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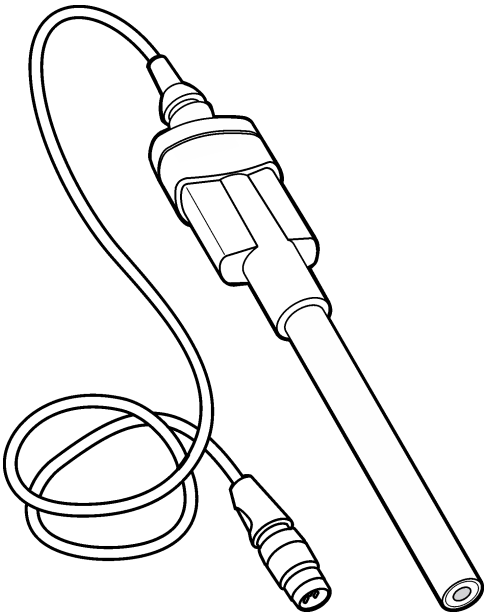
ISENH4181

05/2021, Edition 5

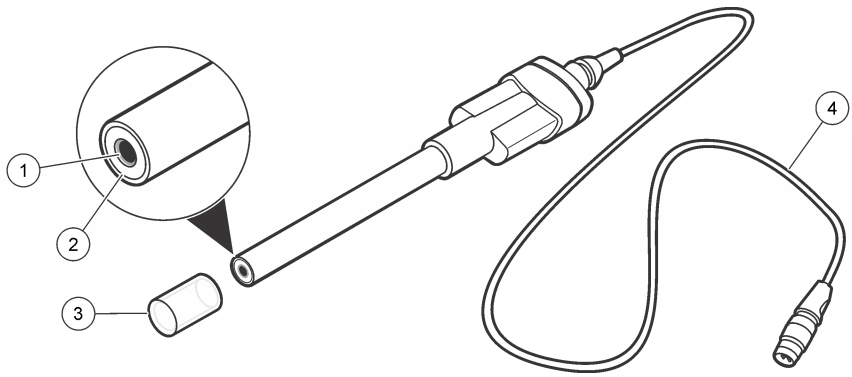
User Manual



Section 1 Product overview

The Intellical ISENH4181 series probes are digital, combination ion-selective electrodes (ISE) that measure the concentration of ammonium in water samples. The Ammonium Ionic Strength Adjuster (ISA) does not adjust the pH of the sample. Thus, the probes measure the ammonium ion (NH_4^+) but not unionized ammonia (NH_3). The probes have a built-in temperature sensor, a non-refillable gel reference and non-replaceable membranes. Refer to Figure 1.

Figure 1 Probe overview



1 Sensing element	**3** Sensor protection cap
2 Reference junction	**4** Cable

Section 2 Specifications

Specifications are subject to change without notice.

Specifications	Details
Probe type	Digital combination probe with a non-refillable reference junction and a built-in temperature sensor
Measurement range	0.018 mg/L (10^{-6} M) to 9,000 mg/L (0.5 M) as ammonium (NH_4^+–N)
Accuracy	±0.02 mV or 0.05% (the larger value)
Sample pH range	pH 0 to 8.5
Reference type	Ag/AgCl
Reference junction	Double junction (ceramic porous pin and annular porous PTFE)
Slope	–58 mV/decade (90 to 110% at 25 °C (77 °F) in linear range per Nernstian theoretical value)
Linear region	0.9 mg/L to 9,000 mg/L as ammonium
Temperature accuracy	±0.3 °C (±0.54 °F)
Temperature sensor type	30 kΩ NTC thermistor
Operating temperature	5 to 50 °C (41 to 122 °F)
Storage temperature	5 to 35 °C (41 to 95 °F)

Specifications	Details
Response time in linear region	< 60 seconds (application dependent)
Minimum sample volume	25 mL
Minimum immersion depth	25.4 mm (1 in.)
Body material (standard)	Epoxy
Membrane	Solid-state PVC membrane
Reference electrolyte	Non-refillable Dritek gel reference element
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: ISENH418101: 1 m (3.3 ft); ISENH418103: 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

Prepare the probe for calibration and measurement as follows.

1. Remove the sensor protection cap from the probe.
2. Rinse the probe with deionized water. Blot dry with a lint-free cloth. Do not wipe the tip of the probe.
3. Condition the probe before use. To condition the probe, soak the probe in approximately 25 mL of the lowest concentration standard solution used for calibration for 30 to 60 minutes. Do not add the ISA to the standard solution.

   Note: *Condition the probe each day for 15 to 30 minutes or for 30 to 60 minutes after long-term storage.*
4. 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.*
5. Connect the probe to the meter.

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.

