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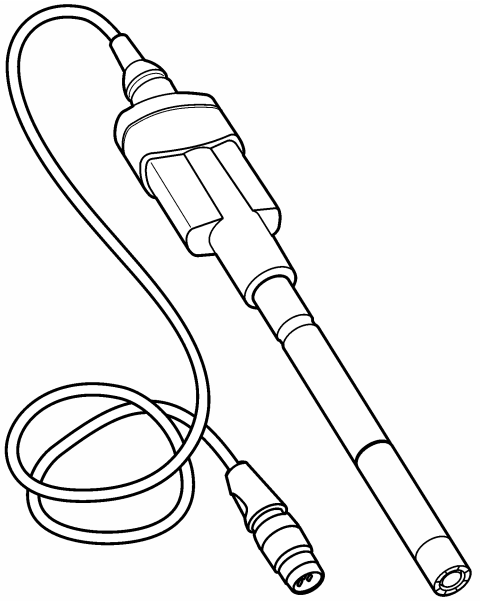
ISENH3181

05/2021, Edition 6

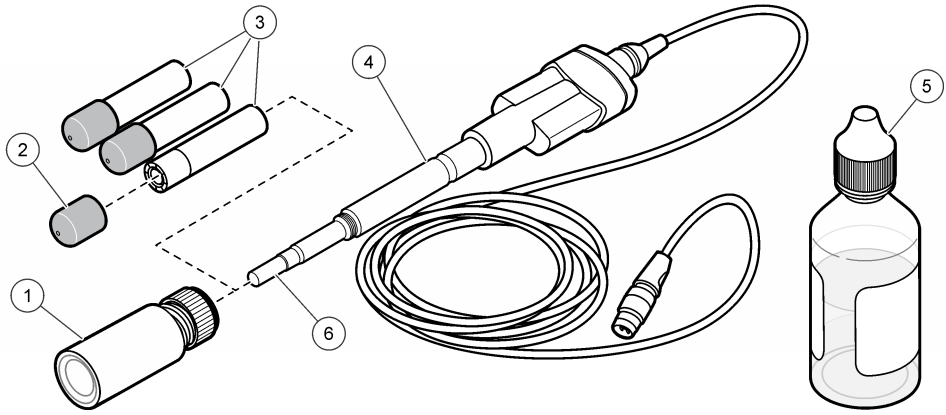
User Manual



Section 1 Product overview

The Intellical ISENH318 series probes are digital, combination electrodes that measure the ammonia concentration in wastewater, drinking water and general water samples. The probes have a built-in temperature sensor, a refillable membrane module and a double-junction reference. The Ammonia Ionic Strength Adjuster (ISA) increases the solution pH to >11, where ammonium and ammonia are measured as NH_3. A 59-mL bottle of electrode filling solution is supplied with the probe. Refer to Figure 1.

Figure 1 Probe overview



1 Probe soaker bottle with storage solution	**4** Probe body
2 Membrane module protector cap (3x)	**5** Electrolyte filling solution
3 Membrane module (3x)	**6** Glass electrode and temperature sensor

Section 2 Specifications

Specifications are subject to change without notice.

Specifications	Details
Probe type	Digital combination gas-sensing ammonia ion selective electrode (ISE) probe with a refillable outer body, double-junction reference and built-in temperature sensor
Measurement range	0.01 mg/L ($5x10^{-7}$ M) to 14,000 mg/L (1 M) as NH_3–N
Accuracy	±0.02 mV or 0.05%, whichever is greater
Sample pH range	> pH 11 with Ammonia ISA
Reference type	Ag/AgCl
Reference junction	Double junction (porous PTFE annular ring)
Slope	57 mV/decade (90 to 110% in linear range at 25 °C (77 °F) per Nernstian theoretical value)
Linear region	0.5 mg/L to 14,000 mg/L as NH_3–N
Temperature accuracy	±0.3 °C (±0.54 °F)
Temperature sensor type	30 kΩ NTC thermistor

