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NH4D sc Ammonium Sensor

USER MANUAL

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Section 1 Specifications

These are subject to change without notice.

General Information	
Measuring method	Ion-selective electrodes for ammonium and potassium, pH reference electrode and temperature sensor
Measuring range	0.2 to 1000 mg/L [NH ₄ -N]
Minimum detection limit	0.2 mg/L [NH ₄ -N]
Precision	5% of the measured value + 0.2 mg/L ¹
Reproducibility	5% of the measured value + 0.2 mg/L ¹
Response time (90%)	< 2 min
Measuring interval	Continuous
pH range	pH 5 to pH 9
Calibration methods	Sensor code for sensor cartridge 1 and 2-point matrix correction
Power consumption	1 Watt
Power supply	via sc controller (sc100 and sc1000)
Data transfer	via sc controller (sc100 and sc1000)
Ambient data	
Typical environment	Municipal waste water applications
Storage temperature	Sensor: -20 to 60 °C (-4 to 140 °F) Sensor cartridge: 5 to 40 °C (41 to 104 °F)
Operating temperature	Air: -20 to 45 °C (-4 to 113 °F)
Sample temperature	+2 to 40 °C (35 to 104 °F)
Max. flow velocity	< 4 m/s
Max. sensor immersion depth/pressure	Can be immersed 0.3 to 3.0 m/max. pressure: 0.3 hPa (4.4 psi).
Max. air pressure for cleaning unit option	3.10 bar (45 psi)
General sensor information	
Sensor dimensions	360.9 mm x 48.3 mm (14.21 x 1.9 in) (L x Ø) See Figure 1 on page 6 .
Sensor cable length	Standard: 10 m (33 ft) Optional extension cables available in 7.6 m (25 ft), 15.2 m (50 ft), 30.5 m (100 ft) Total Maximum length: 100 m (328 ft)
Sensor weight	Approx. 1 326 g (46.77 oz)
Wetted materials	Only for immersed installation: Sensor body made of stainless steel 316 with ends made of Ryton PPS® ² .
Installation angle	45° +/- 15° vertical in flow direction

¹ with standard solutions

² Ryton® is a registered trademark of Phillips 66 Co.

1.1 Dimensions

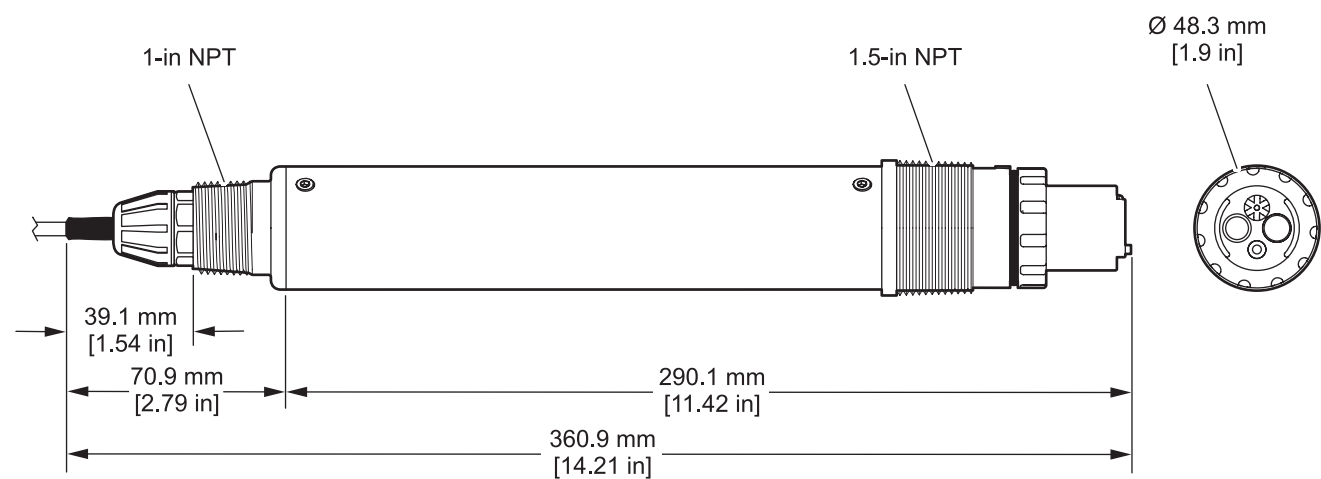


Figure 1 Stainless steel sensor dimensions

Section 2 General Information

2.1 Safety information

Please read this entire manual before unpacking, setting up, or operating this equipment. Pay attention to all danger and caution statements. Failure to do so could result in serious injury to the operator or damage to the equipment.

To ensure that the protection provided by this equipment is not impaired, do not use or install this equipment in any manner other than that specified in this manual.

2.1.1 Use of hazard information

DANGER

Indicates a potentially or imminently hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation that may result in minor or moderate injury.

***Important Note:** Information that requires special emphasis.*

***Note:** Information that supplements points in the main text.*

2.1.2 Precautionary labels

Read all labels and tags attached to the instrument. Personal injury or damage to the instrument could occur if not observed. A symbol, if noted on the instrument, will be included with a danger or caution statement in the manual.

	This symbol, if noted on the instrument, references the user manual for operation and/or safety information.
	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems after 12 August 2005. In conformity with European local and national regulations (EU Directive 2002/96/EC), European electrical equipment users must now return old or end-of life equipment to the manufacturer for disposal at no charge to the user. Note: For return for recycling, please contact the equipment manufacturer or supplier for instructions on how to return end-of-life equipment, manufacturer-supplied electrical accessories, and all auxiliary items for proper disposal.

2.2 General sensor information

The sensor was developed for use in municipal waste water applications.

The NH4D sc sensor (see [Figure 2](#)) with ion-selective electrode (ISE sensor) is a continuous online process sensor for the measurement of ammonium directly in the tank. It operates without reagents and requires no further processing of the sample. The ammonium ions are measured using an ion-selective electrode.

The only wear part is the sensor cartridge (see [Figure 3 on page 8](#)). This includes the ion-selective electrodes for ammonium and potassium (compensation electrode), a pH electrode used as a reference system and a temperature sensor for temperature compensation.

An optional cleaning unit is designed for automatically cleaning the sensor head membranes and can be ordered separately. Refer to the instruction sheet supplied with the cleaning unit.

The manufacturer recommends the use of the High Output Air Blast system for the compressed air supply; this is a compressor in weather-proof plastic housing.

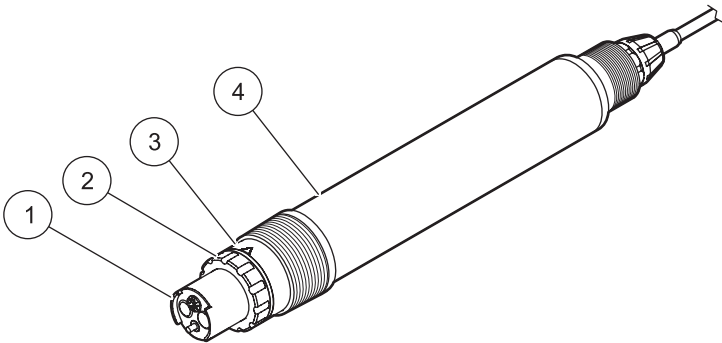


Figure 2 NH4D sc sensor

1	Sensor cartridge	3	Sensor adapter
2	Locking ring	4	Sensor housing

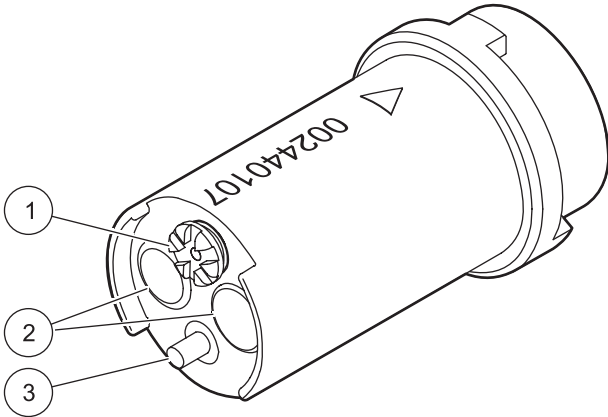


Figure 3 Sensor cartridge

1	Salt bridge	2	Membranes for ammonium and potassium	3	Temperature sensor
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2.3 Theory of operation

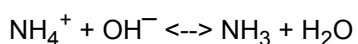
The NH4D sc sensor utilizes ion-selective electrode technology to measure ammonium ions (NH_4^+) in a waste water sample. Well-known interferences of temperature and potassium are compensated by using appropriate built-in sensors. The reference electrode is a differential pH technology and does not have direct contact with the process and therefore, it is particularly stable against drift.

