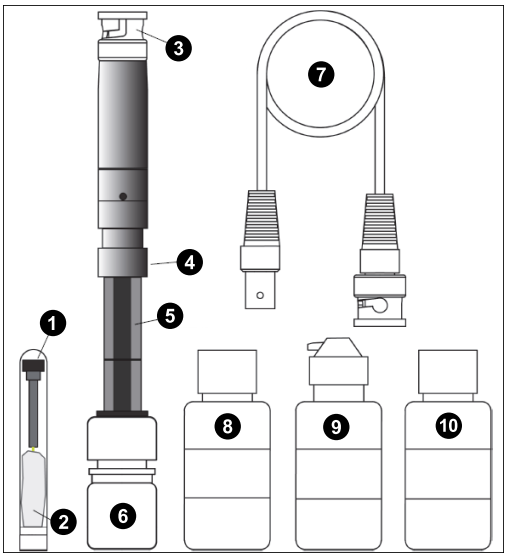
Nitrate ISE Probe (PS-3521)



Included Equipment

1. Nitrate ISE Replacement Module (2x)
2. Cotton (2x)
3. BNC Connector
4. Nitrate ISE (NO_3^-) Probe
5. Reference Chamber
6. Storage Bottle
7. BNC Male-to-Female Cable
8. Nitrate Standard Solution, 1000 ppm
9. Nitrate Reference Fill Solution
10. Nitrate Ionic Strength Adjuster (ISA)

IMPORTANT: DO NOT let the BNC connector at the top of the unit get wet.

Required Equipment

- PASCO Wireless pH/ISE/ORP Sensor (PS-3204)

NOTE: The PS-2147 PASPORT High Precision ph/Temperature with ISE/ORP Amplifier can also be used with the Nitrate ISE Probe, BNC Male-to-Female Cable, and a PASCO Universal Interface. However, the use of this sensor will require manual calibration and conversion of ISE Voltage data to nitrate concentration outside of PASCO software.

- PASCO Capstone or SPARKvue
- Wash bottle filled with distilled or de-ionized water
- Lab wipes
- Pipettes: 1 mL, 10 mL, and 100 mL
- Clean beakers [SE-7287 100mL Beakers (12 pack) or SE-7288 1000 mL Beakers (6 pack)]

Included Required Solutions (SC-3527 Nitrate ISE Solutions)

- Reference Fill Solution
- 1000 ppm Nitrate Standard Solution
- Ionic Strength Adjuster (ISE)

Introduction

This Nitrate Ion Selective Electrode (ISE) Probe is a combination electrode that includes both reference and sensing half cells in one body housing. It is used for measuring nitrate ion (NO_3^-) activity in aqueous samples. This probe is not designed for rugged field collections. Water samples should be brought to a testing table or flat testing surface so BNC connectors do not become wet and corrode. These devices determine nitrate levels best when you are certain interfering ions are not present in the sample.

Technology: Replaceable Polymer/PVC Membrane (included)

Overview

Side and Material	Body (Epoxy): 12 mm OD x 155 mm Length Cap (ABS): 16 mm OD x 57 mm Length
Reference	Double-junction Ag/AgCl, ceramic pin junction, refillable, sodium chloride electrolyte
Features	Replaceable Sensor Module
Reproducibility	±2%
Operating Temperature	0 to 50°C
Applications and Notes	Very popular for environmental, industrial, agriculture, food/beverage

Get the software

You can use the sensor with SPARKvue or PASCO Capstone software. If you're not sure which to use, visit pasco.com/products/guides/software-comparison.

SPARKvue is available as a free app for Chromebook, iOS, and Android devices. We offer a free trial of SPARKvue and Capstone for Windows and Mac. To get the software, go to pasco.com/downloads or search for **SPARKvue** in your device's app store.

If you have installed the software previously, check that you have the latest update:

SPARKvue

Go to Main Menu > **Check for Updates**

PASCO Capstone

Go to **Help** > **Check for Updates**.

Using Ionic Strength Adjuster (ISA) solution to improve accuracy

At low concentrations of nitrate ions, a standard method for removing the influence of charged particles on the detector is to add ionic strength adjuster (ISA) solutions to each of your standard solutions and samples. The addition assures that the overall ion activity in each solution being measured is nearly equal. The ISA contains no ions common to the Nitrate ISE itself.