Specifications	Details
Operating temperature	5 to 50 °C (41 to 122 °F)
Storage temperature	5 to 35 °C (41 to 95 °F)
Minimum sample volume	15 mL
Minimum immersion depth	25.4 mm (1 in.)
Body material (standard)	Epoxy
Membrane	Replaceable Hach ISENH3181 Ammonia membrane module
Electrolyte filling solution	0.1 M NH_4Cl (membrane module)
Reference electrolyte	Non-refillable gel reference element
Storage solution	Short-term and mid-term storage: 1000 mg/L NH_3—N standard solution Long-term storage: Hach pH Electrode Storage Solution
Cable connection	M12 digital output and connector
Dimensions	Diameter: 12 mm (0.47 in.) Length: 175 mm (6.9 in.) total; 103 mm (4.1 in.) below head Cable length: ISENH318101: 1 m (3.3 ft); ISENH318103: 3 m (9.8 ft)
Warranty	1 year on the probe. This warranty covers manufacturing defects, but not improper use or wear.
Certifications	CE, FCC/ISED

Section 3 Safety information

3.1 Intended use

The Intellical probes are intended for use by individuals who measure water quality parameters in the laboratory. The Intellical probes do not treat or alter water.

3.2 Use of hazard information

⚠ DANGER

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

⚠ WARNING

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.

NOTICE

Indicates a situation which, if not avoided, may cause damage to the instrument. Information that requires special emphasis.

3.3 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 on the instrument is referenced in the manual with a precautionary statement.

	Electrical equipment marked with this symbol may not be disposed of in European domestic or public disposal systems. Return old or end-of-life equipment to the manufacturer for disposal at no charge to the user.

3.4 Product hazards

⚠ CAUTION	
	Chemical exposure hazard. Obey laboratory safety procedures and wear all of the personal protective equipment appropriate to the chemicals that are handled. Refer to the current safety data sheets (MSDS/SDS) for safety protocols.

⚠ CAUTION	
	Chemical exposure hazard. Dispose of chemicals and wastes in accordance with local, regional and national regulations.

Section 4 Preparation for use

Install a membrane module that contains ammonia electrode filling solution before use.

1. Fill and install the membrane module on the probe. Do not tighten too much. Refer to the illustrated steps in Figure 2.

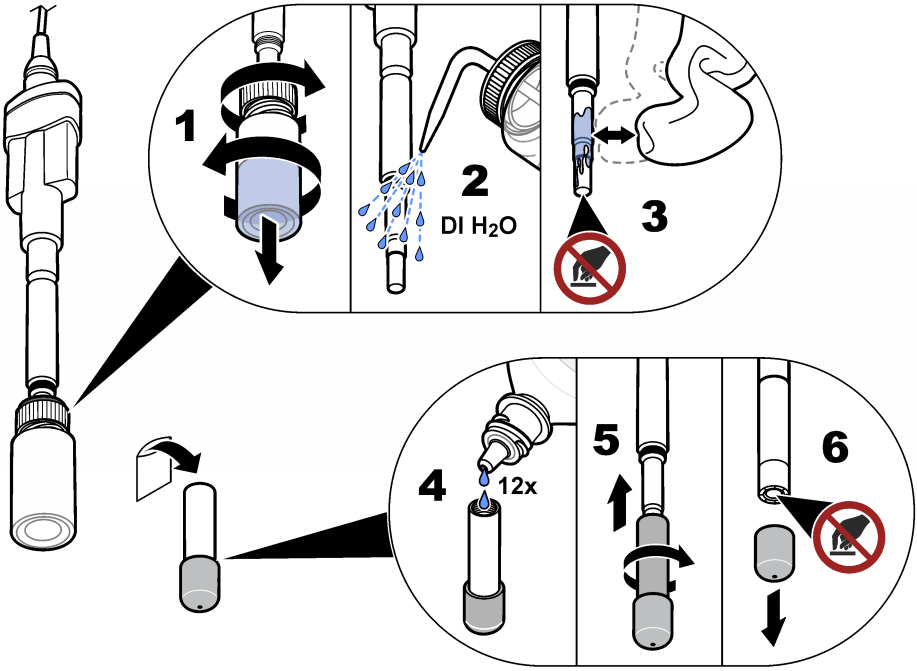
   Note: *Add 12 drops (0.5 mL) of the ammonia electrode filling solution to the membrane module.*

2. Condition the probe before use. To condition the probe, soak the probe in a 1000 mg/L NH_3—N standard solution for 30 to 60 minutes. Do not add the ISA to the standard solution.
3. Make sure that the meter has the correct date and time settings. The service-life time stamp in the probe comes from the date and time settings in the meter.

