



Gas-sensitive Sensor
for ammonia
measurements

201040 Series

B 20.1040.0
Operating Instructions

12.05/00451666

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1 Notes



All necessary settings are described in this manual. However, if any difficulties should still arise during start-up, please do not carry out any manipulations on the unit. You could endanger your rights under the instrument warranty! Please contact the nearest subsidiary or the head office in such a case.

Please read these Operating Instructions before commissioning the instrument. Keep these operating instructions in a place which is accessible to all users at all times. Please assist us to improve these operating instructions, where necessary.

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2 Brief description

This sensor can be used to determine NH_3 molecules in aqueous solutions. A gas-permeable hydrophobic PTFE membrane constitutes the interface between the sample solution and the electrolyte of the sensor. A hydrogen ion-selective electrode dips into this electrolyte. If ammonia diffuses through the PTFE membrane, the pH of the electrolyte changes. In this manner, it is possible to determine the NH_3 content of the sample medium. The measured gas is in chemical equilibrium with the ions contained in the electrolyte. In the case of the ammonia sensor (NH_3 measurement), these are ammonium (NH_4^+) ions.

2.1 Area of application

Leakage monitoring

- in cooling systems

Ammonia determination

- in freshwater/seawater
- in coating baths
- in the wastewater of gas scrubbers
- in wastewater monitoring



The sample medium must not contain any substances that could block PTFE (e.g. oil).
Explanation: the disc for pressure reduction in the fitting that matches the sensor is made of PTFE.

Measurements in an ice-water mixture do not produce meaningful results!

To suit the applications mentioned above, the ammonia sensor can be used with different instrument combinations:

- In combination with the dTRANS Rd 01 (special version)

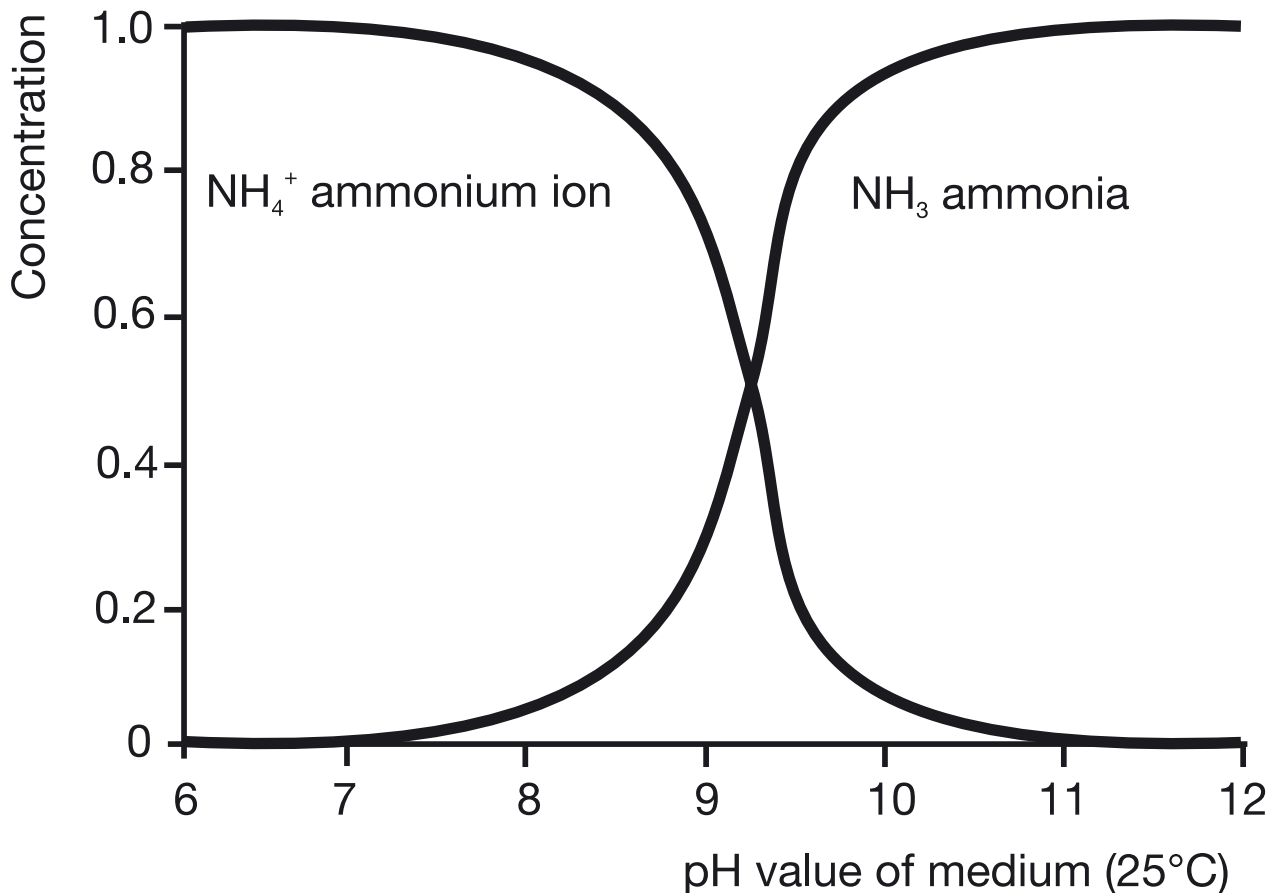
The instrument software has been designed in such a way as to optimally monitor cooling circuits for the occurrence of ammonia. The measurement range extends to 999.9 ppm. The ammonia sensor is calibrated in water that does not contain any ammonia.