Ion-selective electrodes have a special membrane to which only a specific type of ion can adhere. As a result an ion-specific potential forms on the membrane surface. To be able to measure a potential difference, a reference electrode is required, which is not affected by the sample to be measured.

CARTRICAL™ technology reduces cross-sensitivities by not only calibrating each electrode individually but also calibrating all 3 electrodes to each other.

pH value at the time of ammonium measurement:

In water, an equilibrium of ammonium (NH_4^+) and ammonia (NH_3) is established. This equilibrium depends on the pH value.



Since ammonia in most instances has a pH value above 8, ammonia is not directly measured by an ISE electrode.

Section 3 Installation

Important Note: Only qualified personnel should conduct the tasks described in this section of the manual.

3.1 Unpacking the sensor

Remove the sensor from the shipping container and inspect the sensor for damage. Verify that all items listed in [Figure 4](#) are included. If any items are missing or damaged, contact the manufacturer or distributor.

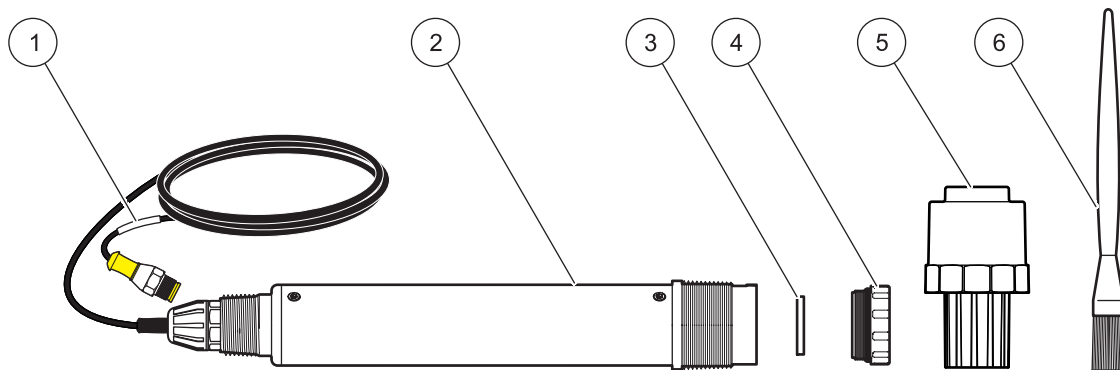


Figure 4 Items supplied

1	Sensor cable	4	Locking ring
2	NH4D sc sensor	5	Sensor cartridge (supplied in a storage container)
3	Opaque gasket	6	Cleaning brush

3.2 Unpacking the sensor cartridge

Important Note: Avoid touching the membrane on the sensor cartridge or damage to the sensor may occur.

1. Pay attention to the set in operation before date on the outside of the sensor cartridge storage container and the certificate. This is not the expiration date but the optimal date for putting the cartridge into operation for maximum life of the sensor cartridge.
2. Remove the cap of the storage container (see [Figure 6 on page 13](#)).
3. Take the sensor cartridge out of the storage container and remove the black gasket. This black gasket is not needed for installation but is useful to create a seal for storage of the sensor cartridge in the storage container.

Note: Make sure that the sensor cartridge is not exposed to air for more than 30 minutes.

Important Note: Before fitting the sensor cartridge in the sensor adapter, hold sensor cartridge in hand with membranes facing straight down and shake gently in a downward motion two times to remove air bubbles that may form underneath the membrane.

4. Connect the sensor cartridge to the sensor (see [3.3 Sensor assembly on page 13](#)).

Important Note: The sensor cartridge only fits correctly in the sensor adapter in one position. Pay attention to the markings on the sensor cartridge and on the sensor adapter (see [Figure 8 on page 14](#)).

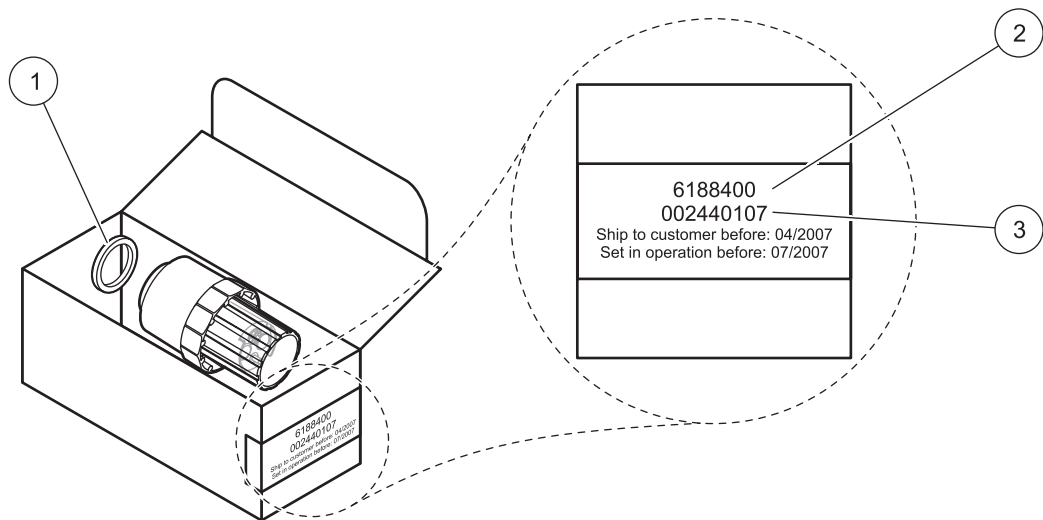


Figure 5 Storage container packaging

1	Opaque gasket	3	Serial numbers
2	Order number		

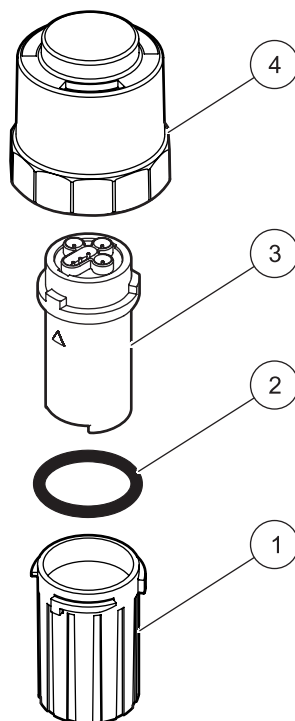


Figure 6 Storage container for sensor cartridge¹

1	Storage container	3	Sensor cartridge
2	Black gasket (remove before installation)	4	Cap

¹ Save items 1, 2 and 4 for sensor storage.

3.3 Sensor assembly

Important Note: Avoid touching the membranes on the sensor cartridge or damage to the sensor may occur.

1. Remove the black gasket.
2. Ensure that the opaque gasket is in place in the sensor adapter. The opaque gasket will be between the sensor and the sensor cartridge. A spare opaque gasket is inside the box that contains the sensor cartridge. Replace the opaque gasket every time the sensor cartridge is replaced.

Important Note: Without the opaque gasket, damage of the sensor will occur.

3. Align the markings on the sensor cartridge with the sensor adapter (see [Figure 8 on page 14](#)) and connect the sensor cartridge into the sensor adapter.
4. Attach the locking ring over the sensor head and hand-tighten.

Note: Use the cap of the storage container as a tool/screwing aid for the locking ring ([Figure 9 on page 15](#)).

WARNING

Do not leave sensor cartridge out of water for more than 30 minutes ([Figure 7 on page 14](#)).

