a xylem brand

ISE GUIDE
DOCUMENT #W79

Ion Selective Electrode Startup and Calibration Guide

This is a general guide to preparing and calibrating a laboratory ISE. The ammonia ISE is quite different than most ISEs, so please check out YSI's Ammonia ISE Intro and Calibration videos if using an ammonia ISE.

Ion selective electrodes (ISEs) can provide very accurate results, but care must be taken when using an ISE, as accurate results are dependent on proper calibration and use. Many YSI ISEs are EPA approved for wastewater and/or drinking water compliance reporting. This guide will help ensure proper procedures are being followed if using an ISE for compliance reporting.

1. Connect to a meter with ISE mode

Connect the ISE to a meter that can directly display ion concentration (e.g. display in mg/L), such as the YSI TruLab 1320, MultiLab 4010-2, or the MultiLab 4010-3.

On the meter, select the ion being measured. The meter will measure and display ion concentration and will consider the valency of the selected ion when evaluating the calibration result.

2. Install sensor module (if applicable)

Some electrodes feature replaceable sensor modules (e.g. NH_4^+ and NO_3^-). A blank, protective module is typically installed on these electrodes for shipping, while the sensor module is placed in another container.

Ensure the sensor module (not the 'blank' module) is installed before using the electrode. Check the sensor module to ensure it is not dirty or damaged.

ISE with blank, protective module installed; the sensor module is in a dry, glass vial

ISE with blank module (left) and electrode with sensor module (right) installed

3. Open the refill hole

The refill hole must be open when calibrating and measuring

Refill hole cover open (left) and closed (right)

4. Fill with clean reference electrolyte

After opening the refill hole cover, refill the reference chamber with enough reference fill solution (i.e. electrolyte) to cover the inner junction (for YSI ISEs, it's the light gray line in the middle of the electrode body). *The level of fill solution must also be above the level of your measurement solution.*

ISEs typically feature liquid electrolyte that flows out through the junction, establishing an electrical connection between the reference system and the sample. Because of this outflow, it is necessary to periodically check the level of fill solution and refill as needed.

5. Condition the ISE

Condition the electrode by soaking it in a mid-range standard (e.g. 10 mg/L if calibrating with 1, 10, and 100 mg/L standards) for ~2 hours before use.

6. Carefully prepare calibration standards

At least 2 but up to 7 standards should be used. For best results, you should bracket the expected concentration of the samples. For example, if your expected sample is 50 mg/L, at least one standard must have a lower concentration and one must have a higher concentration.

There should be at least one order of magnitude (i.e. decade) difference in concentration between the high and low standards (e.g. 10 mg/L and 100 mg/L, not 10 mg/L and 50 mg/L).

If your standards span more than one order of magnitude (e.g. 1 mg/L and 100 mg/L), it is best to prepare at least one mid-range standard (e.g. 10 mg/L).

Each standard (and sample) should have a volume of 100 mL and should be placed in a 150 mL glass beaker.

Standards should be fresh and carefully prepared. Serial dilution is the most accurate method for the preparation of standards. It is best to use a pipette when measuring small volumes of stock solution. Alternatively, prepared standards can be purchased.

7. Measure and calibrate at the same temperature (25 °C)

Electrode response is dependent upon temperature. For highest accuracy, all measurement and calibration solutions should be at the same temperature (e.g. temperature controlled bath is used). Calibrating as close as possible to 25 °C is best.

Alternatively, an external temperature sensor can be used to compensate for temperature. The TruLab and MultiLab can apply the temperature measurement from another sensor (e.g. pH) that is connected to the instrument.

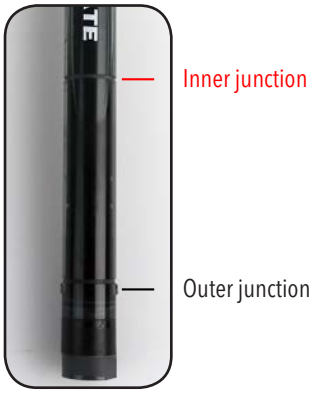
8. Stir the solution

It is best practice to stir standards (and samples!) using a stir bar and stir plate. This ensures the solution is well-mixed and can also increase response time.

Use a slow to moderate stirring speed and use the same stirring rate throughout calibration and measurement. If you do not have a stir plate, swirl the solution or use a stir rod once ISA is added.

9. Immerse the outer reference junction

The outer reference junction should be completely immersed in the standard or sample. Ensure the level of reference fill solution is above the sample *and* the inner junction (see #4).



Location of inner junction (red line) and outer (black line) reference junctions

10. Use ionic strength adjustor (ISA)

Add 2 mL of ISA per 100 mL of solution immediately before calibration and measurement. If used, add to all standards and samples.

Although it is not required that ISA be used, it will ensure samples and standards have the same ionic strength. This acts to "mask" the influence of interfering ions, allowing the ion of interest to be more accurately measured. Therefore, we strongly recommend using ISA.

11. Calibrate in order of increasing concentration

Begin calibrating with the lowest concentration standard and progress in order of increasing concentration. Rinse with DI water between solutions and blot dry with a lint-free cloth.

12. Evaluate the slope after calibration

For monovalent ions (e.g. NO_3^-), the slope should be between 52-62 mV per decade (e.g. the mV difference between 1 mg/L and 10 mg/L standards). For divalent ions (e.g. Pb^{2+}), the slope should be 26-31 mV per decade.

If the electrode slope is out of this range, attempt to recalibrate. Ensure your standards have been carefully prepared and ISA is used.

13. Recalibrate often

In general, calibrate the ISE at the beginning of each day.

For highest accuracy, verify your calibration result every 2 hours by preparing a fresh low standard, adding ISA (if used), and observe the mV value. If the reading has changed more than 2% compared to the reading in that standard during calibration, you will need to recalibrate.

14. Use same procedure for measurements

It is important to remain consistent when calibrating and measuring. Ensure standards and samples are prepared the same way and the same procedures are used (e.g. stirring rate, volume of solution, addition of ISA).

15. Properly store the ISE

Electrode life depends greatly on proper storage. Please consult the electrode user manual for more specific information.

Short term storage

Between measurements and when storing overnight or the weekend, rinse the electrode with DI water and place it in a mid-range standard. Close the refilling opening.

Long term storage

For long term storage, refill the electrode with fill solution and close the refill hole. If applicable, remove the sensor module and place it in a dry, glass vial. Reinstall the blank sensor module. Wet the sponge included in the soaker bottle with mid-range standard and reinstall on the electrode.

16. If needed, perform maintenance

Check the electrode instruction manual before any cleaning procedure, as these procedures vary between electrodes. Regardless of the ISE, ensure the reference electrolyte is clean and replace if needed.

Replacement frequency of the ISE and/or replaceable sensor module will vary based on the type of sensor, samples being measured, frequency of use, and proper storage.

Tel +1 937.767.7241
800.897.4151 (US)
info@ysi.com YSI.com

a xylem brand