-
- Another option is to combine the ammonia sensor with a high-resistance voltmeter (e.g. a dTRANS pH 01 or dTRANS Rd 01 measuring instrument for pH which is switched to mV).
 - The ammonia sensor can also be connected to an ion meter. This device directly indicates the ammonia concentration in ppm. When using this device, the corresponding calibration curve must be set up for the medium concerned.

3 Technical data

Measuring range:	0.01 – 20 000 ppm (= mg/l) NH ₃
Temperature range:	0 to 50°C
Accuracy:	+/- 2%
Length:	120 mm
Diameter:	12 mm
Connection:	plug cap (S7) or threaded cap Pg13.5 (S8)

4 Application range



4.1 Note

The presence of ammonia in the sample medium is strongly dependent on the pH value of the latter (see graph shown above).

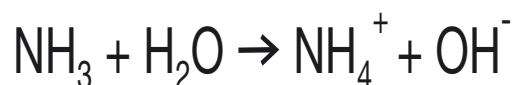
In the acidic range, there will be a predominance of ammonium (NH_4^+) ions that are **not** detected by the sensor.

At approx. 9.3 pH, the concentration ratio between ammonia (NH_3) and ammonium (NH_4^+) is about 1:1.

Only in the strongly alkaline range is there a predominance of ammonia.

4.2 Output signal

The electrochemical process in the thin electrolyte layer before the pH membrane takes place according to the equation:



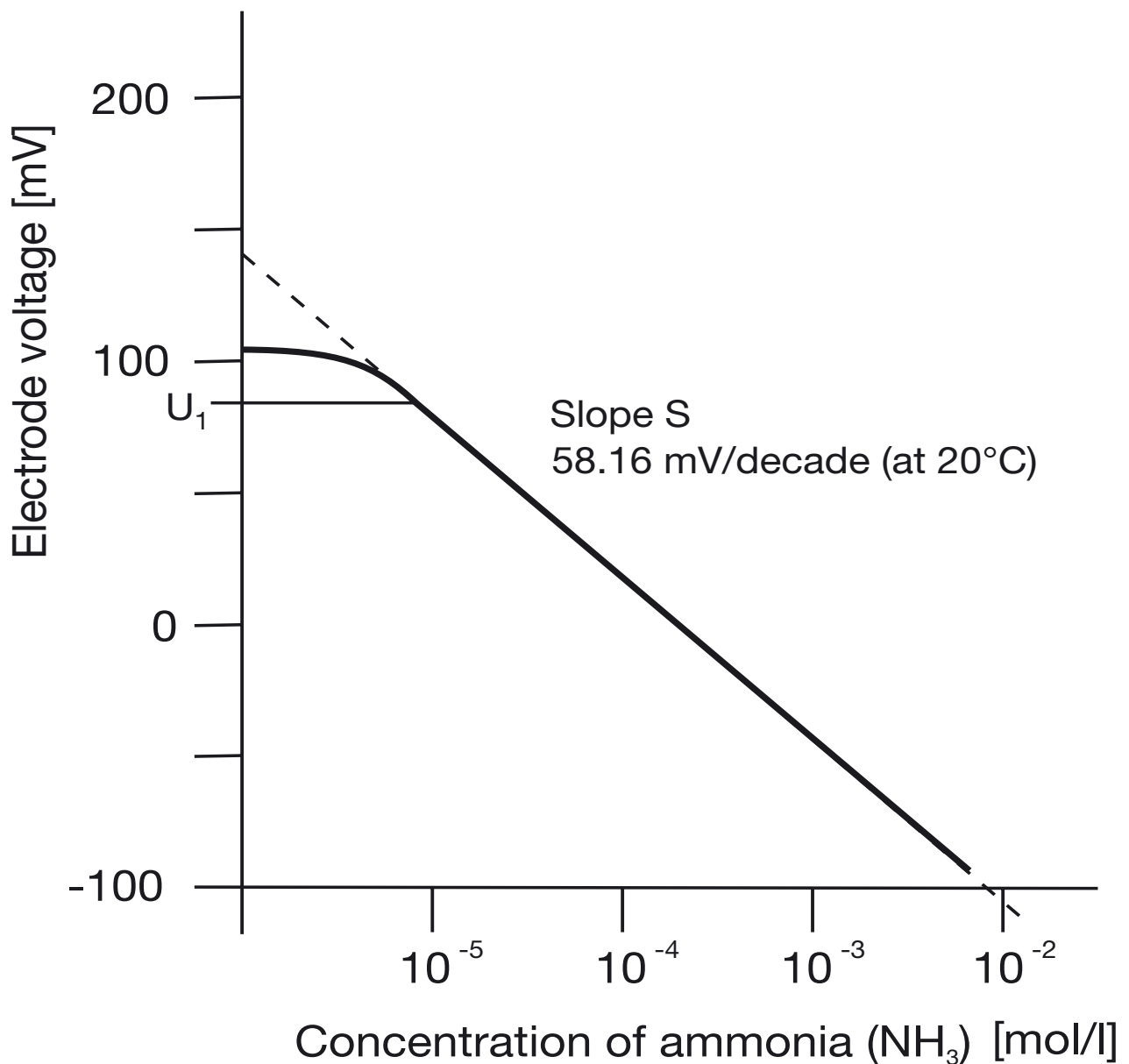
Hydrogen ions are taken out of the electrolyte, which means that the pH will shift to higher values.