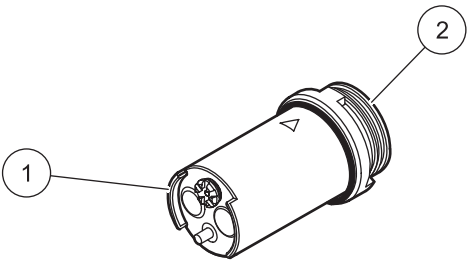


Figure 7 Sensor cartridge

1	Make sure that this end remains wet	2	Make sure that the contacts on this end stay dry
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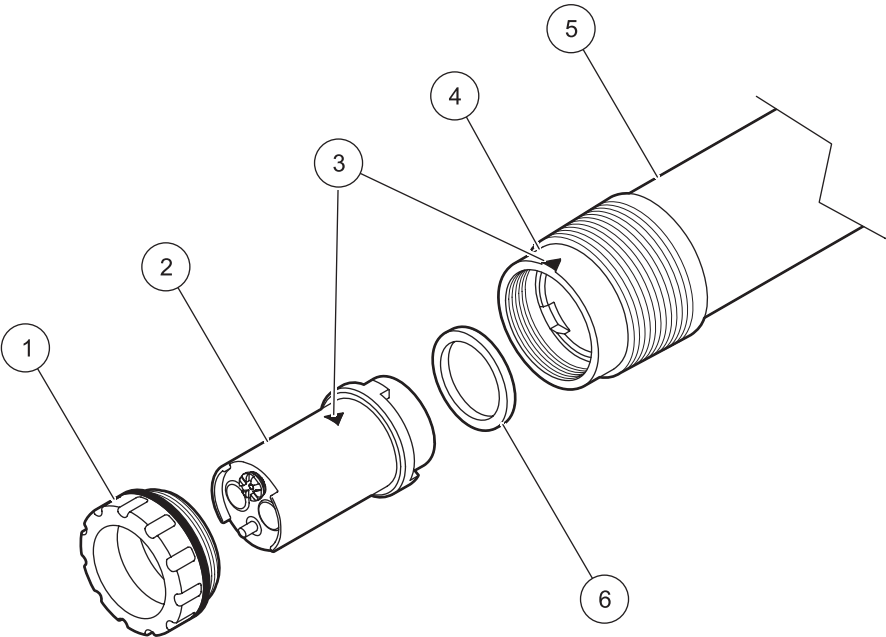


Figure 8 Sensor assembly

1	Locking ring	4	Sensor adapter
2	Sensor cartridge	5	Sensor housing
3	Alignment arrows	6	Opaque gasket

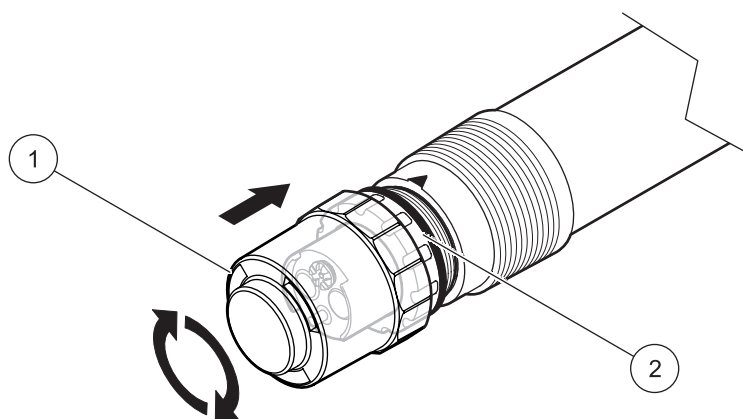


Figure 9 Cap of the storage container as a tool/screwing aid for the locking ring

1 Cap	2 Locking ring
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3.4 Installation of the cleaning unit (optional)

To install the cleaning unit on the sensor, refer to the installation instructions for the cleaning unit ([section 7.4 on page 37](#)).

The cleaning interval can be set using the relay control of the sc controller. Select RTC (Real Time Clock) as the signal source.

3.5 Installation of the sensor in the sample flow

Installation kits are available for the installation of the sensor with or without a cleaning unit for a wide range of requirements.

The following rules must always be considered prior to installation:

- Install the sensor where the sample that comes into contact with the sensor is representative of the entire process.
- Position the sensor at least 200 mm (7.87 in.) from the tank wall and 100 mm (3.94 in.) from the bottom.
- When using a chain bracket, ensure that the sensor cannot hit the tank wall when it moves.
- Immerse the sensor at an angle of approx. 45° +/- 15° in the direction of the flow so that air bubbles cannot remain underneath the membranes.
- Ensure that the sensor is fully immersed.
- When using the cleaning unit refer to the supplied Instruction Sheet.
- Refer to the instructions supplied with the optional mounting accessories for detailed installation information (see [Figure 10 on page 16](#)).

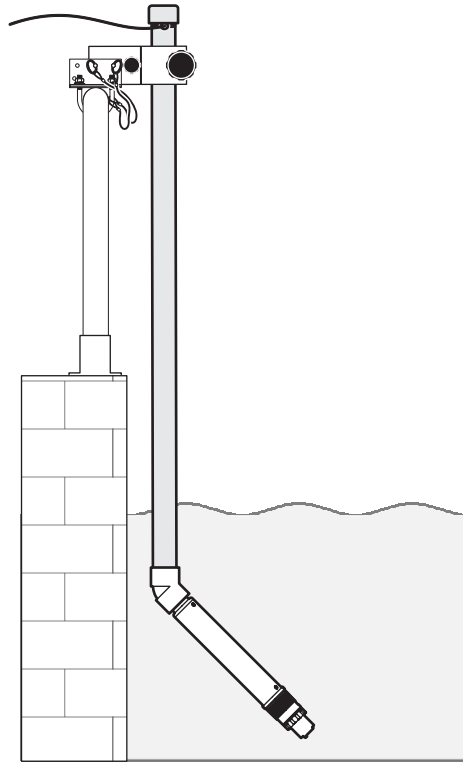


Figure 10 Example of sensor installation with Rail Mount Kit

3.6 Connection/wiring of the sensor to the sc controller

DANGER

Although the sc controller is certified for Class 1, Division 2 Hazardous Locations, it is only certified when installed with sensors listed in Control Drawings 5860078.

The NH4D sc Ammonium sensor is not suitable for Class 1, Division 2 Hazardous locations.

3.6.1 Connect the sensor to the sc controller (non-hazardous location)

3.6.1.1 Connect the sensor with quick-connect fittings

The sensor cable is supplied with a keyed quick-connect fitting for easy attachment to the controller (see [Figure 11 on page 17](#)). Retain the connector cap to seal the connector opening in case the sensor must be removed. Optional extension cables may be purchased to extend the sensor cable length.

1. Unscrew the protective cap from the socket on the controller.
2. Insert the connector in the socket and hand-tighten the union nut.

Note: When using an sc1000 controller, do not use the middle connection for the sensors as this is reserved for the display module.

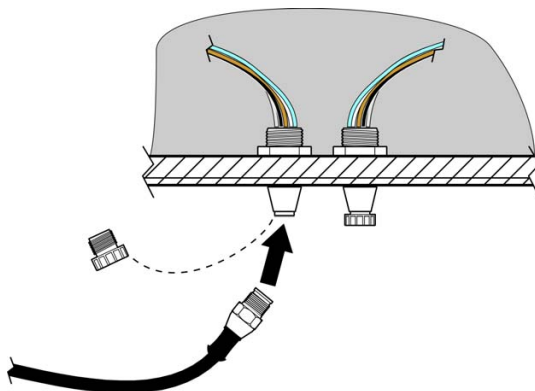


Figure 11 Connect the sensor using quick-connect fitting on the sc controller

Section 4 Operation

4.1 Using an sc controller

Before using the sensor in combination with an sc controller, refer to the controller user manual for navigation information.

4.2 Sensor setup

When a sensor is installed for the first time, the serial number of the sensor is displayed as the sensor name. The sensor name can be changed as follows:

1. Select **MAIN MENU**.
2. From the Main Menu, select **SENSOR SETUP** and confirm.
3. Select the appropriate sensor if more than one sensor is attached and confirm.
4. Select **CONFIGURE** and confirm.
5. Select **EDIT NAME** and edit the name. Confirm or cancel to return to the Sensor Setup menu.

4.3 Sensor data logging

The sc controller provides a data log and an event log for each sensor. The data log contains the measured data at selected intervals. The event log contains a large number of events that occur on the instruments, such as configuration changes, alarms and warnings, etc. The data log and the event log can be exported to CSV format. For information on downloading the logs, refer to the sc controller user manual.

4.4 Sensor diagnostics menu

SELECT SENSOR	
ERROR LIST	Displays all actual error codes.
WARNING LIST	Displays all actual warnings.