Concentration units

Many environmental applications report nitrate concentrations in ppm for the nitrogen atoms in solution. This is converted from mg/L of the entire compound to just nitrogen using the ratio of masses of nitrogen alone to formula mass, as shown below:

$$6.07\text{mg NaNO}_3\left(\frac{14\text{g N}}{85\text{g NaNO}_3}\right) = 1000\text{mg N /L (or ppm N-NO}_3\text{)}$$

Electrode preparation

Replace the Module Blank

This electrode performs better when the reference junction is kept wetted during transit and storage. However, the sensor module is best stored and transported dry. Therefore, the electrode is shipped with a plastic Module Blank that must be removed prior to use.

1. Unscrew the cap of the storage solution bottle (also known as "Soaker Bottle") and remove the electrode. Unscrew the plastic Module Blank from the end of the electrode. Replace the blank with the included Nitrate ISE Replacement Module. The Module Blank can be retained for long-term storage.

IMPORTANT: Do not touch the PVC sensor membrane on the end of the Nitrate ISE Replacement Module with your fingers.

2. Thoroughly rinse the electrode with distilled water. Wipe carefully with a clean lab wipe.
3. Return the electrode to the storage bottle when it is not in use.

Fill the electrode with electrolyte

The reference (outer) chamber must be filled with Reference Fill Solution and remain open during testing:

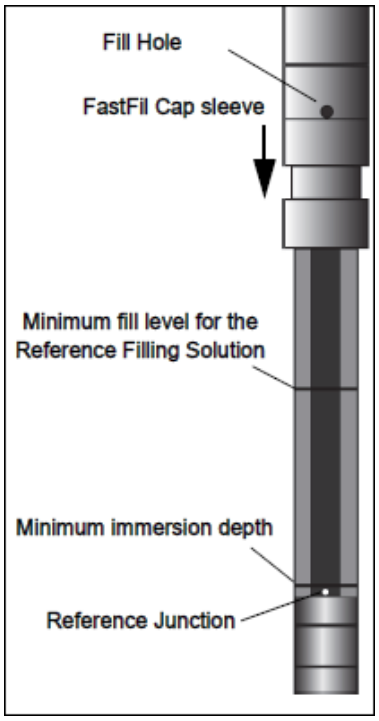


Figure 1. Reference fill chamber diagram

To fill the electrode with electrolyte, follow these steps:

1. Slide the sleeve of the electrode FastFil cap down to uncover the fill hole. (See Figure 1.)
2. Shake the electrode downward like a thermometer to remove any air bubbles trapped inside.
    a. The surface of the Reference Fill Solution in the reference chamber must be above the inner junction. This is approximately 3" from the electrode tip.
3. Rinse the electrode with DI water; blot dry. Do not rub dry.
4. Soak the electrode in DI water for 10 minutes, then in a diluted Nitrate Standard Solution for two hours prior to calibration or use.

NOTE: The probe end is meant to be immersed in solution; however, be careful not to get the BNC connector to the wireless amplifier wet. If the connector becomes wet, immediately turn off and disconnect the device, rinse the area with distilled water, blot dry with a paper towel, and allow the water to evaporate at room temperature before using the sensor again. DO NOT use a heat source like an air dryer or drying oven, as this will damage the unit.

Calibration

Sensors are shipped with calibration conversions ready to apply in the software. These calibrations should provide accurate data for many months. These calibrations are mostly affected by the membrane pores at the tip of the probe. As your probe ages, performing a two-point calibration will ensure that the voltage reading from the probe continues to report out as accurate concentrations; this will increase how long the probe tip and instrument continue to function.

Preparing calibration solutions

Your electrode ships with a 1000ppm N-NO_3 concentration solution included. Standards should be set two orders of magnitude apart in concentration (for example, 100 mg/L and 1 mg/L). You can dilute samples of the stock solution to create a set of standards. Adding 10 mL of stock to a 100 mL volumetric flask, filling up to the line with distilled water, and mixing the resulting solution is one method of standard preparation. For a similar but slightly less precise procedure, you could add 10 mL of stock to 90 mL of distilled water in a graduated cylinder. In either case, this new 100 mg/L (ppm) solution would be your high solution. From this new solution, pipette 1 mL into a different 100 mL volumetric flask or graduated cylinder and dilute to 100 mL to create your low, 1mg/L standard solution.