   Note: *Some meters automatically open the date and time settings when the meter starts for the first time, or after battery replacement.*

4. Connect the probe to the meter.

Figure 2 Install the membrane module



Section 5 Calibration

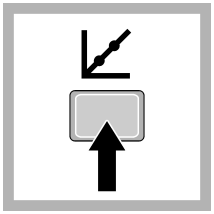
The procedure that follows is applicable to meters that can connect to Intellical ISE probes. Refer to the applicable meter documentation for meter operation and probe-specific settings.

5.1 Calibration notes

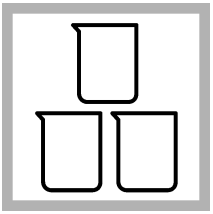
Read the notes that follow before calibration.

- Make sure to install the ammonia membrane module with ammonia electrode filling solution on the probe.
- Measure the standard solutions from lowest to highest concentration for best results.
- For best results, reset the filling solution after calibration. To reset the filling solution, put the probe (with installed membrane) in a 1000 mg/L NH_3—N standard solution without ISA for 30 seconds to 1 minute.
- Keep all of the solutions (standard solutions and samples) at the same temperature (± 2 °C (± 3.6 °F)) for best results.
- Stir the standards and samples at a slow and constant rate to prevent the formation of a vortex.
- Use the default calibration options or change the options in the probe settings menu.
- Use the single display mode for calibration when more than one probe is connected to the meter (if applicable).
- Calibrate the probes and verify the calibration regularly for best results. Use the meter to set calibration reminders.
- The calibration data is stored in the probe. When a calibrated probe is connected to a different meter with the same calibration options, a new calibration is not necessary.
- Air bubbles below the sensor when in solution can cause a slow response or error in the calibration. Make sure to remove air bubbles during calibration.

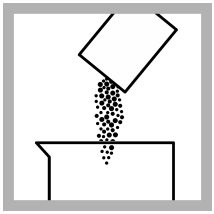
5.2 Calibration procedure



1. Go to the calibrate menu. Select the probe, if applicable. The display shows the standard solutions to use for calibration.



2. Add 25 mL of each standard solution to different beakers.

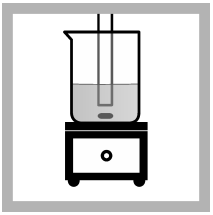


3. Add one Ammonia Ionic Strength Adjustor (ISA) Powder Pillow to each 25 mL of standard solution.

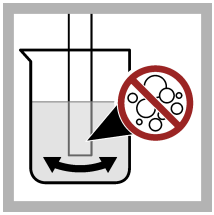
Note: *As an alternative, add 0.5 mL of Ammonia ISA Solution.*

4. Add a stir bar to the first standard solution. Put the standard solution on an electromagnetic stirrer. Stir at a moderate rate.

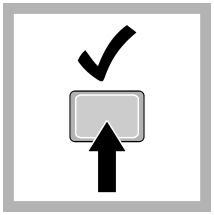
5. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



6. Put the probe in the standard solution with the sensor fully submerged. Do not put the probe on the bottom or sides of the beaker.

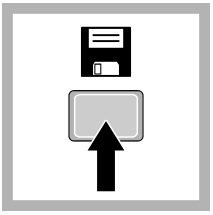


7. Shake the probe from side to side to remove air bubbles.



8. Stir for 30 to 60 seconds, then read the ammonia concentration of the standard solution.

9. Do steps 3 through 8 to read the value of the remaining standard solutions.



10. Save the calibration.

Section 6 Sample measurement

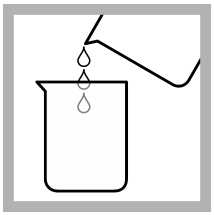
The procedure that follows is applicable to meters that can connect to Intellical ISE probes. Refer to the applicable meter documentation for meter operation and probe-specific settings.

6.1 Sample measurement notes

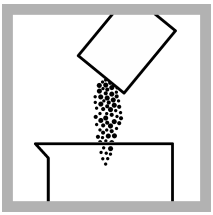
Read the notes that follow before sample measurements.