4.5 Sensor setup menu

SELECT SENSOR (if there is more than one sensor)

CALIBRATE	
CAL.CONFIG.	Note: If once a calibration method is chosen the entries will be displayed in the first submenu of the calibrate menu. Select SENSOR CODE, MATX1, MATX1 K+, MATX2, MATX2 K+, VALUE CORR, PREVIOUS CAL or FACTORY CAL
-or-	
CAL.CONFIG.>SENSOR CODE	
DATE	Displays the date of sensor cartridge start up
SENSOR CODE	Display and entry of the sensor code
-or-	
CAL.CONFIG.>MATX1	1 point matrix correction (see section 4.6.3.1 on page 24)
DATE	Displays the date of the current correction
CONC MEAS 1	Saving the currently measured measurement

4.5 Sensor setup menu (continued)

SET NH ₄ -N CONC	Entry and display of the NH ₄ -N reference value (lab value)
-or-	
CAL.CONFIG.>MATX1 K+	1 point matrix correction with potassium (see section 4.6.3.2 on page 24)
DATE	Displays the date of the current correction
CONC MEAS 1	Saving the currently measured measurement
SET K+ CONC	Entry and display of the K ⁺ reference value (lab value)
SET NH ₄ -N CONC	Entry and display of the NH ₄ -N reference value (lab value)
-or-	
CAL.CONFIG.>MATX2	2 point matrix correction (see section 4.6.3.3 on page 25)
CONC MEAS 1	Saving the currently measured measurement
DATE	Displays the date of the current correction
SET NH ₄ -N CON	Entry and display of the NH ₄ -N reference value (lab value)
CONC MEAS 2	Saving the second measured measurement
DATE	Displays the date of the current correction
SET NH ₄ -N CONC	Entry and display of the NH ₄ -N reference value (lab value)
-or-	
CAL.CONFIG.>MATX2 K+	2 point matrix correction with potassium (see section 4.6.3.4 on page 26) Note: Carry out the matrix correction only as a standard addition in the sample matrix.
CONC MEAS 1	Saving the currently measured measurement
DATE	Displays the date of the current correction
SET K+ CONC	Entry and display of the K ⁺ reference value (lab value)
SET NH ₄ -N CONC	Entry and display of the NH ₄ -N reference value (lab value)
CONC MEAS 2	Saving the second measured measurement
DATE	Displays the date of the current correction
SET K+ CONC	Entry and display of the K ⁺ reference value (lab value)
SET NH ₄ -N CONC	Entry and display of the NH ₄ -N reference value (lab value)

CALIBRATE(continued)

CAL.CONFIG.> VALUE CORR	Value correction (see section 4.6.3.5 on page 28) Once value correction is complete, the correction data are displayed in the form of the MATX2	
	1st NH ₄ -N NH4DSC	Enter the NH ₄ -N concentration (NH4D sc) of the 1st point
	1st K+ NH4DSC	Enter the K ⁺ concentration (NH4D sc) of the 1st point
	1st NH ₄ -N LABOR	Enter the NH ₄ -N concentration (lab) of the 1st point
	2nd NH ₄ -N NH4DSC	Enter the NH ₄ -N concentration (NH4D sc) of the second point
	2nd K+ NH4DSC	Enter the K ⁺ concentration (NH4D sc) of the second point
	2nd NH ₄ -N LABOR	Enter the NH ₄ -N concentration (lab) of the second point
-or-		
CAL.CONFIG.> PREVIOUS CAL	Selection of one of the last four matrix and value corrections performed	
-or-		

4.5 Sensor setup menu (continued)

CAL.CONFIG.> FACTORY CAL	Selection of the preset sensor code
DATE	Date of last calibration
SENSOR CODE	Enter the sensor code

CONFIGURE

EDIT NAME	Entry or editing of the name. Up to 10 alphanumeric characters.
MEAS UNITS	Selection of mg/L or ppm as measurement unit
SET PARAMETER	Selection of NH ₄ -N or NH ₄
TEMP UNITS	Selection of °C or °F as temperature unit.
TEMP CORR	Entry of the temperature correction (–1.5 to +1.5 °C or –2.7 to +2.7 °F)
RESPONSE TIME	Entry of the response time (30 sec to 300 sec)
LOG SETUP	Selects the interval for the data logging (deactivate, 1, 2, 5, 10, 15, 30 min, 1, 2, 6 hr).
K+ COMPENSATE.	Selection of the potassium compensation: On or off
SET DEFAULTS	Resets the configuration on the factory setting.

DIAG/TEST

PROBE INFO	Information on the connected sensor	
	EDIT NAME	Name of the connected sensor
	SERIAL NUMBER	Serial number of the connected sensor
	SOFTWARE VERS	Software version
CAL DATA	Data of the selected MATRIX correction	
SIGNALS	Signals and measurements of the individual measurement channels	
	AMMONIUM	Displays the signals and measurement results
	POTASSIUM	Displays the signals and measurement results
	TEMP	Displays the temperature
COUNTERS	Sensor code (time the sensor code was entered generally corresponds with the age of the cartridge) and CAL. days	
SERVICE	Performing a sensor check using TEST CARTRIDGE (see 7.2 on page 37)	

4.6 Calibration

The membranes on the ion-selective electrodes are not 100% selective due to other substances that may affect the measurement. Perform a matrix correction to compensate the influences of other ions on the ammonium ISE electrode.

Potassium has the largest interference effect on the ammonium membrane. This problem is compensated in the NH4D sc sensor using the integrated potassium electrode.

CARTRICAL™ is a compact sensor cartridge with 3 electrodes, which are perfectly factory calibrated to each other.

Cross sensitivities between ammonium and potassium are automatically eliminated. Solids do not interfere with the measurement. Due to matrix effects calibration and validation can not be performed with standard solutions. A matrix correction can be carried out quickly and easily at any time.

Important Note: Matrix correction must not be performed until the sensor has been immersed in the process longer than 12 hours. 12 hours is the minimum amount of time required for the ISE membranes to adapt to the waste water matrix.

The 12 hours is required to allow the sensor cartridge to adapt to the process.

4.6.1 Sensor code calibration

When activating a new sensor cartridge or during initial calibration, the sensor code must be entered. The default sensor code is FYM7N725PGK7I0FF. With this code, the sensor is ready for operation. To meet published specifications, enter the individual sensor code for the specific CARTRICAL cartridge.

Enter the sensor cartridge's sensor code to accept the CARTRICAL calibration. The sensor code is a 16 character code (letters and numbers) and will be supplied with the sensor cartridge certificate. The code contains the factory calibration for the sensor cartridge, which includes a multi-point ammonium and potassium calibration and the cross sensitivity of potassium on ammonium and vice versa.

When the code is entered, the sensor is completely calibrated. It is recommended to perform a matrix correction to correct the cartridge on the specific matrix.

To change the sensor code:

1. Select **SENSOR SETUP>NH4D SC>CALIBRATE>CAL.CONFIG.>SENSORCODE**
2. Enter the 16 character sensor code.
3. Press **ENTER** to confirm and activate the sensor code.
The day meter is set to zero.

All old calibration data are now overwritten with the new calibration data from the sensor code. The sensor code data are checked by the system. If an error is indicated, check the sensor code and if necessary repeat the entry of the sensor code.

4.6.2 Matrix correction overview

With the NH4D sc sensor, there are various options ([Table 1](#)) for correcting the measured value with laboratory reference values.

For the laboratory reference value, a sample is taken for laboratory analysis and the measurement value at that time is stored.

Depending on the parameter set, the laboratory reference value of the water sample is stored as ammonium nitrogen ($\text{NH}_4\text{-N}$) or as ammonium (NH_4). This laboratory reference value replaces the prior value measured by the sensor.

Table 1 Correction options for the NH4D sc sensor

Correction Option	Application
MATX1	The most commonly used Matrix correction. It performs a 1 point matrix correction (offset adjustment) for ammonium (4.6.3.1 on page 24).
MATX1 K+	With the MATX1 K+ the ammonium value will be corrected as with the MATX1 and in addition the potassium value can be corrected. This is necessary if a higher precision of the ammonium value is required as the potassium value will interfere the ammonium measurement (4.6.3.2 on page 24).
MATX2	Where there is a dynamic process with a large ammonium fluctuation (at least 1/2 decade between the lowest and highest concentration) ¹ , it is recommended to perform the MATX2 (4.6.3.3 on page 25).
MATX2 K+	Where there is a dynamic process with a large ammonium fluctuation (at least 1/2 decade between the lowest and highest concentration) ¹ and potassium value is to be corrected, it is recommended to perform the MATX2 K+ (4.6.3.4 on page 26).
VALUE CORR	The ammonium and potassium displayed value and the ammonium laboratory value can be entered for two points. This is a different way to perform a MATX2 Correction. Here, for two points, the displayed ammonium and potassium values and the ammonium laboratory value are entered via an input screen.
PREVIOUS CAL	Activation of one of the last 4 matrix and value corrections performed.
FACTORY CAL	If the current sensor code is no longer available, average data for the sensor can be activated using FACTORY CAL.