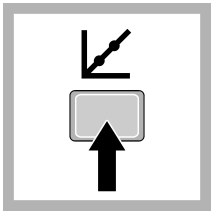
5.1 Calibration notes

Read the notes that follow before calibration.

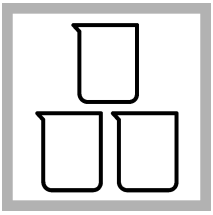
- Measure the standard solutions from lowest to highest concentration for best results.
- Keep all of the solutions (standard solutions and samples) at the same temperature (± 2 °C (± 3.6 °F)) for best results.
- Stir the standards and samples at a slow and constant rate to prevent the formation of a 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.

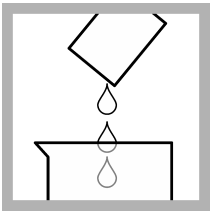
5.2 Calibration procedure



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



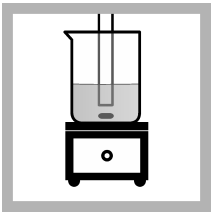
2. Add 25 mL of each standard solution to different beakers.



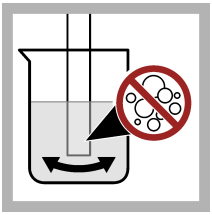
3. Add one Ammonium Ionic Strength Adjustor (ISA) Solution Pillow to each 25 mL of standard solution.

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

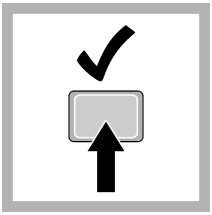
5. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



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.

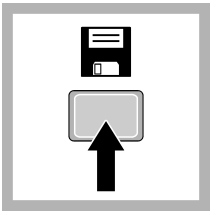


7. Shake the probe from side to side to remove air bubbles.



8. Stir for 30 to 60 seconds, then read the ammonium 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

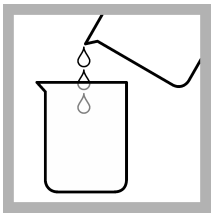
The procedure that follows is applicable to meters that can connect to Intellical ISE probes. Refer to the applicable meter documentation for meter operation and probe-specific settings.

6.1 Sample measurement notes

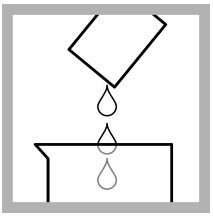
Read the notes that follow before sample measurements.

- Rinse the probe with deionized water and dry with a lint-free cloth between measurements to prevent contamination.
- 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



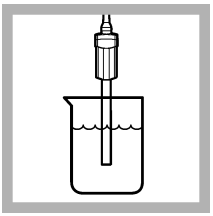
1. Pour 25 mL of fresh sample into a 50-mL beaker.



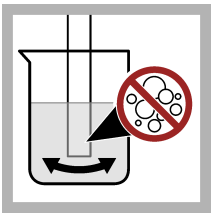
2. Add one Ammonium Ionic Strength Adjustor (ISA) Solution Pillow.

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

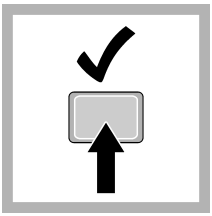
4. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



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 ammonium concentration of the sample. The display shows the value when the reading is stable.

6.3 Low-level measurements

Use the guidelines that follow for measurements at low concentrations (<1 mg/L NH_4^+–N).

- Fully rinse the probe with deionized water and blot dry between measurements.
- Soak the probe in the lowest concentration standard solution for 1 hour maximum before calibration and measurement.
- Use the meter to set the stability criteria for the probe to a low value.
- Stir the standards and samples at a slow and steady rate to prevent the formation of a vortex.
- Use a dilute ionic strength adjustor (ISA) solution for calibration and measurements:

1. Dissolve the contents of one ionic strength adjustor powder pillow in 50 mL of deionized water.
2. Add 5 mL of the dilute (ISA) solution to each 25 mL of standard solution or sample.

Note: *The ISA is not necessary when all of the conditions that follow apply:*

- *The sample does not contain interferences.*
- *The sample pH is within the range given in the specifications.*
- *Omission of the ISA is accepted by the regulatory reporting agency (if the measurement is for regulatory reporting).*

6.4 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 ammonium ion-selective electrodes are perchlorate (ClO_4^-), chlorate (ClO_3^-) and iodide (I^-). There is no procedure to remove the interference from these ions. Other interferences are shown in Table 1. Addition of the Ammonium ISA adjusts the pH and prevents most of the interferences from Table 1.

The selectivity coefficient is the approximate apparent increase in the measured concentration that is caused by one unit of the interfering ion (e.g., 1 unit of K^+ increases the ammonium concentration by 0.1). The approximate selectivity coefficients for some ions with the Intellical Ammonium ISE are shown in Table 1.