- Make sure to install the ammonia membrane module with ammonia electrode filling solution on the probe.
- Rinse the probe with deionized water and dry with a lint-free cloth between measurements to prevent contamination.
- To measure samples of low concentration after measurements of high concentration, reset the filling solution for best results. To reset the filling solution, put the probe (with installed membrane) in a 1000 mg/L NH_3—N standard solution without ISA for 30 seconds to 1 minute.
- If the stabilization time is long, try a different stir rate and make sure to condition the probe.
- Keep all of the solutions (standard solutions and samples) at the same temperature (± 2 °C (± 3.6 °F)) for best results.
- If complete traceability is necessary, enter a sample ID and operator ID before measurement. Refer to the meter manual for instructions.
- Stir the standards and samples at a slow and constant rate to prevent the formation of a vortex.
- The meter automatically saves the measurement data when the user manually reads each data point and when the meter is set to read at regular intervals. The user must manually save each data point when the meter is set to read continuously.
- Air bubbles below the sensor can cause a slow response or error in the measurement. Make sure to remove air bubbles before and during measurements.

6.2 Sample measurement procedure



1. Pour 25 mL of fresh sample into a 50-mL beaker.

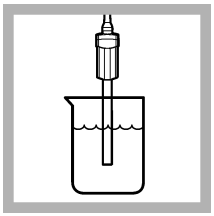


2. Add one Ammonia Ionic Strength Adjustor (ISA) Powder Pillow.

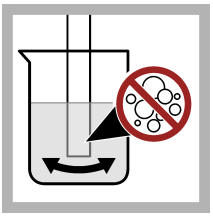
Note: *As an alternative, add 0.5 mL of Ammonia ISA Solution.*

3. Add a stir bar. Put the beaker on an electromagnetic stirrer. Stir at a moderate rate.

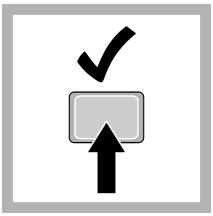
4. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



5. Put the probe in the sample with the sensor fully in the sample. Do not put the probe on the bottom or sides of the beaker.



6. Shake the probe from side to side to refresh the reference junction and remove air bubbles.



7. Stir for 30 to 60 seconds, then read the ammonia concentration of the sample. The display shows the value when the reading is stable.

6.3 Interferences

The sensing element will measure some other ions that are known to interfere with the method. The probe response to other ions usually increases the mV potential and causes a positive error. The response to other ions can be semi-quantitatively calculated through the Nikolsky equation, an extended Nernst equation:

$E = E^o + (RT/(zF))\ln[aN_a + KN_ax \times ax]$

Where

- ax = the activity of the interfering ion
- KN_ax = the selectivity coefficient for the interfering ion relative to the primary ion

The primary interferences for ammonia ion-selective electrodes are volatile amines. Most other gases will change to ionic species at the high pH of the test and will not interfere directly. The concentration of ions will change the solubility of ammonia. Thus, standard solutions should have about the same concentration of ions and dissolved species as the samples.

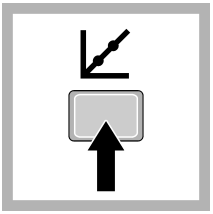
Ammonia forms complexes with a number of metal ions: mercury, silver, copper, gold, nickel, cobalt, cadmium and zinc. The ammonia ISA contains a high concentration of hydroxide ion and adjusts the pH to >11, where most metals form complexes with hydroxide or precipitate. Mercury will form a complex with ammonia when the hydroxide concentration is 0.1 M and the ammonia concentration is below 10^{-3} M. Mercury will not interfere if the mercury in the sample is preferentially bound to a different species such as iodide, which forms a soluble mercury complex at all pH levels.

Section 7 Verify the calibration

Measure the value of a fresh standard solution at regular intervals to make sure the result is accurate. The meter compares the expected standard solution value to the measured value and accepts or rejects the measurement. For the best results, reset the filling solution before verification. To reset the filling solution, put the probe with the installed membrane module in a 1000 mg/L NH_3—N standard solution without ISA for 30 seconds to 1 minute. The user can change the standard solution and acceptance criteria for verification in the probe-specific settings.