¹ Example of a half decade: The ammonium nitrogen concentration moves between 1 and 5 mg $\text{NH}_4\text{-N}$ or between 5 and 25 mg/L $\text{NH}_4\text{-N}$.

4.6.3 Matrix correction

4.6.3.1 MATX1 correction (one point matrix correction)

Proceed as follows to perform the MATX1:

CALIBRATE
CAL. CONFIG.
DATE
CONC MEAS 1
SET NH4-N CONC

1. Select **SENSOR SETUP>NH4D SC>CALIBRATE> CAL CONFIG.**
2. Select **MATX1** in the selection window and press **ENTER**.
3. Select **CONC MEAS 1**.

READING STABLE?
NH4-N:
DRIFT
K+
DRIFT

The currently measured ammonium and potassium values are displayed. The drift indicates whether the measured value is stable.

4. Wait until the measured value is stable and confirm by pressing **ENTER** (Drift should be < 0.03 mg/L). The values for ammonium and potassium are saved.
5. Immediately after saving, take a water sample for laboratory analysis from as close to the sensor as possible.
6. Analyze the sample immediately after taking the sample as its ammonium content can change quickly.

After determining the laboratory reference value, proceed as follows:

7. Select **SENSOR SETUP>NH4D SC>CALIBRATE> SET NH4-N CONC.**
8. Enter the laboratory value (reference value) for NH₄-N and press **ENTER** to confirm. Confirmation of the entered laboratory value activates the matrix correction.

4.6.3.2 MATX1 K+ correction

Proceed as follows to perform the MATX1 K+:

CALIBRATE
CAL. CONFIG.
DATE
CONC MEAS 1
SET K+ CONC
SET NH4-N CONC

1. Select **SENSOR SETUP>NH4D SC>CALIBRATE> CAL CONFIG.**
2. Select **MATX1 K+** in the selection window and press **ENTER**.
3. Select **CONC MEAS 1**.

READING STABLE?
NH4-N:
DRIFT
K+
DRIFT

The currently measured ammonium and potassium values are displayed. The drift indicates whether the measured value is stable.

4. Wait until the measured value is stable and confirm by pressing **ENTER** (Drift should be < 0.03 mg/L). The values for ammonium and potassium are saved.
5. Immediately after saving, take a water sample for laboratory analysis from as close to the sensor as possible.

6. Analyze the sample immediately after taking the sample as its ammonium content can change quickly.

After determining the laboratory reference values for potassium and ammonium, proceed as follows:

7. Select **SENSOR SETUP>NH4D SC>CALIBRATE>SET NH4-N CONC.**
8. Enter the laboratory reference value for NH4-N and press **ENTER** to confirm.
9. Select **SENSOR SETUP>NH4D SC>CALIBRATE>SET K+ CONC.**
10. Enter the laboratory reference value for potassium and press **ENTER** to confirm.

Confirmation of the entered laboratory value activates the matrix correction.

4.6.3.3 MATX2 correction (2nd point matrix correction)

Proceed as follows to perform the MATX2:

CALIBRATE
CAL. CONFIG.
CONC MEAS 1
DATE
SET NH4-N CONC
CONC MEAS 2
DATE
SET NH4-N CONC

1. Select **SENSOR SETUP>NH4D SC>CALIBRATE>CAL CONFIG.**
2. Select **MATX2** in the selection window and press **ENTER**.
3. Select **CONC MEAS 1**.

READING STABLE?
NH4-N:
DRIFT
K+
DRIFT

The currently measured ammonium and potassium values are displayed. The drift indicates whether the measured value is stable.

4. Wait until the measured value is stable (Drift should be < 0.03 mg/L) and press **ENTER** to confirm. The value for ammonium is saved.
5. Immediately after measuring, take a water sample for laboratory analysis from as close to the sensor as possible.
6. Analyze the sample immediately after taking the sample as its ammonium content can change quickly.

After determining the laboratory reference value, proceed as follows:

7. Select **SENSOR SETUP>NH4D SC>CALIBRATE>SET NH4-N CONC.**
8. Enter the laboratory value (reference value) for NH4-N and press **ENTER** to confirm.
9. Select **MEAS CONC 2** and repeat the sequence from Point 4 to 8 for the second value after a concentration change of at least half a decade.

10. By confirming the second laboratory value, the Matrix2 correction is activated.

4.6.3.4 MATX2 K+ correction

Select **MATX2 K+** to calibrate the ammonium and potassium sensor simultaneously at two different measuring points.

The calibration is carried out via a standard addition in the sample matrix. Proceed as follows to perform the MATX2 K+:

1. Fill a 10-liter bucket with 3 to 5 liters of sample from the sample flow in which the sensor is immersed.
2. Then place the probe in the bucket containing the sample.

CALIBRATE
CAL. CONFIG.
CONC MEAS 1
DATE
SET K+ CONC
SET NH4-N CONC
CONC MEAS 2
DATE
SET K+ CONC
SET NH4-N CONC

3. Select **SENSOR SETUP>NH4D SC>CALIBRATE> CAL CONFIG.**

4. Select **MATX2 K+** in the selection window and press **ENTER**.

5. Select **CONC MEAS 1** and wait until the NH₄-N and K values are stable (drift should be <0.03 mg/L).

Additional steps for various sample concentrations:

Sample concentration 1: ≤ 10 mg/L NH₄-N and ≤ 60 mg/L K

6. Press **ENTER**.
7. Perform the ammonium cuvette/vial test (TNT831 and TNT832) and the potassium test (Method 8049) simultaneously from the filtered or sedimented sample.
8. During the reaction phase of both cuvette/vial tests, pipette 8 mL from the LCW892 mix standard to the sample in the bucket.
9. With the probe, mix the sample in the bucket and wait 3 minutes.
10. Select **CONC MEAS 2** and wait until the NH₄-N and K values are stable (drift should be <0.03 mg/L).
11. Press **ENTER**.
12. Dilute the sample for the cuvette/vial tests 1:3.
13. Perform the TNT 832 ammonium cuvette/vial test and the potassium test (Method 8049) simultaneously from the filtered or sedimented sample.
14. When having the results of all cuvette/vial tests, enter the ammonium and potassium concentrations for both measuring points under **SET K+** and **SET NH4-N**.
15. The message **CAL. COMPLETED OK.** appears if the calibration was successful.

Sample concentration 2: $\geq 10 \leq 100$ mg/L NH₄-N and 60 mg/L K

6. Press **ENTER**.
7. Perform the TNT832 ammonium cuvette/vial test and the potassium test (Method 8049) simultaneously from the filtered or sedimented sample (if necessary, dilute the sample accordingly).

8. During the reaction phase of both cuvette/vial tests, add 40 mL from the LCW892 mix standard to the sample in the bucket.
9. With the probe, mix the sample in the bucket once and wait 3 minutes.
10. Select **CONC MEAS 2** and wait until the $\text{NH}_4\text{-N}$ and K values are stable (drift should be <0.03 mg/L).
11. Press **ENTER**.
12. Dilute the sample for the ammonium cuvette/vial test 1:5 and for the potassium test 1:10.
13. Perform the TNT832 ammonium cuvette/vial test and the potassium test (Method 8049) simultaneously from the filtered or sedimented sample.
14. When having the results of all cuvette/vial tests, enter the ammonium and potassium concentrations for both measuring points under **SET K+ CONC** and **SET $\text{NH}_4\text{-N}$ CONC**.
15. The message **CAL. COMPLETED OK.** appears if the calibration was successful.

**Sample concentration 3: > 60 mg/L K
(very high potassium concentrations in the waste water)**

6. Press **ENTER**.
7. Perform the TNT832 ammonium cuvette/vial test and the potassium test (Method 8049) simultaneously from the filtered or sedimented sample (dilute the sample accordingly).
8. During the reaction phase of both cuvette/vial tests, add 80 mL from the LCW 892 mix standard to the sample in the bucket.
9. With the probe, mix the sample in the bucket once and wait 3 minutes.
10. Select **CONC MEAS 2** and wait until the $\text{NH}_4\text{-N}$ and K values are stable (drift should be <0.03 mg/L).
11. Press **ENTER**.
12. Dilute the sample for the ammonium cuvette/vial test 1:10 and for the potassium test 1:25.
13. Perform the TNT832 ammonium cuvette/vial test and the potassium test (Method 8049) simultaneously from the filtered or sedimented sample.
14. When having the results of all cuvette/vial tests, enter the ammonium and potassium concentrations for both measuring points under **SET K+ CONC** and **SET $\text{NH}_4\text{-N}$ CONC**.
15. The message **CAL COMPLETED OK.** appears if the calibration was successful.