Table 1 Interferences

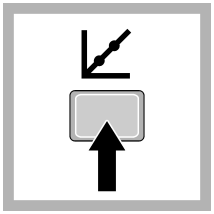
Interference	Selectivity coefficient
Potassium (K^+)	0.1 (interferes more)
Sodium (Na^+)	0.002
Magnesium (Mg^{2+})	0.00002
Lithium (Li^+)	0.00003
Calcium (Ca^{2+})	0.00006 (interferes less)

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. The user can change the standard solution and acceptance criteria for verification in the probe-specific settings.

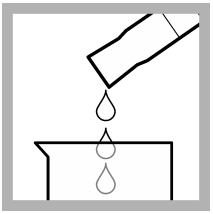
Note: *Password protection may prevent access to the acceptance criteria.*

7.1 Verification procedure

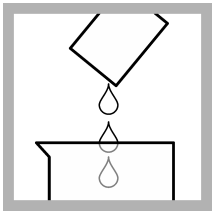


1. Go to the verification menu. The display shows the standard solution to use for verification.

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



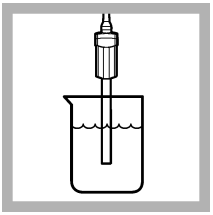
2. Pour 25 mL of the standard solution into a 50-mL beaker.



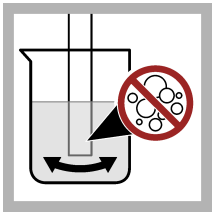
3. Add one Ammonium Ionic Strength Adjustor (ISA) Solution Pillow.

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

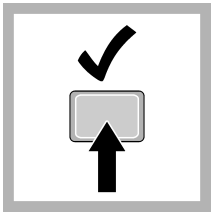
5. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.



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. Fully rinse the probe with deionized water between measurements to keep the probe clean.

8.1 Clean the probe

Rinse the probe with deionized water regularly to remove mineral or sample buildup on the sensing element. Symptoms of contamination:

- Incorrect or irregular readings
- Slow stabilization times
- Calibration errors
- Sample material stays on the probe

1. Rinse the probe with deionized water. Blot dry with a lint-free cloth. Do not touch the tip of the probe.
2. Polish the white reference junction on the probe tip with a soft cloth or cotton swab. Refer to Product overview on page 3. Do not polish the PVC sensing element in the center of the probe tip. Do not use cleaning solutions. Make sure to fully rinse the probe with deionized water between sample measurements to prevent mineral or sample buildup on the sensing element.
3. Soak the probe for 30 minutes in a 100-mg/L ammonium standard solution.

8.2 Storage

Keep the sensor protection cap on the probe during storage to prevent damage to the sensing element.
Note: *Make sure to condition the probe after long-term storage. Refer to* Preparation for use *on page 5.*

1. Rinse the probe with deionized water. Dry the probe with a lint-free cloth.
2. Make sure that the probe sensor is dry, then install the sensor protection cap. Refer to Product overview on page 3.

Section 9 Troubleshooting

Refer to Table 2 for general troubleshooting information. To check the probe performance, refer to Slope check on page 11. To check the accuracy of sample measurements, refer to Standard additions check on page 11.

Table 2 Troubleshooting information

Problem	Possible cause	Solution
Decreased probe performance causes slow stabilization and prevents accurate calibrations or measurements.	The probe has contamination on the sensing element.	Rinse and condition the probe. Refer to Clean the probe on page 10.
	The reference junction is clogged.	Fully rinse the reference junction with deionized water. Shake the probe down to remove air bubbles.
	The probe is not conditioned to the sample sufficiently.	Condition the probe. Refer to Preparation for use on page 5.

Table 2 Troubleshooting information (continued)

Problem	Possible cause	Solution
Sample properties cause slow stabilization or inaccurate measurements.	The sample pH with ISA is incorrect.	Make sure that the sample pH after the ISA is added is less than pH 8.5. Make sure to add one ISA pillow to each 25 mL of sample.
	The sample temperature is low, or there is a large temperature difference between samples.	Increase the sample temperature or adjust the temperature of different samples to be the same (within 2 °C (3.6 °F)).
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 time passed after the ISA was added.	Measure the sample or standard solutions immediately after the ISA is added.

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 1.8 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 58 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 3.

Table 3 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
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.
Ammonium Ionic Strength Adjustor (ISA) Powder Pillows	100/pkg	2980699
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
Wash bottle, polyethylene, 500 mL	1	62011
Disposable wipes, 11 x 22 cm	280/pkg	2097000
Beaker, 30 mL, plastic, colorless	80/pkg	SM5010
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