If you plan to use the electrode above this range, you will need to prepare your own standards and use those for soaking and calibration. The 1000 ppm N-NO_3 can be ordered from PASCO or prepared by dissolving 6.07 g Na-NO_3 into 1 L of solution.

Calibrating the electrode

All ISEs measure the linear response in potential to the log of concentration, written as "[ion of interest]" (in this case, "[NO_3]"). For the nitrate probe, every change of -59.2 mV corresponds to a 10x change in concentration. You can use two concentrations during the calibration process to establish the linear voltage response of the sensor to the log of the concentration. Immerse the sensor in your first standard, enter the concentration of the standard in ppm, and enter. Rinse the probe tip and blot dry, then measure the second standard to enter its concentration and complete the calibration.

Essentially, you are applying the Nernst equation to the potential readings to convert them into concentration units. Should you want the software to report out in molarity, rerun the calibration process and enter in the molarity of your standards. Every 14 ppm N is equivalent to 1M NO_3, as given by:

$$\text{Starting N ppm}\left(\frac{1\text{ M of N}}{14\text{g/L of N}}\right)\left(\frac{1\text{ M NO}_3}{1\text{ M of N}}\right) = [\text{NO}_3]$$

Reading a sample with the electrode

Various procedures may be used to determine the concentration of a sample. The most common is the Direct Calibration method, which is described below. Contact PASCO's Technical Support department for details of other methods.

In Direct Calibration, a series of standard solutions of differing concentrations is used to calibrate the electrode. From there, each sample requires only a single measurement device reading, which is compared with the calibration readings to obtain the sample concentration. ISA is added to all solutions to ensure that the samples and the standards have very similar ionic strength.

Set up the sensor display

1. Plug the electrode directly into the port on the Wireless pH Sensor (PS-3204), then turn on the sensor.
2. Start PASCO Capstone or SPARKvue, then open **Hardware Setup** (Capstone) or **Sensor Data** (SPARKvue).
3. From the list of available wireless devices, select the pH sensor matching your device's printed ID number (XXX-XXX) to connect to the sensor.
4. Set up the sensor to measure the Nitrate ISE concentration through the following methods based on your program:
   - PASCO capstone™: From the Hardware Setup menu, click the gear icon to open the **Properties** menu; from this menu, click the dropdown box next to "**ISE Configuration**" and select "Nitrate ISE".
   - SPARKvue®: From the Sensor Data menu, click "Configure ISE" under the list of measurements from the sensor in the "**Select Measurements for Templates**" table; select "Nitrate ISE" from the list of available options, then click "OK".

Sensor calibration

To calibrate the sensor, start by preparing two standard solutions that differ in concentration by a factor of ten and bracket the expected sample concentration range. For example, if your expected sample concentration is 5 mg/L Calcium, you should use a 1 mg/L low Standard Solution and a 10 mg/L high Standard Solution.

The following steps will allow you to calibrate the sensor after it has been connected to the data collection software.

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1. Open the **Calibration** tool, then select "Concentration" from the dropdown box and click "Next".
2. Ensure that "**Two Standards (2 point)**" is selected from the list of calibration types, then click "Next".
3. Place 100 mL of the low standard into a 150 mL beaker. Add 2 mL of ISA. Stir thoroughly.
4. Rinse electrode with DI water, blot dry, and place in the beaker. Wait for a stable reading, then enter the known calibration of the first standard into the "Standard Value" box and select **Set Current Value to Standard Value**.
5. Measure 100 mL of the high standard into a second 150 mL beaker. Add 2 mL of ISA and stir.
6. Rinse electrode with DI water, blot dry, and place in the second beaker. Wait for a stable reading, then enter the known calibration of the second standard into the "Standard Value" box and select **Set Current Value to Standard Value**.
7. Review the calibration produced from these points, then select "Finish" to apply the calibration.

The calibration screen for PASCO Capstone can be seen in Figure 2.

SPARKvue®

1. From the **Sensor Data** menu, select "Configure ISE" again, then select "**Calibrate ISE**" from the bottom of the Sensor Properties window.
2. Check to ensure the Calibration Type is listed as "**2 point (Adjust Slope and Offset)**", then click "Continue".