Note: In case of a measuring range exceedance an appropriate dilution of the sample is required.

4.6.3.5 Value correction

Value correction offers the option of subsequently correcting a matrix at two different concentrations.

Take several samples on various days with different concentrations and perform an analysis of the samples in the laboratory.

Note: *The concentrations should be in a concentration range of at least half a decade.*

1. Note the two displayed ammonium and potassium values, which are measured with the sensor at the time of the sampling.
2. Then note the measured ammonium laboratory reference value.

All 3 values form a correction point.

3. From the values recorded, select the two correction points with ammonium concentrations as far apart as possible.
4. Select **CAL CONFIG.> CALIBRATE>VALUE CORR** from the menu and press **ENTER** to confirm.

Enter the 3 noted values:

5. **1. NH₄-N NH4D sc:** Enter the displayed NH₄-N value for the 1st correction point. Press **ENTER** to confirm.
6. **1. K+ NH4D sc:** Enter the displayed K+ value for the 1st correction point. Press **ENTER** to confirm.
7. **1. NH₄-N lab:** Enter the measured NH₄-N laboratory reference value for the 1st correction point. Press **ENTER** to confirm.
8. **2. NH₄-N NH4D sc:** Enter the displayed NH₄-N value for the 2nd correction point. Press **ENTER** to confirm.
9. **2. K+ NH4D sc:** Enter the displayed K+ value for the 2nd correction point. Press **ENTER** to confirm.
10. **2. NH₄-N lab:** Enter the measured NH₄-N laboratory reference value for the 2nd correction point. Press **ENTER** to confirm.

Value correction is activated and displayed as **MATX2**.

Section 5 Maintenance

Important Note: Only qualified personnel should conduct the tasks described in this section of the manual.

5.1 Maintenance schedule

Maintenance task	30 days ¹	6 months
Clean sensor ²	x	
Replace the sensor cartridge ^{3, 4}		x
Check sensor for damage	x	
Check measured value by lab reference analysis and correct values by matrix correction if required ³	x	

¹ Recommendation: weekly during the first month in operation

² The frequency of cleaning depends on the application. In some applications more or less frequent cleaning may be necessary.

³ In typical operating conditions, a different interval may be required depending on the specific application and local conditions.

⁴ Sensor cartridges are wear parts and are not covered by the instrument warranty.

Important Note: Do not check the sensor with usual $\text{NH}_4\text{-N}$ standard solutions, because the ion strength of normal standard solutions are not strong enough. Use therefore calibration solutions with artificial ion matrix generate to have plausible measurements (e.g. LCW892).

5.2 Clean the sensor

Important Note:

Do not touch the membranes with fingers.

Do not clean the sensor cartridge with sharp objects that may cause scratches and do not use any chemical cleaning agent.

1. Clean the sensor cartridge with the soft brush supplied.
2. Clean the sensor body (not the cartridge) with a sponge or brush.
3. Rinse the sensor with clean, lukewarm tap water.

Note: Do not use distilled water.

5.3 Replace the sensor cartridge

The sensor cartridge is replaced as described below and in [Figure 12 on page 30](#).

1. Clean the sensor and thoroughly dry the sensor cartridge and the sensor adapter.
2. Unscrew the locking ring and remove.

Important Note: The sensor cartridge must direct downwards so that no water can run into the sensor adapter. The contacts between the sensor and the sensor cartridge must remain dry.

3. Pull the sensor cartridge out of the sensor adapter and dispose of the old sensor cartridge and opaque gasket per applicable regulations.
4. Ensure that the new opaque gasket is installed during every sensor cartridge replacement.

5. Insert the new sensor cartridge in the sensor adapter. Pay attention to the triangular marking on the cartridge and on the sensor.

Important Note: The sensor cartridge only fits correctly in the sensor adapter in one position. Pay attention to the markings on the sensor cartridge and on the sensor adapter.

6. Attach the locking ring over the sensor head and hand-tighten.

Note: Use the cap of the storage container as a tool/screwing aid for the locking ring.

7. Enter the new sensor code (see certificate).

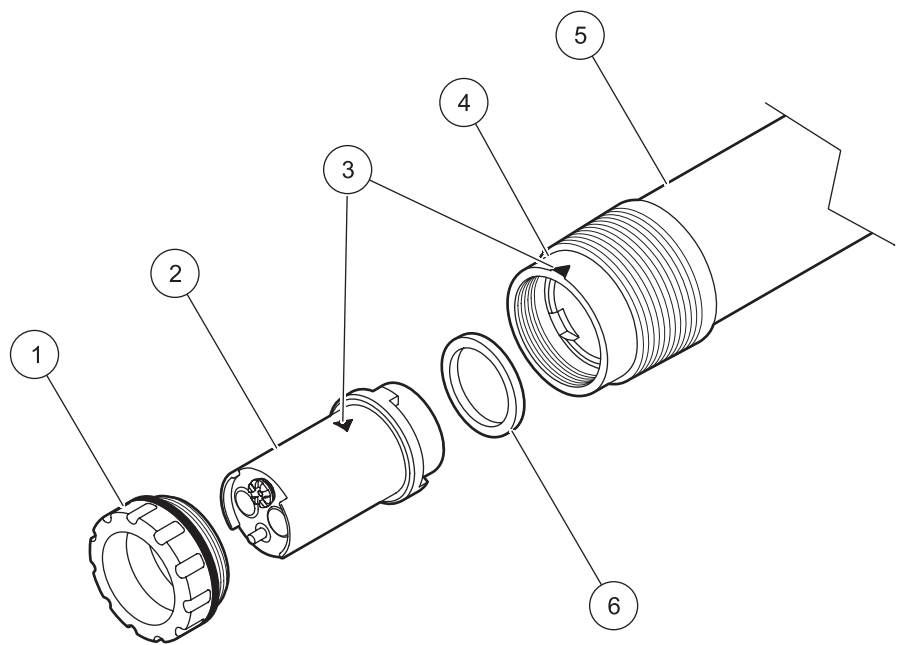


Figure 12 Replace the sensor cartridge

1	Locking ring	4	Sensor adapter
2	Sensor cartridge	5	Sensor housing
3	Markings	6	Opaque gasket

5.4 Sensor and Sensor Cartridge Storage

Remove the sensor from the sample flow and clean the sensor thoroughly.

Short term storage

Keep the membranes and the salt bridge moist (NO DISTILLED WATER OR DI WATER). This will help avoid long response times when placing the sensor back in the sample flow. Otherwise, the correct operation of the sensor is no longer guaranteed.

Long term storage

Important Note: Use the delivered storage container for long term storage. Fill the container with drinking water (NO DISTILLED WATER) and ensure that the sensor cartridge remains wet.

Check the membranes and ensure they are still moist every 2–4 weeks, depending on environmental conditions.

Note: A storage container is supplied to keep the sensor cartridge moist. Keep sensor cartridge capped within the storage container during short and long term storage. Refer to [Section 1 Specifications on page 5](#) for storage temperatures.

Note: The black gasket is needed for sealing function. See [Figure 6 on page 13](#).

Sensor and sensor cartridge

Note: Take care of contacts between sensor and sensor cartridge. The contacts must be dry. Store in a dry place.

Section 6 Troubleshooting

6.1 Error codes

When the sensor is experiencing an error condition, the sensor reading on the measurement screen will flash and the relays and analog outputs associated with this sensor will be held. Errors are defined in [Table 2](#).

Table 2 Error codes

Displayed errors	Definition	Resolution
NH4 mV RANGE!	Ammonium mV value is out of measuring range	See 6.3.1 Troubleshooting during operation on page 34 .
K+ mV RANGE!	Potassium mV value is out of measuring range	
pHD RANGE!	pHD reference value out of measuring range	
TEMP RANGE	Temperature value out of measuring range	
NO CARTRIDGE	No sensor cartridge connected	Connect sensor cartridge, see section 3.3 on page 13 .
SENSOR CODE	Sensor code calibration failed	See 6.3.2 Troubleshooting during calibration on page 36
CALIBRATING	Data transfer from software 1.3x has failed	

6.2 Warning codes

A sensor warning will leave all menus, relays and outputs functioning normally, but will cause a warning icon to flash.

