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Environmental Solutions

Technical Note
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EXO NitraLED™

SITE SPECIFIC CORRECTION PROCEDURE

The YSI **EXO NitraLED**™ is an absorbance-based UV Nitrate sensor which uses two LED's housed internally and the EXO turbidity sensor to compute a nitrate measurement.

For additional information on the mechanics and computations of the NitraLED sensor, please reference Corrections for Turbidity and NOM

In addition to the standard calibration procedure, this sensor allows a user to correct the internal default coefficients that correct for the effects of turbidity and natural organic matter (NOM) for the particular site of interest. The surrogates that YSI used to determine the defaults for the sensor were kaolin for turbidity and Suwannee NOM for NOM.

The Site Specific Correction (SSC) procedure is a simple 4-step process with a 5th step that shows the new coefficients that have now been programmed in the sensor. This procedure can only be performed in Kor software; the correction functionality is not available in the handheld. The data from the final (5th) step is saved as a calibration record for the NitraLED sensor.

Additional equipment is required for the SSC procedure and if it not already in possession can be acquired by purchasing from a laboratory equipment retailer or by purchasing from this Amazon list. The required and optional equipment is as follows:

- Pump (vacuum or peristaltic)
- Filtering flask and membrane filters (for use with vacuum pump)
- Capsule filters (for use with peristaltic pump)
- Ring stand and clamp that fits the EXO in use
- Stir plate and stir bars
- 1L beaker (two of these are recommended)
- Lint-free cloths
- Gloves and eye protection

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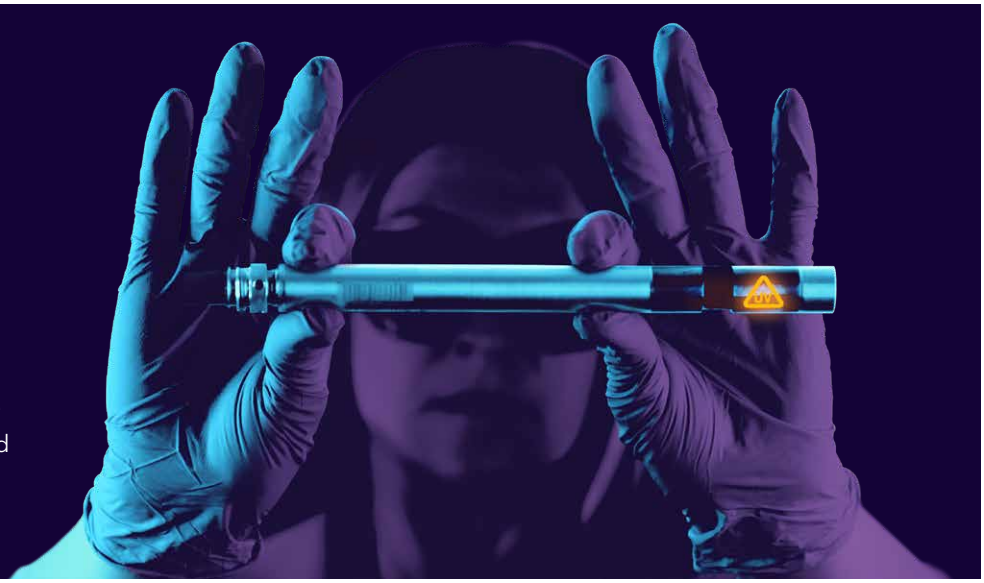
SAFETY PRECAUTIONS

The NitraLED sensor emits UV-B and UV-C light. Exposure to these can be harmful over time, so we recommend wearing protective gear such as gloves and eye protection.



INITIAL PREPARATION

In order to complete the site specific correction procedure, at least two liters of water will need to be collected. One liter will be used for the raw water step and one liter will be filtered for the two filtered steps.