The relationship between the ammonia concentration $[\text{NH}_3]$ and the voltage U is given by the Nernst equation:

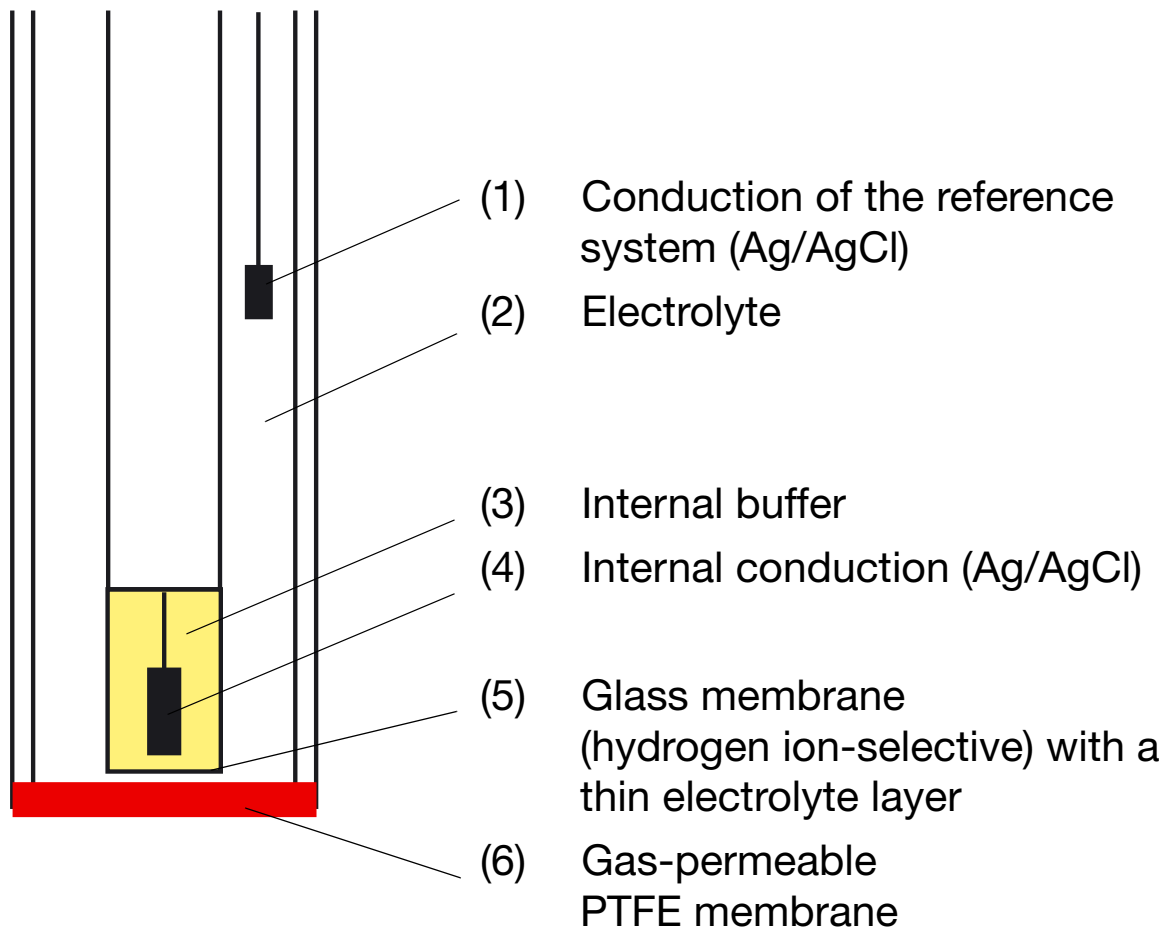
$$U = U_0 - S \cdot \log [\text{NH}_3] \quad (1)$$

In the ideal case, the value of the slope S is 58.16 mV/decade (at 20°C). U_0 is the cell zero point.

The dependence levels off towards a low ammonia concentration, i.e. a lower detection limit will result. The following diagram shows a typical characteristic.