Warnings may be used to trigger a relay and users can set warning levels to define the severity. Warnings are defined in [Table 3](#).

Table 3 Warning codes

Displayed warnings	Definition	Resolution
NH4 mV RANGE!	Ammonium mV value is close to measuring range limit	See 6.3.1 Troubleshooting during operation on page 34 .
K+ mV RANGE!	Potassium mV value is close to measuring range limit	
pHD RANGE!	pHD reference value is close to limit	
TEMPERATURE	Temperature is close to limit	
CARTRIDGE OLD	Sensor cartridge more than 1 year old	Replace the sensor cartridge
AMMONIUM		See 6.3.2 Troubleshooting during calibration on page 36 .
OFFSET	Ammonium offset is out of measuring range	
SLOPE	Ammonium slope is out of measuring range	
POTASSIUM		
OFFSET	Potassium offset is out of measuring range	
SLOPE	Potassium slope is out of measuring range	

6.3 Troubleshooting

6.3.1 Troubleshooting during operation

Symptom	Possible cause	Corrective actions
Incorrect measurement values	Calibration too old; calibration was not suitable for the particular case; big change in the waste water matrix	Carry out suitable calibration
	Strongly fluctuating pH values above pH 8, see section 2.3 on page 9 .	Carry out external pH compensation. Contact our service department.
	Strongly contaminated membranes and/or reference electrode	Clean the sensor cartridge using a brush and/or rinse the sensor cartridge with clean water (without cleaning agents), and wipe the sensor cartridge carefully with a soft, clean cloth.
		Clean all components (membranes/reference electrode/temperature sensor).
		Install cleaning unit
		Increase cleaning interval
	Sensor membrane damaged	Check sensor installation/replace sensor cartridge
	Reference element damaged	Check sensor installation/replace sensor cartridge
	NH4 mV RANGE! (Ammonium mV value is out of measuring range)	Replace sensor cartridge
	K+ mV RANGE! (Potassium mV value is out of measuring range)	Replace sensor cartridge
	pHD RANGE! (pHD reference value is out of range)	Replace sensor cartridge
	TEMPERATURE (temperature value is out of range)	Replace sensor cartridge/check waste water temperature
	CARTRIDGE OLD (cartridge more than 1 year old)	Replace sensor cartridge
	Dampness at the contacts of the sensor cartridge	Dry the contacts with a cloth, some paper or hairdryer. Check the opaque gasket for damage and the correct position. Screw the locking ring on. Note: Use the cap of the storage container as a tool/screwing aid for the locking ring (Figure 9 on page 15).

6.3.1 Troubleshooting during operation (continued)

Symptom	Possible cause	Corrective actions
Incorrect measurement values	Dampness inside the measuring probe/faulty sensor electronics Check the sensor electronics by using the test cartridge (section 7.2 on page 37). - Select SENSOR-SETUP>DIAG/TEST>SERVICE>TEST CARTRIDGE>Test cartridge Ready? Press ENTER - Compare the displayed values with the guide values. The displayed values should be in the same range as the guide values below. Wait for stabilization before pressing ENTER: AMMONIUM: SIGNAL $-237.0 < (-226.2 \text{ mV}) < -217.0$ MEAS $2263.6 < (2274.4 \text{ mV}) < 2283.6$ REF $2450.6 < (2500.6 \text{ mV}) < 2550.6$ ENTER POTASSIUM: SIGNAL $-10.0 < (-2.9 \text{ mV}) < 10.0$ MEAS $2490.6 < (2497.7 \text{ mV}) < 2510.6$ REF $2450.6 < (2500.6 \text{ mV}) < 2550.6$ ENTER TEMPERATURE VALUES: TEMP $24.5 < (24.8 \text{ }^{\circ}\text{C}) < 25.5 / 76.1 < (76.6^{\circ}\text{F}) < 77.9$ ENTER - If the test cartridge data are within range, the sensor electronics are functional: Test cartridge OK ENTER	If the test cartridge data are not within this range or if the test cartridge check is not successful, contact our service department.
	Potassium concentrations too high ($>700 \text{ mg/L}$; with small ammonium concentrations)	Switch off potassium compensation
Unstable measurement values	Air bubbles, depth of immersion	Check the installation Check the configuration of the cleaning unit
	Dampness at the contacts of the sensor cartridge	Dry the contacts with a cloth, some paper or hairdryer. Check the opaque gasket for damage and the correct position of the gasket. Screw the locking ring on. Note: Use the cap of the storage container as a tool/screwing aid for the locking ring.
	Sensor membrane damaged	Check installation/replace sensor cartridge
	Reference element damaged	Check installation/replace sensor cartridge

6.3.2 Troubleshooting during calibration

Symptom	Possible cause	Corrective actions
SENSOR CODE	Sensor code entered incorrectly	Using the certificate, check whether the sensor code was entered correctly. If not having the certificate, carry out "Factory Calibration" (Factory cal).
CALIBRATING	Data transfer from software 1.3x has failed	Carry out a completely new calibration: a) sensor code or factory calibration, b) suitable matrix correction
AMMONIUM		
OFFSET	Error in the last ammonium calibration, sensor cartridge too old, contaminated, faulty	Repeat the calibration. Use the previous calibration. Clean or replace the sensor cartridge.
SLOPE	Error in the last ammonium calibration, sensor cartridge too old, contaminated, faulty	Repeat the calibration. Use the previous calibration. Clean or replace the sensor cartridge.
POTASSIUM		
OFFSET	Error in the last potassium calibration, sensor cartridge too old, contaminated, faulty	Repeat the calibration. Use the previous calibration. Clean or replace the sensor cartridge.
SLOPE	Error in the last potassium calibration, sensor cartridge too old, contaminated, faulty	Repeat the calibration. Use the previous calibration. Clean or replace the sensor cartridge.

Section 7 Spare Parts and Accessories

7.1 Spare parts

Description	Catalog Number
NH4D sc (sensor with 10 m (32.8 ft.) integral cable and one pre-calibrated Sensor Cartridge)	LZV437.99.00002
Calibrated Sensor Cartridge ¹	6188400
Cleaning brush	6183600
Locking ring kit	6176900
Opaque gasket	HZD176

¹ Sensor cartridges are wearing parts that are not covered by the instrument warranty.

7.2 Accessories

Description	Catalog Number
Cleaning Unit	LZY331
Rail Mount Kit	6184900
Chain Mount Kit	LZX914.99.12400
Stainless Steel Basin Edge Mounting	LZX414.00.80000
High Output Air Blast compressor 115 V/50 Hz	6860003
High Output Air Blast compressor 230 V/50 Hz	6860103
Test cartridge	6188300

7.3 Validation accessories

Description	Catalog Number
TNT plus Ammonium Vial Test (Measuring range: 2–47 mg/L NH ₄ –N/2.5–60.0 mg/L NH ₄)	TNT832
TNT plus Ammonium Vial Test (Measuring range: 1–12 mg/L NH ₄ –N/1.3–15.0 mg/L NH ₄)	TNT831
Potassium Reagent Set (Measuring range: 0.1–7 mg/L)	2459100
Potassium Reagent 1 Powder Pillow (25/pkg)	1432198
Potassium Reagent 2 Powder Pillow (25/pkg)	1432298
Potassium Reagent 3 Powder Pillow (100/pkg)	1432399
Ammonium/Potassium standard (5000 mg/L NH ₄ –N, 20,000 mg/L Potassium)	LCW892

Note: The following instruments are suitable as photometers:
The Pocket Colorimeter II and the Spectrophotometer in the DR Series.

7.4 Corresponding documentation

Description	Catalog Number
Instruction sheet Cleaning Unit	DOC306.53.00747
Instruction sheet Rail Mounting	DOC306.53.00145
Instruction sheet Chain Mounting	DOC306.53.00147
Manual HOAB compressor	DOC026.53.00811
Manual sc100	DOC023.52.00032
Manual sc1000	DOC023.53.90007

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Section 9 Limited warranty

Hach Company warrants its products to the original purchaser against any defects that are due to faulty material or workmanship for a period of one year from date of shipment unless otherwise noted in the product manual.

In the event that a defect is discovered during the warranty period, Hach Company agrees that, at its option, it will repair or replace the defective product or refund the purchase price excluding original shipping and handling charges. Any product repaired or replaced under this warranty will be warranted only for the remainder of the original product warranty period.