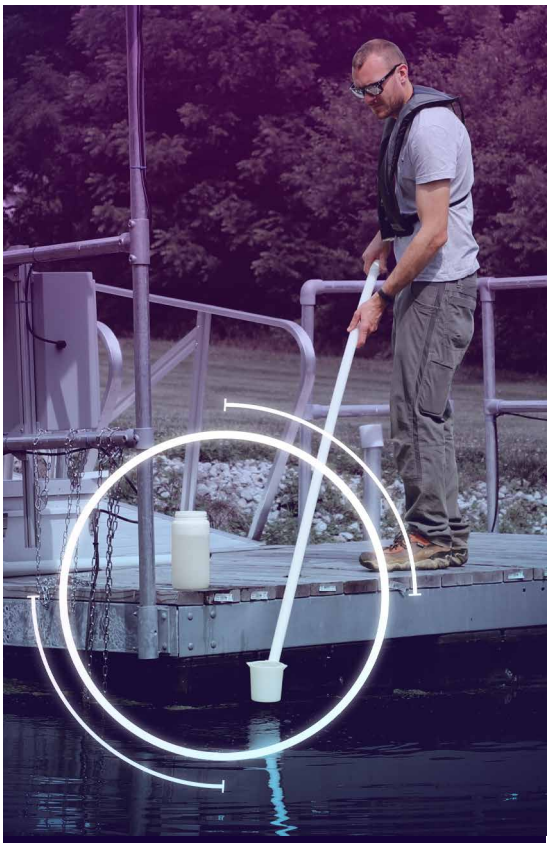
When collecting the water samples, all attempts should be made to avoid stirring up bed sediment, as this can cause inaccuracies in the correction procedure which can lead to errors in data upon deployment.

It is also important to collect the sample water as close to the deployment location as possible. For example, if the sensor will be deployed on a buoy, the sample should be collected from near the buoy as opposed to along the bank.

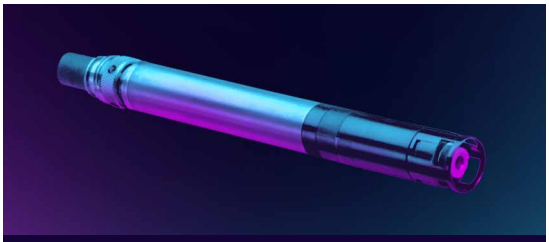
A nitrate reading from an external source should also be collected as part of the initial preparation. This reading could be from a variety of sources, but be aware that the error in the NitraLED site specific correction procedure is going to be greater than or equal to that of the comparison sensor.

YSI recommends collecting a reading with either a calibrated benchtop photometer or from an EPA-approved laboratory method. However, the use of ion selective electrodes and colorimeters are still acceptable.

If a sample is to be sent to the lab for analysis, keeping the two liters of sample water in a dark bottle in the refrigerator at less than 4°C is ideal for preservation and the sample can be stored this way for one month with very little change in nitrate levels.



Collect water sample as near to the deployment location as possible.



A ProDSS or EXO Nitrate ISE can be used to determine the nitrate concetnration for Step 1 of the procedure.

One caveat to this is in extremely biologically active environments – preservation with sulfuric acid to a pH less than two standard units may be necessary to stop the biological activity and alteration of nitrate values. If sulfuric acid is added to the sample, there will be no effects on the NitraLED sensor because sulfuric acid absorbs light at a different wavelength than the two LED's inside the sensor.

In order to prevent bubbles from accumulating on the sensor faces of the NitraLED and turbidity sensors, it is recommended to soak the sensors (ideally overnight) in a beaker of outgassed DI water.

Finally, the turbidity sensor that is used during this procedure must be the same sensor that the NitraLED sensor was calibrated with and must also be the same sensor that the sonde will be deployed with. Any changes to the turbidity sensor will skew results.

Ensure that the turbidity sensor installed on the sonde during calibration procedures is the same sensor used during deployment.