Note: *Password protection may prevent access to the acceptance criteria.*

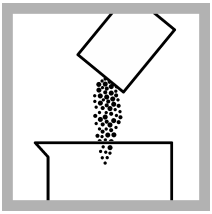
7.1 Verification procedure



1. Go to the verification menu. The display shows the standard solution to use for verification.

Note: *Menu name for HQd meters: Run check standard.*

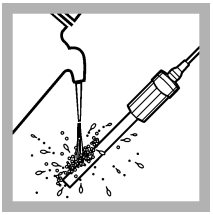
2. Pour 25 mL of the standard solution into a 50-mL beaker.



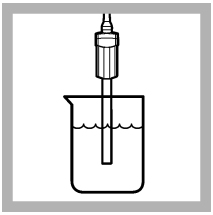
3. Add one Ammonia Ionic Strength Adjustor (ISA) Powder Pillow.

Note: *As an alternative, add 0.5 mL of Ammonia ISA Solution.*

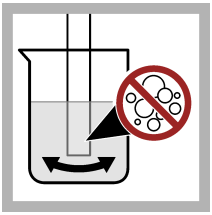
4. Add a stir bar. Put the beaker on an electromagnetic stirrer. Stir at a moderate rate.



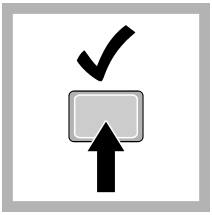
5. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



6. Put the probe in the standard solution with the sensor fully in the solution. Do not put the probe on the bottom or sides of the beaker.



7. Shake the probe from side to side to remove air bubbles.



8. Stir for 30 to 60 seconds, then read the value of the standard solution. The meter accepts or rejects the result.

Section 8 Maintenance

Regular maintenance is necessary for the best accuracy, stabilization time and life of the probe. Make sure to rinse the probe with deionized water between measurements. Keep the probe in the recommended storage solution when not in use.

For dirty applications such as wastewater, where the samples contain substances (e.g., surfactants, oils, and fats) that clog or damage the membrane, use the air gap assembly. Refer to Consumables on page 14. The air gap assembly keeps the membrane module above the sample and significantly extends the life of the membrane module. Make sure to use the air gap assembly for calibrations, measurements and verifications.

8.1 Storage

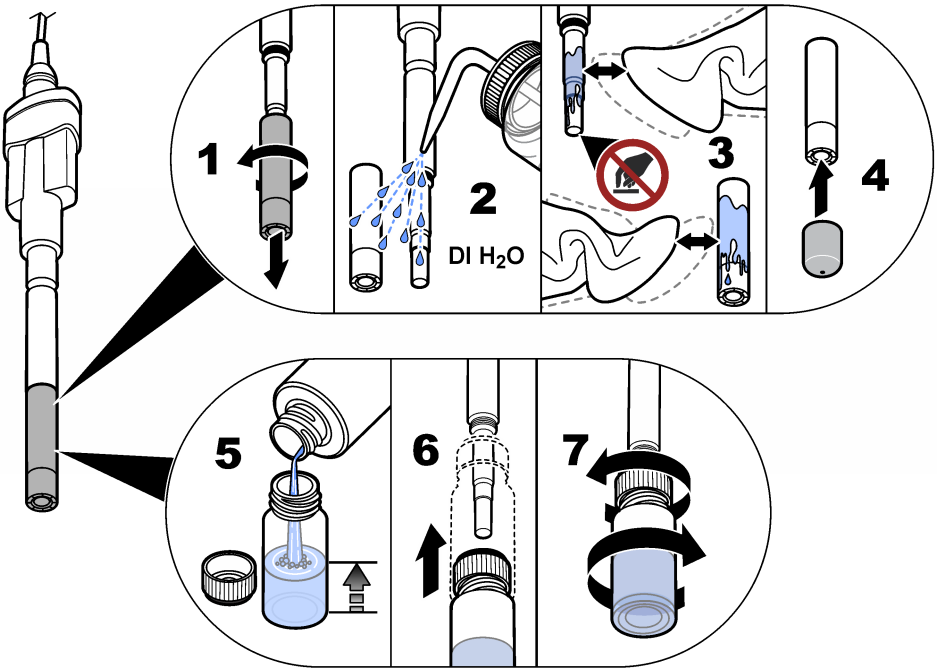
NOTICE

Probes can become permanently damaged if kept in a storage solution that is not specified by the manufacturer. Use only the specified storage solution.