This warranty does not apply to consumable products such as chemical reagents; or consumable components of a product, such as, but not limited to, lamps and tubing.

Contact Hach Company or your distributor to initiate warranty support. Products may not be returned without authorization from Hach Company.

Limitations

This warranty does not cover:

- Damage caused by acts of God, natural disaster, labor unrest, acts of war (declared or undeclared), terrorism, civil strife or acts of any governmental jurisdiction
- Damage caused by misuse, neglect, accident or improper application or installation
- Damage caused by any repair or attempted repair not authorized by Hach Company
- Any product not used in accordance with the instructions furnished by Hach Company
- Freight charges to return merchandise to Hach Company
- Freight charges on expedited or express shipment of warranted parts or product
- Travel fees associated with on-site warranty repair

This warranty contains the sole express warranty made by Hach Company in connection with its products. All implied warranties, including without limitation, the warranties of merchantability and fitness for a particular purpose, are expressly disclaimed.

Some states within the United States do not allow the disclaimer of implied warranties and if this is true in your state the above limitation may not apply to you. This warranty gives you specific rights, and you may also have other rights that vary from state to state.

This warranty constitutes the final, complete, and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Hach Company.

Limitation of Remedies

The remedies of repair, replacement or refund of purchase price as stated above are the exclusive remedies for the breach of this warranty. On the basis of strict liability or under any other legal theory, in no event shall Hach Company be liable for any incidental or consequential damages of any kind for breach of warranty or negligence.

Section 10 Certification

Electromagnetic compatibility

The device has been tested with an sc100 and sc1000 controller for electromagnetic compatibility (EMC) in the industrial environment in accordance with the following standard(s):

EN 61326 (EMC Requirements for Electrical Equipment for Measurement, Control and Laboratory Use) per 2004/108/EC: Supporting test records and compliance certification by the manufacturer.

Immunity

IEC 1000-4-2 (EN 61000-4-2) Electromagnetic compatibility (EMC). Testing and measurement techniques. Electrostatic discharge immunity test. Basic EMC standard (criterion B)

IEC 1000-4-3 (EN 61000-4-3) Electromagnetic compatibility (EMC). Testing and measurement techniques. Radio-frequency, electromagnetic field immunity test. Part 4-3: Testing and measurement techniques — Radio-frequency, electromagnetic field immunity test (criterion A)

IEC 1000-4-4 (EN 61000-4-4) Electromagnetic compatibility (EMC). Testing and measurement techniques. Fast electrical transient/burst immunity test. Basic EMC standard (criterion B)

IEC 1000-4-5 (EN 61000-4-5) Electromagnetic compatibility (EMC). Testing and measurement techniques. Surge immunity test (criterion B)

IEC 1000-4-6 (EN 61000-4-6) Electromagnetic compatibility (EMC). Testing and measurement techniques. Immunity to conducted disturbances, induced by radio-frequency fields (criterion A)

IEC 1000-4-11 (EN 61000-4-11) Electromagnetic compatibility (EMC). Testing and measurement techniques. Voltage dips, short interruptions and voltage variations immunity tests (criterion B)

Emissions

The instrument has been tested for radio-frequency emissions in accordance with the following standard(s):

As per EMC directive 89/336/EEC: EN 61326 (Electrical equipment for measurement, control and laboratory use, EMC requirements), class A emission limits. Confirmation of the test by the manufacturer.

EN 61000-3-2 Electromagnetic compatibility (EMC). Limits for harmonic currents.

EN 61000-3-3 Electromagnetic compatibility (EMC). Limitation of voltage changes, voltage variations and flicker in public low-voltage supply systems.

Other test standard(s) in emissions:

EN 55011 (CISPR 11), industrial, scientific and medical (ISM) radio-frequency equipment, radio disturbance, limits and methods of measurement

Appendix A Modbus Register

Table 4 Sensor Modbus Register

Tag Name	Register #	Data Type	Length	R/W	Discrete Range	Min/Max Range	Description
AMMONIUM NH4-N	40001	Float	2	R		0/2000	Ammonium in mg/L
AMMONIUM NH4	40003	Float	2	R		0/2576	Ammonium in mg/L
K+	40005	Float	2	R		0/2000	k+ mg/L
TEMP DEG C	40007	Float	2	R		−30/100	Temp in Deg Celsius
TEMP DEG F	40009	Float	2	R		−54/180	Temp Fahrenheit
POTASS COMPENS	40013	Unsigned Integer	1	R/W	0/1		
DATA LOG INTRVL	40014	Unsigned Integer	1	R/W	0/1/2/3/4/5/6/7/8/9		
SENS INTERVAL	40015	Unsigned Integer	1	R/W		30/300	
TEMP SELECT	40016	Unsigned Integer	1	R/W	U25/26		
PARAMETER SELECT	40017	Unsigned Integer	1	R/W	P19/42		
UNIT SELECT	40018	Unsigned Integer	1	R/W	U0/2		
TEMP. OFFSET C	40019	Float	2	R/W		−1.5/1.5	
TEMP. OFFSET F	40021	Float	2	R/W		−2.7/2.7	
SENSOR NAME	40024	String	8	R/W			
CAL CONFIG	40032	Unsigned Integer	1	R/W	0/1/2/3/4/5/6/7		
SENSOR CODE	40033	String	8	R/W			
Last Sensor Code [day]	40041	Unsigned Integer	1	R		0/730	
Last Calibration [day]	40042	Unsigned Integer	1	R		0/730	
SERIAL NUMBER	40043	String	6	R/W			
SOFTWARE VERS	40049	Float	2	R		0/655.35	
DRIVER VERS	40051	Float	2	R		0/655.35	
STRUCTURE VERSION	40053	Unsigned Integer	1	R		0/65535	
CONTENT VERSION	40054	Unsigned Integer	1	R		0/65535	
FIRMWARE VERSION	40055	Unsigned Integer	1	R		0/65535	
DATE SENSOR CODE	40068	Time2	2	R			
DATE CAL POINT 1	40070	Time2	2	R			
DATE CALPOINT 2	40072	Time2	2	R			
SENSOR CODE	40074	Unsigned Integer	1	R	0/1/2/3/4/5/6/7		
DATE	40075	Time2	2	R			
NH4 N CONC 1	40077	Float	2	R		0/2000	

Modbus Register

Table 4 Sensor Modbus Register (continued)

Tag Name	Register #	Data Type	Length	R/W	Discrete Range	Min/Max Range	Description
NH4 CONC 1	40079	Float	2	R		0/2576	
NH4 mV CONC 1	40081	Float	2	R		-250/400	
NH4 mV drift CONC 1	40083	Float	2	R		-500/500	
K+ CONC 1	40085	Float	2	R		0/2000	
K+ mV CONC 1	40087	Float	2	R		-300/400	
K+ mV drift CONC 1	40089	Float	2	R		-500/500	
TEMP CONC 1	40091	Float	2	R		0/45	
DATE 2	40093	Time2	2	R			
NH4 N CONC 2	40095	Float	2	R		0/2000	
NH4 CONC 2	40097	Float	2	R		0/2576	
NH4 mV CONC 2	40099	Float	2	R		-250/400	
NH4 mV drift CONC 2	40101	Float	2	R		-500/500	
K+ CONC 2	40103	Float	2	R		0/2000	
K+ mV CONC 2	40105	Float	2	R		-300/400	
K+ mV drift CONC 2	40107	Float	2	R		-500/500	
TEMP CONC 2	40109	Float	2	R		0/45	
OFFSET BY AMMON	40111	Float	2	R		-70/50	
SLOPE AMMON	40113	Float	2	R		20/150	
OFFSET BY POTASS	40115	Float	2	R		-150/50	
SLOPE POTASS	40117	Float	2	R		20/100	
NH4NmV	40129	Float	2	R		-2500/2500	
AmmonMeasmV	40131	Float	2	R		-5000/5000	
AmmonmVDrift	40133	Float	2	R		-5000/5000	Drift in mg/L 5sec
Ammon Noise	40135	Float	2	R		-100/500	Noise in 10 seconds
K+mV	40137	Float	2	R		-5000/5000	Signal K+
PotassMeasmV	40139	Float	2	R		-5000/5000	
Potass Drift mg/L	40141	Float	2	R		-5000/5000	Drift in mg/L 5sec
Potass Noise	40143	Float	2	R		-100/+500	Noise in 10 seconds
pHDmV	40145	Float	2	R		-5000/5000	

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