must be taken to ensure that a little water always drains off via the overflow pipe. If this is not the case, the needle valve must be opened a little further.

The calibration of the measuring amplifiers should be checked every week, unless shorter intervals are prescribed by local regulations. They must be recalibrated if necessary (see above).

The filters in the sample water supply should be examined at the same intervals. If fouled, they must be cleaned or replaced in order to avoid measurement errors due to chlorine consumption in the filters.

7. Switching off
The flow of water through the sensor should not be switched off for short breaks in operation, otherwise deposits may build up on the surface of the electrodes. These would first have to be removed by the rotating balls when the system is restarted and a renewed startup phase would have to be expected for the chlorine sensor. It is advisable to drain all water from the instrument block and to dry the chlorine measuring cell when shutting down for longer periods of several days or for the winter, for example.

IMPORTANT !
Ensure that the glass balls are not lost when removing the electrodes.

The pH, redox and reference electrodes must not be allowed to dry out. This can be ensured by filling the enclosed rubber cap with KCl solution and fitting them over the bottom of the electrodes. The electrodes are stored in an upright position with the electrode bottom facing downwards.

8. Maintenance
The annual maintenance work consists of examining all components and cleaning the instrument block if necessary, as well as replacing the seals.

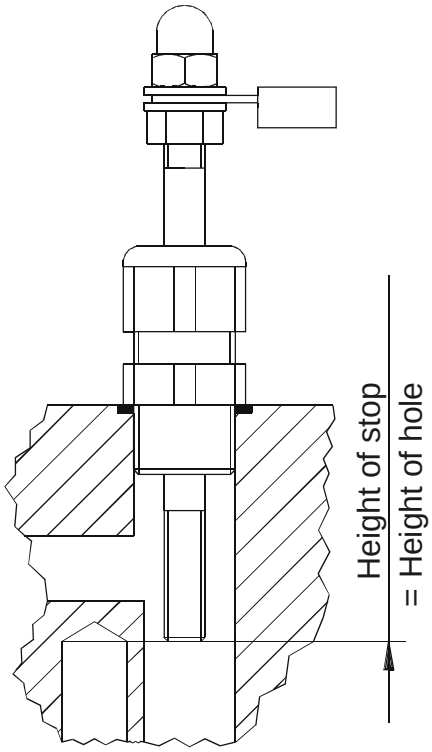
The service life of the glass electrodes depends on the service conditions and water properties (e.g. corrosiveness, greases, etc.) and normally comprises 12 – 15 months, including 50% storage time. When refitting the reference electrode, ensure that the O-ring is fitted over the glass shaft.

Gold and stainless steel electrodes can have a service life of several years, depending on the corrosiveness and abrasiveness of the water. They need only be replaced if severely worn (e.g. very thin points in the gold wire). Extensive contamination on the metal surface can be carefully removed with fine abrasive cloth (e.g. grain size 800), for example.

IMPORTANT!
Ensure that the glass balls are not lost when removing the electrodes.

The nozzle through which water flows to the chlorine sensor can be drawn out sideways with a size M5 threaded bar for cleaning and subsequently refitted.

The upper stop of the float must be readjusted after dismantling the complete block. The adjustment is made as shown in the following drawing. Electrical continuity of the Reed contact must be checked in order to verify the switching function (float at top: contact makes; float at bottom: contact breaks).



If the switching function is still not correct after adjusting the upper stop, the Reed contact can be shifted in the screw terminal in order to obtain a precise adjustment.

9. Troubleshooting

Fault	Possible cause	Remedy
The balls in the chlorine sensor rotate too slowly or the float does not rise.	Water supply pressure too low.	Use a sample water line with a larger cross-section. IMPORTANT! Note the delay.
		Install a sample water pump (see 4.1 Hydraulic connection).
	Filter in sample water line or instrument block fouled.	Clean or replace filter cartridge.
	Needle valve clogged.	Fully open the needle valve once and readjust.
	Supply nozzle of chlorine sensor is severely soiled.	Clean the nozzle (see 8. Maintenance).
	Reference electrode of the chlorine sensor is not centered in the hole.	Fit O-ring on reference electrode (see 5.1 Installation of the sensors).
Float rises but Reed contact does not make	Float out of alignment with Reed contact.	Adjust upper stop for float (see 8. Maintenance). Adjust Reed contact in screw connection if necessary.
	Reed contact defective.	Replace Reed contact.
Reading of the connected measuring amplifier varies irregularly and does not correspond with the comparison measurement.	Small leakage flows in pumps produce imported voltages in the sample water.	Connect equipotential bonding pin, e.g. to protective conductor of measuring amplifier.
	Connected devices are electrically isolated.	Connect isolators at the current outputs 0(4)...20mA of the measuring amplifier.
	Particularly for measurement of the surplus chlorine: Fluctuations in pH value have a disproportionately strong effect on chlorine measurement. (In manual DPD measurement, a reduction in pH value means that non-active chlorine in the water is also detected, thus indicating a higher level of free chlorine than actually present).	Stabilize the pH value of the water (e.g. optimize the control system, control parameters).
Reading for free chlorine on measuring amplifier is identical with that on water sampling station, but differs from that obtained by comparative measurement directly at the pool.	Chlorine consumption in the sample water line due to severely fouled filters or metal pipes.	Clean or replace filter cartridges, use plastic pipes or hoses instead of metal pipes.
	Long delay due to long sample water line with relatively large cross-section. The water at the water sampling station corresponds to that in the pool some time ago.	Reduce the delay, e.g. by using a sample water pump (see 4.1 Hydraulic connection).