4.3 Construction



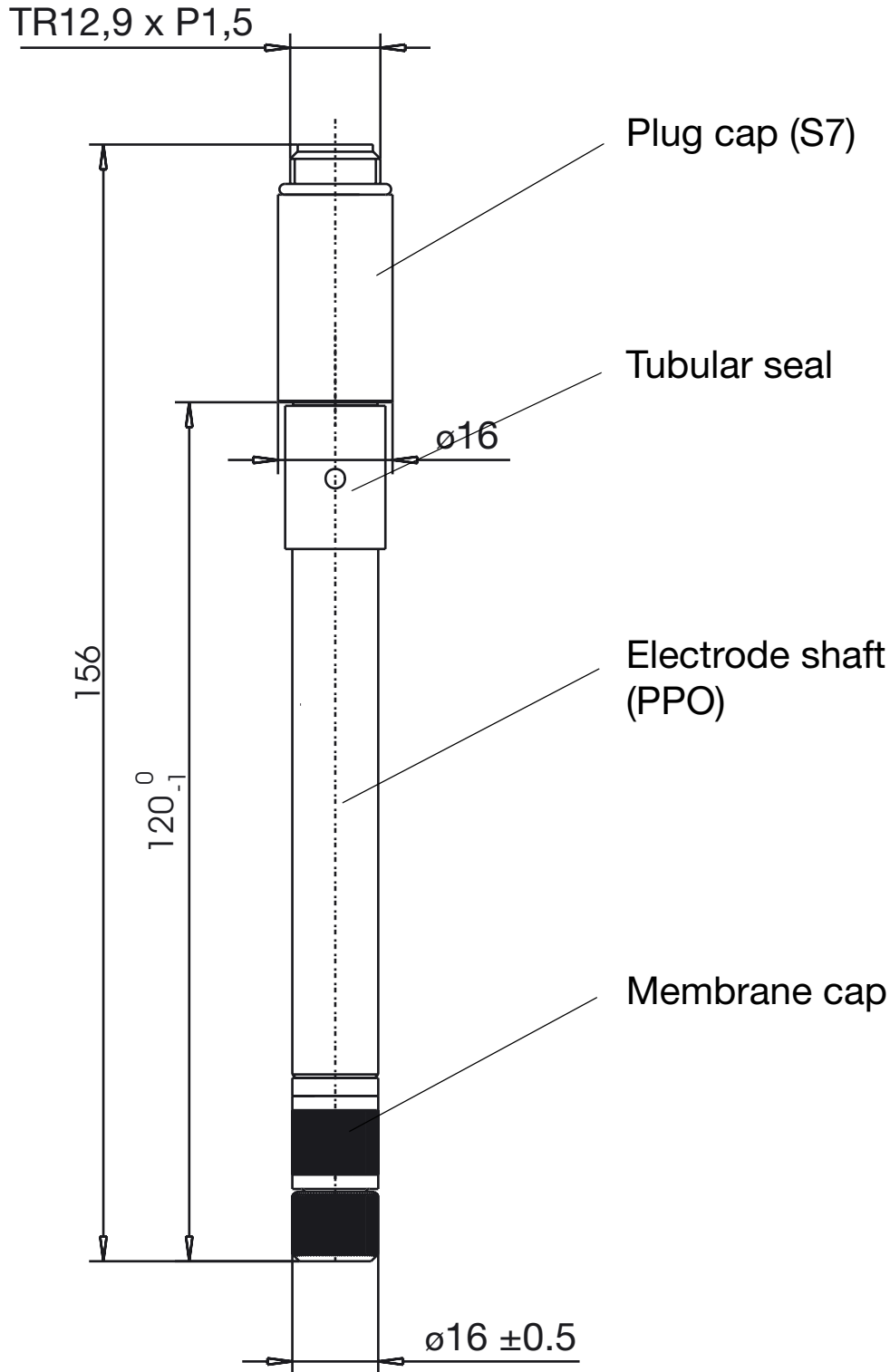
The conduction of the reference system (1) dips into the electrolyte, and, as an Ag/AgCl electrode, supplies a fixed reference potential for the measurement, together with the chloride ions contained in the electrolyte.

If the sample solution contains ammonia (NH_3), for example, then the gas diffuses through the microporous PTFE membrane (6) until the partial pressure of the ammonia on either side of the membrane (6) is the same. As the partial pressure alters, so does the pH value in the thin liquid layer before the glass membrane (5). This process is detected by the hydrogen ion-selective glass membrane (5). Since the partial pressure depends on the ammonia concentration of the sample solution, the pH value can be used to determine the concentration of ammonia in the solution.