Follow the applicable storage procedure:

- **Short-term and mid-term (maximum one week) storage**—Put the ammonia probe with the installed membrane module in a 1000 mg/L NH_3—N standard solution without Ionic Strength Adjustor (ISA). Do not let the membrane dry out. A soaker bottle is not necessary. Put a cover on the storage beaker and probe body to prevent solution evaporation.
- **Long-term (more than one week) storage**—Remove the membrane module and soak the probe in pH Electrode Storage Solution. Refer to Figure 3.
  Note: *After long-term storage, soak the probe (with the installed membrane module) in a 1000 mg/L NH_3—N standard solution without Ionic Strength Adjustor (ISA) for 30 to 60 minutes for the best stabilization speed.*

Figure 3 Long-term storage



Section 9 Troubleshooting

Refer to Table 1 for general troubleshooting information. To check the accuracy of sample measurements, refer to Standard additions check on page 13. To check the probe performance, refer to Slope check on page 13.

Table 1 Troubleshooting information

Problem	Possible cause	Solution
Decreased probe performance causes slow stabilization and prevents accurate calibrations or measurements.	The membrane module is dirty or clogged.	Replace the membrane module and filling solution, then condition the probe. Refer to Preparation for use on page 5. To extend the life of the membrane module, use the air gap assembly for calibrations, measurements and verifications.
	The filling solution is low or is contaminated.	Replace or reset the filling solution. To reset the filling solution, put the probe (with the installed membrane) in a 1000 mg/L NH_3—N standard solution without ISA for 30 seconds to 1 minute.
	The probe is not conditioned sufficiently after membrane replacement.	Soak the probe (with the installed membrane module) in a 1000 mg/L NH_3—N standard solution without ISA for 30 to 60 minutes.
Sample properties cause slow stabilization or inaccurate measurements.	Increase the sample temperature or adjust the temperature of different samples to be the same (within 2 °C (3.6 °F)).	Increase the sample temperature or adjust the temperature of different samples to be the same (within 2 °C (3.6 °F)).
	The sample contains substances (e.g., surfactants, oils, and fats) that clog or damage the membrane.	Use the air gap assembly for calibrations, measurements and verifications.
	The sample pH with ISA is less than pH 11.	Make sure that the sample pH after the ISA is added is higher than pH 11. Make sure to add one ISA pillow per 25 mL of sample.

Table 1 Troubleshooting information (continued)

Problem	Possible cause	Solution
Procedure problem causes slow stabilization and prevents accurate calibrations or measurements.	Air bubbles are around or below the probe tip.	Carefully tap or shake the probe to remove air bubbles.
	The ISA was not added.	Add one ISA powder pillow to each 25 mL of sample and standard solution.
	The stir speed is too slow or too fast.	Try a different stir speed.
	Magnetic stirrers can become warm and increase the solution temperature.	Put a piece of insulating material between the stirrer and beaker.
	An incorrect standard solution was used or the standard solution has contamination.	Use the specified standard solution of good quality.
	Too much ammonia gas goes into the air after the ISA is added.	Measure the sample or standard solutions immediately after the ISA is added to prevent the loss of ammonia gas. Put a cover on the beaker with a hole for the probe to decrease the loss of ammonia.

9.1 Slope check

Use the mV value of two standard solutions to make sure the probe gives the correct slope.

1. Prepare two standard solutions that are ten times apart in concentration (e.g., 10 mg/L and 100 mg/L NH_3—N). Select standard solutions with a concentration above and below the typical sample concentration. Use a minimum concentration of 0.5 mg/L.
2. Use the measurement procedure to add the ISA and measure the mV value of each standard solution.
3. Calculate the difference in the mV value of the two standard solutions to find the slope. If the probe is in good condition, the slope will be 57 mV (within the ± slope limits of the method) at 25 °C (77 °F).

