

Frequently Asked Questions

1. What does ISE actually mean?

- An ISE is an Ion-Specific Electrode. It converts the activity of a specific ion dissolved in water to an electrical potential.

2. What are ISE sensors best suited for?

- The ISE sensors are best suited for spot monitoring activities. These sensors drift more than other sensors and are not well-suited for long-term deployment. Do frequent QA/QC and calibration on ISE sensors, especially ammonium and nitrate, if they are to be used for extended deployment.

3. What is the life expectancy of ISE sensors?

- Ammonium and Nitrate sensor tips will last from three to six months whether they are stored on a shelf or installed in a sonde. Chloride sensor tips may last a year or more in the same conditions.

4. What is the maximum submersion depth of ISE sensors?

- Maximum of 15 meters for all ISE sensors. If deployment exceeds 15 meters, the ISE sensor must be removed and a dummy plug (included with sensor) must be installed in the sensor adaptor or the sensor will be damaged.

5. What type of water should ISE sensors be used in?

- Use Ammonium and Nitrate sensors in fresh water whose specific conductivity is less than 1000uS/cm. Sodium is a major interference for Ammonium and Chlorate ions are major interferences for Nitrate activity. Chloride sensors suffer interferences when the concentrations of bromide, iodide, cyanide, silver, and sulfide ions are much higher than the chloride ion concentration.

6. What are the best practices for calibrating the HL series ISE sensors?

- Rebuild the reference if needed, and calibrate conductivity and pH before calibrating any ISE sensor.
- Calibrate ISE sensors with standards that either bracket your expected measurements or that are close to what you expect to measure.
- The ISE sensors need frequent maintenance and calibration compared to other water sensors. ISE calibrations do not last as long and will drift faster. Bio-fouling and water conditions will affect maintenance and calibration frequency. A difficult to calibrate ISE sensor indicates that it needs to be replaced.
- Before calibrating a new sonde with ISE sensors, soak the sensors in the calibration cup with a high conductivity standard, like 47.6 mS/cm, for 2 to 4 hours to condition the reference electrode. When the reference mV is stable, it is ready.
- Soak a new ISE sensor in any of its standards overnight to condition it. It will calibrate more easily.
- To calibrate an ISE sensor reliably will take a minimum of 20 minutes per sensor. ISE sensors need more time to stabilize than other sensors during calibration as well as during measurements in the field.
- For best results, calibrate the ISE sensor at or near the water temperature it will be sampling. In any case, be consistent in your calibration temperatures.
- When calibrating sensors, it is important to use deionized (DI) water to rinse between calibration steps.
- If at all possible, use a stir plate to calibrate ISE sensors. Keeping the standard well-mixed improves calibration stability.



7. What are the best practices for installing the HL series ISE sensors?

- When installing, be sure to calibrate pH and conductivity first and then ISE sensors as a best practice.
- Sensors work best in flowing water. We recommend choosing a site in a location with good water flow to ensure movement of water over the sensor.
- After placing the sonde in the water, allow several minutes for the sensors to stabilize for consistent measurements.

8. Importance of maintenance?

- Maintenance of the reference electrode is critical because ISE potentials are measured with respect to the reference electrode.

9. Which accessories or add-ons are needed, and for which reasons?

- Stir plate:
We recommend using a stir plate, if you have one, during calibrations as a best practice to ensure an equalized standard. Constantly stirring ensures a set consistency for the liquid.

10. Why should I consider HYDROLAB measurements?

HYDROLAB measurement solutions provide these benefits:

- Ruggedized ISE sensors operate to depths up to 15 meters
- Automatic calculation of Ammonia and Total Ammonia concentrations
- User-serviceable reference electrode
- As well as HYDROLAB's application advice from the customer support team

11. Range and accuracy of each, recommended measurements for each?

Ammonium

- Range: 0 to 250 mg/L-N
- Accuracy: +/- 10 % or +/- 2 mg/L-N, whichever is larger
- Temperature range: 0 to 40 °C (non-freezing)
- Not recommended for measurements less than 2mg/L-N

Nitrate

- Range: 0 to 250 mg/L-N
- Accuracy: +/- 10 % or 2 mg/L-N, whichever is larger
- Temperature range: 0 to 40 °C (non-freezing)
- Not recommended for measurements less than 2 mg/L-N

Chloride

- Range: 0 to 18,000 mg/L
- Accuracy: +/- 10 % or 5 mg/L, whichever is larger
- Temperature range: 0 to 50 °C (non-freezing)
- Not recommended for measurements less than 2 mg/L

12. What are the best environments for measuring each of: Ammonium, Nitrate, and Chloride?

Ammonium:

- Can suffer interferences from other ions, especially sodium, potassium, and magnesium. These can reduce your accuracy.
- Specific conductivity of less than 1000 uS/cm.