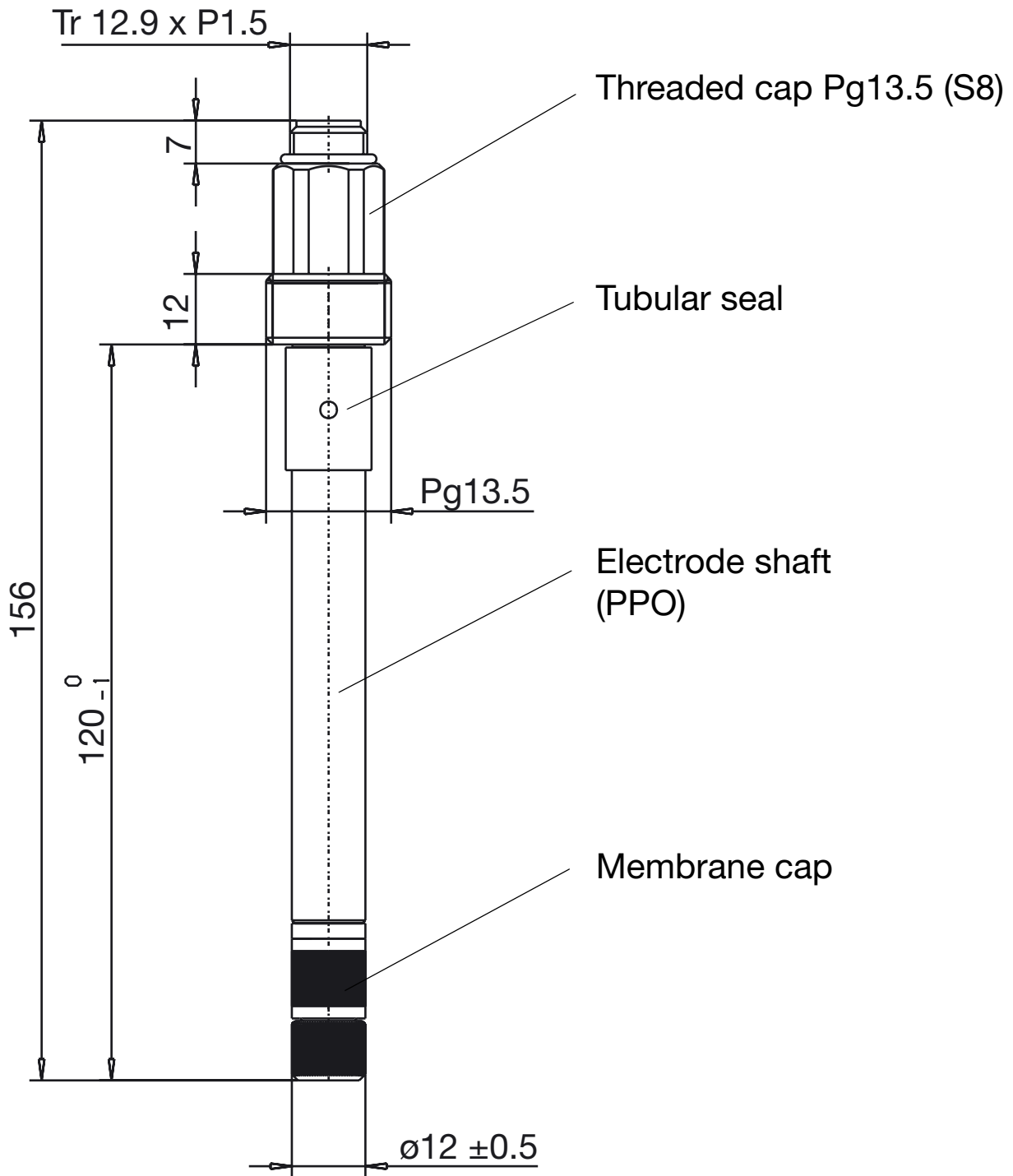
5 Installation

5.1 Dimensions

5.1.1 Type 201040/80-21-120/000



5.1.2 Type 201040/80-22-120/000



5.2 Installation

- Only operate the sensor in the **vertical** position!
- For suitable fittings, see data sheet 20.2822.
- Screw in sensor with a maximum torque of 10 Nm.

6 Electrical connection

- ❑ Sensor leads must only be run as twisted and shielded, uninterrupted cables (**not** routed via terminal blocks etc).

Connection of the ion-selective sensor

Internal conductor= measuring electrode

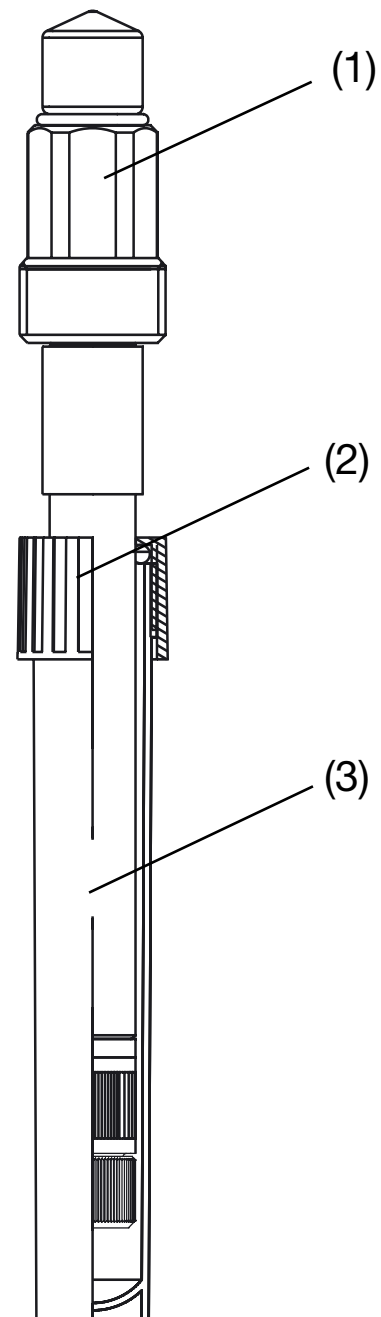
External conductor= reference electrode

7 Commissioning

- * Completely screw on the white plastic ring (2) and slide it up.
- * Pull the sensor (1) out of the wet-storage reservoir (3).
- * Remove O-ring from the sensor shaft.

The sensor is now ready for measurement.

- * Pour away the electrolyte.
Keep the reservoir for a possible transport at a later time, or for storing the sensor.



7.1 Calibrating

General

The slope of the sensors varies somewhat from one specimen to another and, in addition, alters during operation (due to deposits such as lime, or as a result of wear). This leads to a change in the sensor output signal.