9.2 Standard additions check

To make sure that the sample measurement is accurate, add a small volume of a standard solution to the sample and calculate the percent recovery. The sample with the known volume of standard solution is known as a spiked sample.

1. Use the measurement procedure to measure the concentration of a 25-mL sample.
2. Use a pipet to add the applicable volume of standard solution to the sample. Refer to Table 2.

Table 2 Standard solution volumes and concentrations

Measured sample concentration	Volume of standard to add	Concentration of standard solution
1 to 2 mg/L	0.5 mL	100 mg/L NH_3—N
3 to 6 mg/L	1.0 mL	100 mg/L NH_3—N
7 to 15 mg/L	0.3 mL	1000 mg/L NH_3—N

Table 2 Standard solution volumes and concentrations (continued)

Measured sample concentration	Volume of standard to add	Concentration of standard solution
15 to 30 mg/L	0.5 mL	1000 mg/L NH_3—N
30 to 60 mg/L	1.0 mL	1000 mg/L NH_3—N

3. Measure the concentration of the spiked sample.
4. Calculate the expected (theoretical) concentration of the spiked sample:

   $C_E = (C_S \times V_S/V_T) + (C_{SS} \times V_{SS}/V_T)$

   Where:

   - C_E = expected (theoretical) concentration of the spiked sample
   - C_S = concentration of the sample (mg/L) before the standard solution was added
   - C_{SS} = concentration of the standard solution (mg/L)
   - V_S = sample volume (mL) before the standard solution was added
   - V_{SS} = volume of the standard solution (mL)
   - V_T = total volume (standard solution volume (mL) + sample volume)
5. Calculate the percent recovery of the standard addition. A percent recovery of 100 (±5)% is an indication that the sample measurements are accurate.

   Percent recovery = $C_M/C_E \times 100$

   Where:

   - C_M = measured concentration of the sample after the addition of the standard solution
   - C_E = expected (theoretical) concentration of the sample after the addition of the standard solution

Section 10 Consumables

Note: *Product and Article numbers may vary for some selling regions. Contact the appropriate distributor or refer to the company website for contact information.*

Description	Quantity	Item no.
Ammonia Ionic Strength Adjustor (ISA) Powder Pillows	100/pkg	4447169
Ammonia Ionic Strength Adjustor (ISA) Solution	500 mL	2824349
Ammonia electrode filling solution, 0.1 M NH_4Cl	50 mL	4447226
Ammonia standard solution, 1 mg/L as NH_3–N	500 mL	189149
Ammonia standard solution, 10 mg/L as NH_3–N	500 mL	15349
Ammonia standard solution, 100 mg/L as NH_3–N	500 mL	2406549
Ammonia standard solution, 1000 mg/L as NH_3–N	1 L	2354153
Hach pH electrode storage solution	500 mL	2756549
Membrane modules for ISENH3181 probes	3/pkg	5812711
Air gap assembly for ammonia ISE	1	5025300
Wash bottle, polyethylene, 500 mL	1	62011
Disposable wipes, 11 x 22 cm	280/pkg	2097000
Beaker, 30 mL, plastic, colorless	80/pkg	SM5010

Section 10 Consumables (continued)

Description	Quantity	Item no.
Beaker, 100 mL, polypropylene	1	108042
Probe stand for standard Intellical probes	1	8508850

10.1 Accessories

Description	Quantity	Item no.
Beaker, polypropylene, 50 mL, low form	1	108041
Disposable wipes, 11 x 22 cm	280/pkg	2097000
Wash bottle, polyethylene, 500 mL	1	62011
Probe stand for standard Intellical probes	1	8508850

HACH COMPANY World Headquarters
P.O. Box 389, Loveland, CO 80539-0389 U.S.A.
Tel. (970) 669-3050
(800) 227-4224 (U.S.A. only)
Fax (970) 669-2932
orders@hach.com
www.hach.com

HACH LANGE GMBH
Willstätterstraße 11
D-40549 Düsseldorf, Germany
Tel. +49 (0) 2 11 52 88-320
Fax +49 (0) 2 11 52 88-210
info-de@hach.com
www.de.hach.com

HACH LANGE Sàrl
6, route de Compois
1222 Vésenaz
SWITZERLAND
Tel. +41 22 594 6400
Fax +41 22 594 6499