3. Place 100 mL of the low standard into a 150 mL beaker. Add 2 mL of ISA. Stir thoroughly.
4. Rinse electrode with DI water, blot dry, and place in the beaker. Wait for a stable reading, then enter the known calibration of the first standard into the "Standard Value" box under **Calibration Point 1** and click "Set Calibration".
5. Measure 100 mL of the high standard into a second 150 mL beaker. Add 2 mL of ISA and stir.
6. Rinse electrode with DI water, blot dry, and place in the second beaker. Wait for a stable reading, and then enter the known concentration of the second standard into the "Standard Value" box under **Calibration Point 2** and click "Set Calibration".
7. Check the calibration produced from these points in the **New Calibration** section, then select "OK" to apply the calibration.

The calibration screen for SPARKvue can be seen in Figure 3.

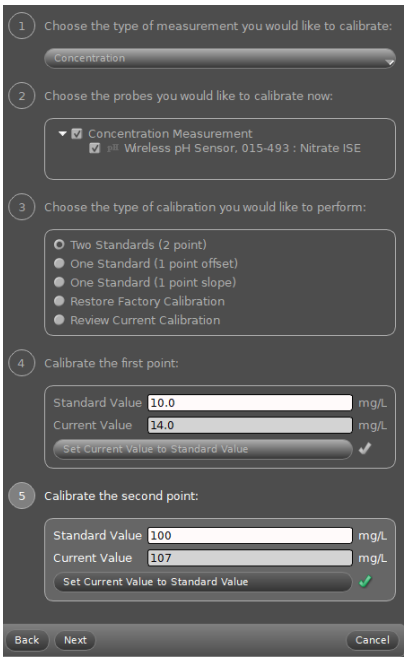

Figure 2. Capstone calibration screen

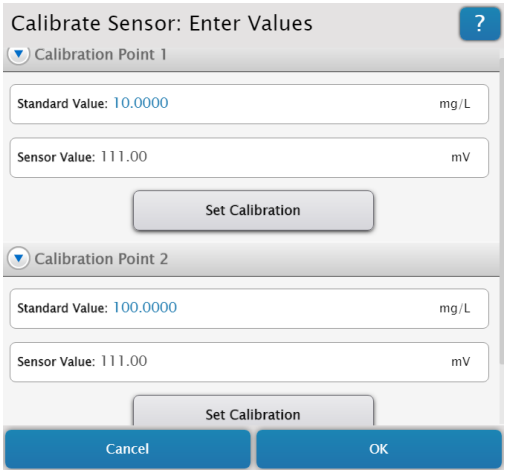

Figure 3. SPARKvue calibration screen

Measurement

Once the sensor has been connected and calibrated, follow these steps to obtain a concentration reading:

1. Create a **Digits** display recording the Nitrate ISE measurement in mg/L, if you have not already done so.
2. Pipette 100 mL of sample into a 150 mL beaker. Add 2 mL of ISA. Stir thoroughly.
3. Rinse electrode with DI water, blot dry, and place in the sample beaker. Wait for a stable reading; once this is achieved, the sample concentration will be displayed on the measuring device.

NOTE: Temperature compensation is not typical of ISE measurements. For best performance, try to ensure that the standards are within 5 to 10°C of the sample.

Electrode storage

Short term (overnight or over the weekend)

During a few days of active use, you can store the ISE in a soaking bottle with your high concentration standard. Slide the FastFil sleeve upward to close the fill hole, then tighten the bottle cap with the ISE inside the bottle.

Long term

Keep the sponge in the bottom of the long-term storage bottle moist with distilled water; this humidity will keep the tip and reference junctions from drying. Do not rest the tip on the sponge, in order to keep the pores of the electrode tip clean. Rinse off the ISE with distilled water and blot it dry with a paper towel. Make sure the white reference mark is inside the bottle. Turn off or disconnect the Wireless pH Sensor and store. We recommend storing the devices in a cupboard at room temperature conditions between uses. Temperatures over 35°C will shorten the battery life in the amplifier.

All our ion-specific ISEs have a one year warranty to be free of defects. Proper storage techniques should give your sensor longer lifespans than the warranty. If using ISEs annually for a specific lab or unit, make sure the electrode slope stays within 4 mV of 59.2mV for best results. (See **Checking electrode operation (Slope)** for details.) When results are outside this range, consider getting replacement membrane module tips. Tips naturally degrade from the point of manufacture, more so once they are first used, so replacements should be ordered close to when they are needed to ensure maximal life.