The output signal of the gas-sensitive sensor depends on temperature; the temperature of the sample solution must therefore be known for proper measurement. The temperature can either be measured automatically, with a Pt100 or Pt1000 temperature probe or a customized temperature probe, or must be set manually on the transmitter by the user. The slope S (see equation (1), page 7) is dependent on temperature. According to which transmitter is used, this value has to be entered or will be determined automatically. On the dTRANS Rd 01 (special version), the slope S is automatically defined through the temperature of the medium.

Some transmitters can be calibrated for the ammonia sensor by using solutions with a known ammonia concentration.

If the ammonia sensor is used with an ion meter, please observe the calibration instructions given by the supplier of the ion meter.

If the ammonia sensor is used with a high-resistance voltmeter, a calibration curve must be set up using solutions of different ammonia concentrations. Afterwards, the ammonia content of the sample solution can be determined by means of this curve.

The time intervals between calibrations depend on the conditions in which the cell is used.

7.2 Calibrating in combination with the dTRANS Rd 01 (special version)

Calculation of ammonia

The output signal of the ammonia sensor follows a straight characteristic up to the voltage U_1 (default = 84 mV). Above U_1 , the characteristic will be curved (see diagram on page 8).

Lower detection limit U_0

U_0 is the voltage produced by the ammonia sensor at the low detection limit for ammonia (0.1 ppm).




The default setting for U_0 is 138 mV.

1-point calibration

With 1-point calibration, the voltage U_0 is determined for the low detection limit.

Requirement:

The sample medium must be free from ammonia.

- * Immerse the ammonia sensor in the sample medium.
- * Start the 1-point calibration on the dTRANS Rd 01 (special version).
- * Wait until the voltage indicated on the dTRANS dTRANS Rd 01 (special version) is stable.
Please do not make any changes by pressing the  or  key!
- * Finish calibration by pressing the  key.

The dTRANS dTRANS Rd 01 (special version) indicates 0.0 PPM.

Manual setting of the slope

The slope (Nernst voltage) is indirectly set on the dTRANS dTRANS Rd 01 (special version) via the temperature.

- * Assign the value "0" to the parameter C111 (manual temperature compensation).

-
- * Assign the required temperature to the parameter “InP2”.



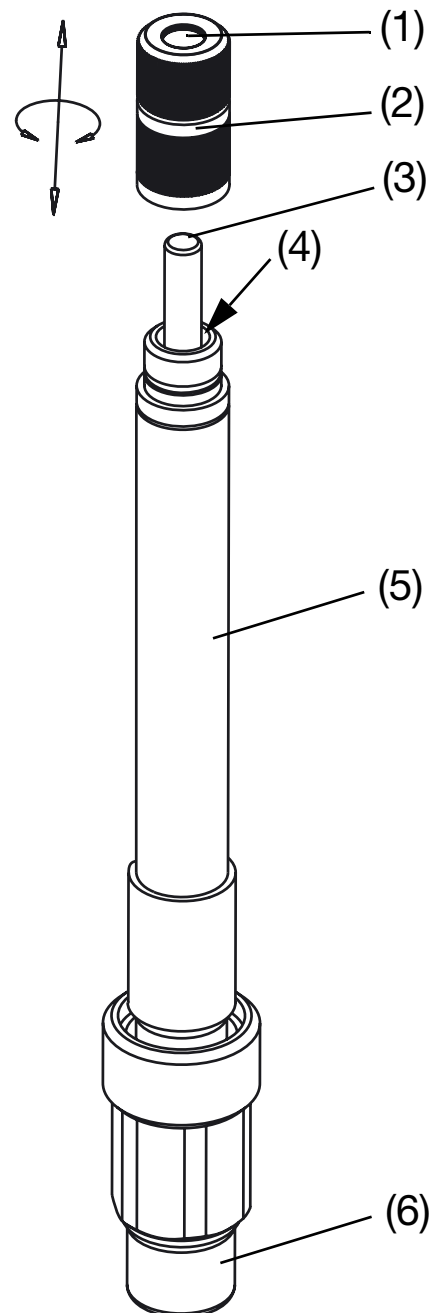
With manual temperature compensation, the temperature of the medium will no longer be indicated on the dTRANS dTRANS Rd 01 (special version).