Nitrate:

- Can suffer interferences from other ions, especially chloride, bromide, bicarbonate, perchlorate, nitrate, and chlorate. These can reduce your accuracy.
- Specific conductivity of less than 1000 uS/cm.

Chloride:

- Can suffer interferences from other ions, especially bromide, iodide, cyanide, silver, and sulfide. These can reduce your accuracy.

Ammonium and Nitrate:

1. What are ammonium and nitrate?

Ammonium (NH_4^+) and nitrate (NO_3^-) are ionized forms of nitrogen. Nitrate is related to ammonia in that bacteria colonies convert ammonia and ammonium to nitrite and then to nitrate. This final nitrate stage is the least toxic to water life. Ammonia has two forms - the ammonium ion, and the unionized, dissolved ammonia gas (NH_3). The form depends on pH, with ammonium predominating when the pH is below 8.75, and ammonia predominating above pH 9.75. Total ammonia is the sum of ammonium and ammonia concentrations. Ammonia is very toxic to water life, ammonium is less toxic.

2. How are they measured?

Ammonium and Nitrate ISE sensors operate by measuring the electrical potential of specific ions in water as they move from an area of high concentration to an area of low concentration across a membrane that is designed to allow only a specific ion to cross it. This activity is compared to an electrode filled with a Potassium Chloride and Silver Chloride electrolyte (KCl and AgCl) which has a known ionic activity constant. The difference between these two “half cells” gives electrical potential in millivolts (mV).

The relationship between Ammonium (NH_4^+) and Ammonia (NH_3) is determined by the pH of the water. The Total Ammonia Nitrogen is the sum of Ammonium and Ammonia. Ammonium and pH can both be measured, and the ratio of Ammonium and Ammonia related to pH is known. This allows the Ammonia concentration to be calculated even if it is not what is measured. However, when pH is above 10 and most of the Total Ammonia Nitrogen is Ammonia, accurate measurements of Ammonium are difficult.

Sodium is a major interference for Ammonium and Chlorate ions are major interferences for Nitrate activity. This is why these sensors work best in fresh water where these interferences should be minimal.

Notice that ISEs are sensitive only to the ionized form of the chemical in question. Un-ionized forms of the chemical (for instance, insoluble salts or organic compounds), will not be detected by the ISE.

Chloride:

1. What is chloride?

Chloride, Cl^- , is an ionized form of chlorine. Because most chloride salts are ubiquitous and highly soluble, chloride is one of the most common ions found in natural waters and is the prevalent ion in sea water. Though not considered a nutrient, chloride is abundant in all living cells.

2. How is chloride measured?

Chloride ion concentration is also measured with a chloride ion-selective electrode (ISE). The chloride ISE is a pellet of silver chloride in direct contact with the sample water. Because silver chloride has extremely low solubility in water, the silver chloride pellet never reaches chemical equilibrium with the sample water. Instead, a small amount of chloride ion dissolves into the sample. The resulting relative surplus of silver ions at the surface of the pellet creates a measurable electrical potential that varies with the concentration of chloride ions in the sample. This activity is compared to an electrode filled with a Potassium Chloride and Silver Chloride electrolyte (KCl and AgCl) which has a known ionic activity constant. The difference between these two "half cells" gives electrical potential in millivolts (mV).

Chloride sensors suffer interferences from other ions, working best when the concentrations of bromide, iodide, cyanide, silver, and sulfide ions are much lower than the chloride ion concentration.

Notice that ISEs are sensitive only to the ionized form of the chemical in question. Un-ionized forms of the chemical (for instance, insoluble salts or organic compounds), will not be detected by the ISE.

3. How is chloride measurement useful in water quality applications?

The chloride ion does not react with, or adsorb to, most components of rocks and soils, and so is easily transported through water columns. Thus, chloride is an effective tracer for pollution from chemicals moving from man-made sources into natural water bodies, or for salt water intrusion.

Applications for Chloride ion measurement include monitoring landfills for leaks, tracing the movement of point or non-point source pollutants within a natural water body (for instance, storm water runoff), monitoring estuary waters for changes in salinity, and detection of salt water intrusion into drinking water supplies.