Checking electrode operation (Slope)

The following procedure allows you to check the electrode slope of your sensor; this process is used to ensure your sensor is recording accurate measurements. It is recommended that you perform this test once every few years to check your sensor's functionality.

1. Connect your electrode to the input connector on the Wireless pH Sensor.
2. Turn on the pH Sensor, then open PASCO Capstone or SPARKvue and connect to the sensor using the program; ensure that the measurement of Nitrate ISE concentration is enabled, as discussed in "**Set up the sensor display**".

3. Create a **Digits** display measuring the voltage from the Wireless pH Sensor.
4. Pipet 1 mL of 1000 ppm Nitrate Standard Solution into a 150 mL beaker. Fill the beaker to the 100 mL line with DI water, then add 2 mL of Nitrate ISA to the beaker and stir thoroughly.
5. Rinse the electrode with DI water, blot dry, and place in the beaker with the prepared solution. Record the potential (E_1) in mV when a stable reading is displayed.
6. Pipet 10 mL of the same standard solution into a separate 150 mL beaker. Fill the beaker to the 100 mL line with DI water, then add 2 mL of Nitrate ISA to the beaker and stir thoroughly.
7. Rinse the electrode with DI water, blot dry, and place in the second beaker. When a stable reading is displayed, record the potential (E_2) in mV.
8. The difference between the first and second potential readings, (E_2 - E_1), is defined as the electrode slope. The normal range for the slope is -56±4 mV at 25°C.

Troubleshooting

If the electrode slope is not within the normal range, the following procedure may restore the electrode.

1. Soak the electrode in a diluted standard solution for 2 hours before use.
2. Repeat "Checking Electrode Operation" procedure again. **Note:** All standard solutions should be prepared fresh. For best performance, use ISA in all solutions.

Periodically check the Reference Fill Solution level in the reference chamber of the electrode. The solution level must be higher than the inner junction, which is visible as a white ceramic pin on the inner body.

If the electrode slope is still outside the normal range after this procedure, you must replace the sensing module.

Electrode cleaning

Cleaning should only be attempted if troubleshooting methods fail. The PVC membrane is a delicate sensor and should not be brushed or otherwise contacted. It can be rinsed vigorously under warm water to remove debris. Soaking for 10-15 minutes in DI water might be useful in extracting other contaminants.

Recondition the electrode by soaking in a low standard solution immediately after any cleaning method.

Replacement items

- SC-3527 Nitrate ISE Solutions: 60 mL Standard Solution, 30 mL Reference Fill Solution, 30 mL ISA Solution

Specifications and accessories

Visit the product page at pasco.com/product/PS-3521 to view the specifications and explore accessories. You can also download support documents from the product page.

Software help

The SPARKvue and PASCO Capstone Help provide additional information on how to use this product with the software. You can access the help within the software or online.

SPARKvue

Software: Main Menu > Help

Online: help.pasco.com/sparkvue

PASCO Capstone

Software: Help > PASCO Capstone Help

Online: help.pasco.com/capstone

Technical support

Need more help? Our knowledgeable and friendly Technical Support staff is ready to answer your questions or walk you through any issues.

Chat	pasco.com
Phone	1-800-772-8700 x1004 (USA) +1 916 462 8384 (outside USA)
Email	support@pasco.com

Regulatory information

Limited warranty

For a description of the product warranty, see the Warranty and Returns page at www.pasco.com/legal.

Copyright

Trademarks

Product end-of-life disposal

This electronic product is subject to disposal and recycling regulations that vary by country and region.
It is your responsibility to recycle your electronic equipment per your local environmental laws and regulations to ensure that it will be recycled in a manner that protects human health and the environment.
To find out where you can drop off your waste equipment for recycling, please contact your local waste recycle or disposal service, or the place where you purchased the product.
The European Union WEEE (Waste Electronic and Electrical Equipment) symbol on the product or its packaging indicates that this product must not be disposed of in a standard waste container.

CE statement

This device has been tested and found to comply with the essential requirements and other relevant provisions of the applicable EU Directives.