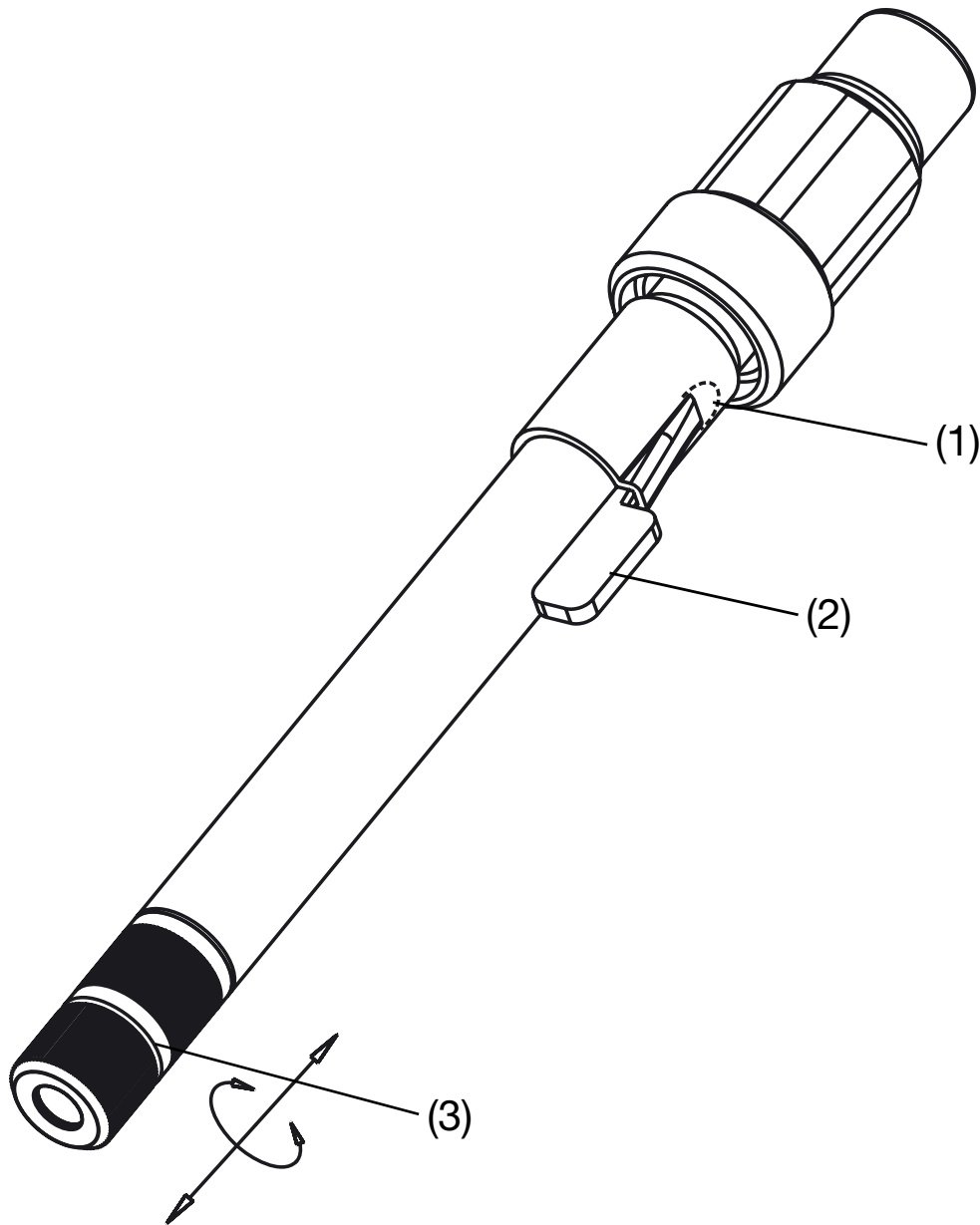
8 Maintenance

8.1 Refilling/changing the electrolyte

- * Hold the sensor (5) with the electrical connection (6) vertically downwards.
- * Remove old measurement membrane cap (2).
- * In the gap (4), fill the electrolyte up to the brim.
- * Fill new measurement membrane cap (2) with 3 drops of the electrolyte to lubricate the O-ring in the membrane cap. This will prevent the sensitive PTFE membrane (1) from being damaged by the glass membrane (3).
- * Place the measurement membrane cap (2) onto the thread until the O-ring seals.

Caution: Do not screw the measurement membrane cap on up to the stop. This could destroy it!





- * Hold the sensor as shown in the diagram above.
- * At the level of the vent opening (1), slide the vent wedge (2) under the silicone tubing.
- * Screw on the measurement membrane cap (3) up to the stop (any surplus electrolyte will run out).
- * Remove the vent wedge (2).
- * Use an absorbent cloth to soak up the surplus electrolyte. The electrolyte must not be allowed to enter the plug cap of the sensor. This would lead to contact problems.

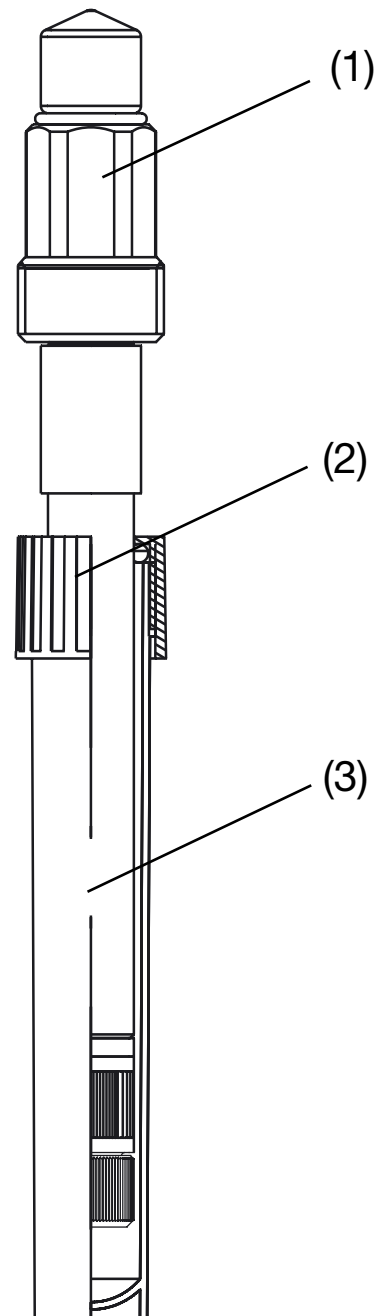
The ammonia sensor is now ready for measurement.

8.2 Storing the sensor in the wet-storage reservoir

Caution: It is essential to strictly observe the procedure described below, since otherwise the measurement membrane of the sensor will be destroyed by the pressure that builds up.

- * Slide the screw fitting (2) of the wet-storage reservoir (3) onto the sensor shaft.
- * Slide the O-ring of the screw fitting (2) onto the sensor shaft.
- * Insert the sensor in the wet-storage reservoir, which is filled with distilled water (filling level: 2 cm max.).
- * Close the wet-storage reservoir (3) with the screw fitting (2).

Caution: Do not shift the sensor in the reservoir after the screw fitting has been closed. The resulting over/underpressure could destroy the PTFE membrane!



8.3 Removing the electrode

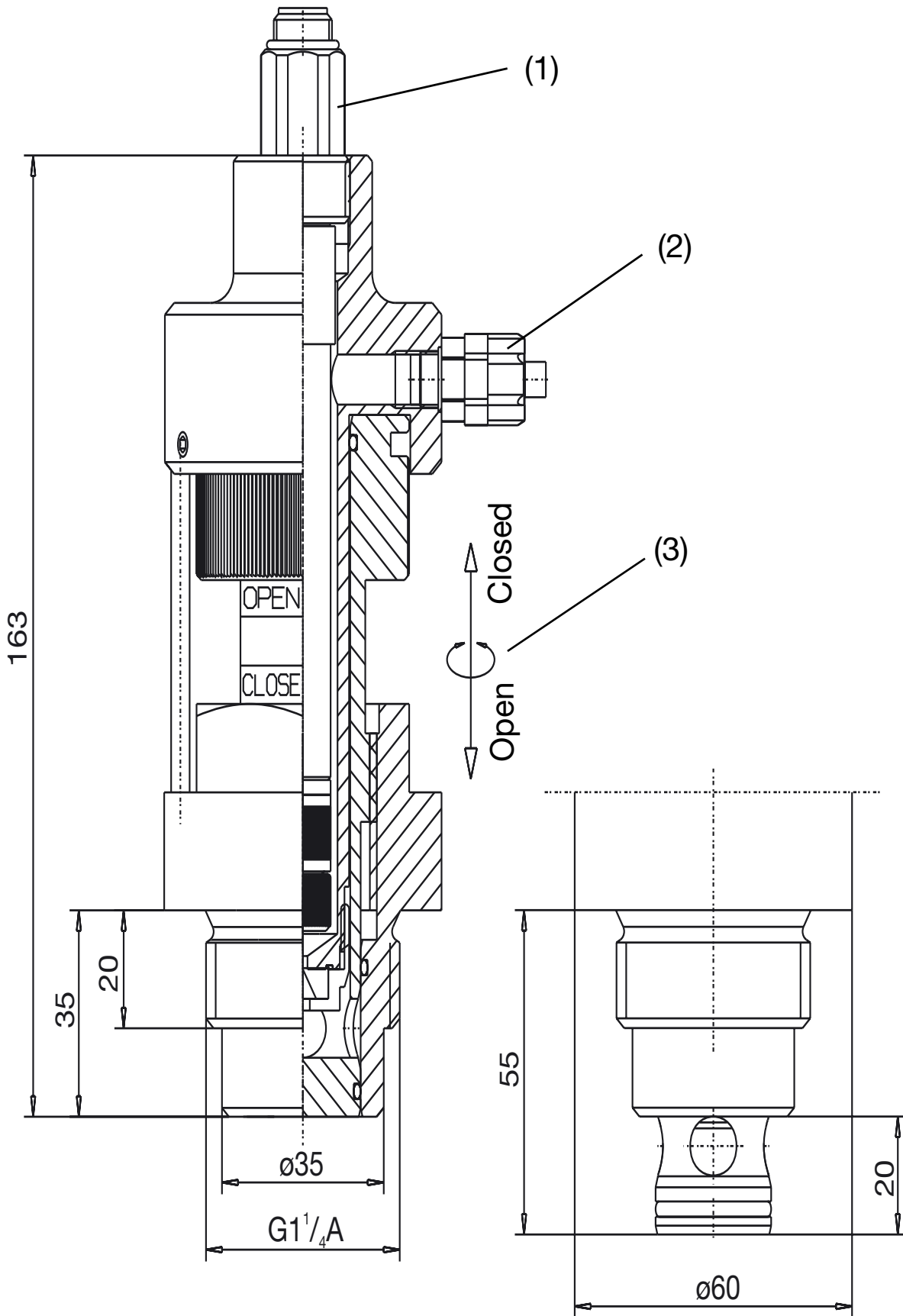
- * Open the screw fitting, then take the electrode out of the wet-storage reservoir.

9 Environment / disposal

Faulty sensors can be returned to JUMO for proper disposal.

10 Accessories

10.1 Quick-change fitting for ammonia sensor



Caution:

The installation position of the fitting is vertical (as shown in the diagram).

The sensor may only be removed when the fitting is closed.

Do not close the overflow (2).

Optimum operating pressure: 2 – 3 bar

Maximum operating pressure: 6 bar

- (1) Sensor head
Screw in sensor with 5 Nm.
- (2) The sample medium that runs out of the overflow can be drained using a hose.
- (3) A left turn (counterclockwise) will close the fitting, a right turn (clockwise) will open it.