STEPS FOR CORRECTION PROCEDURE

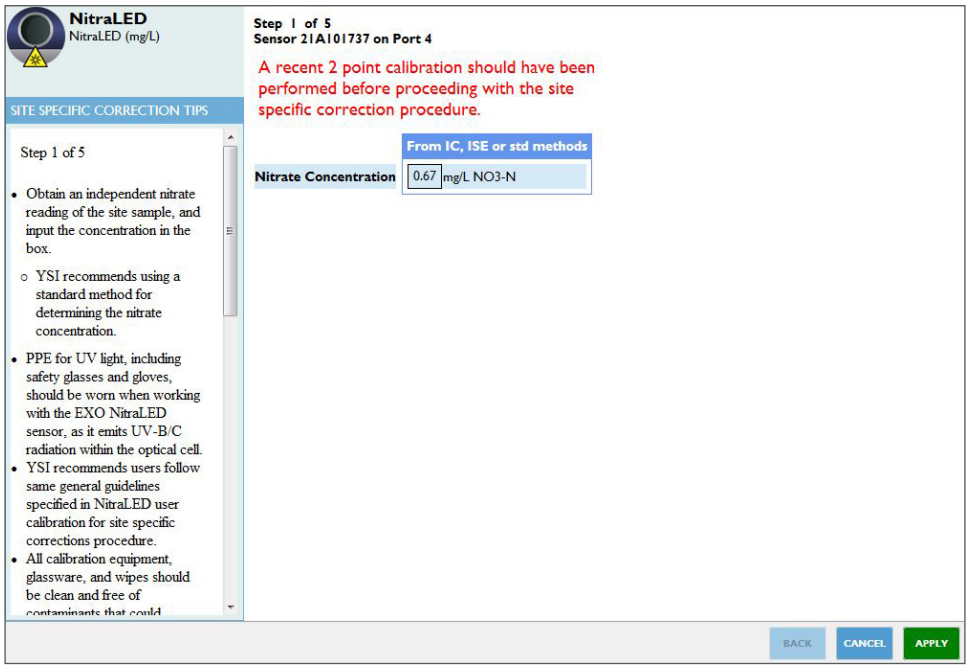
1

From the Calibration menu option in Kor, click on the **NitraLED sensor** and then click on the **Corrections** button. The correction window will appear.

In the first step, simply input the nitrate value from the external meter and click **Next** to continue.

Important notes about the Corrections screen layout:

- All corrections data appears on the right side of the screen
- For help during the procedure, reference the tips on the left side of the screen

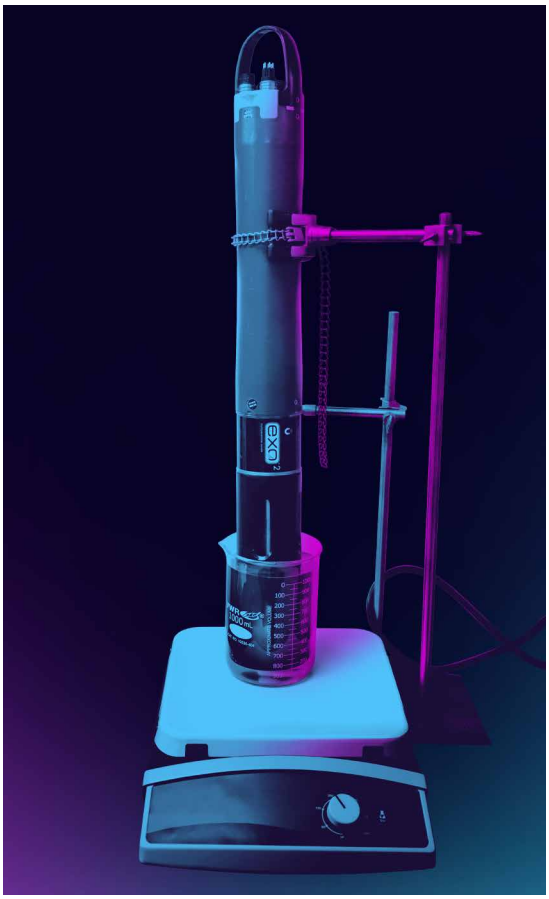


2

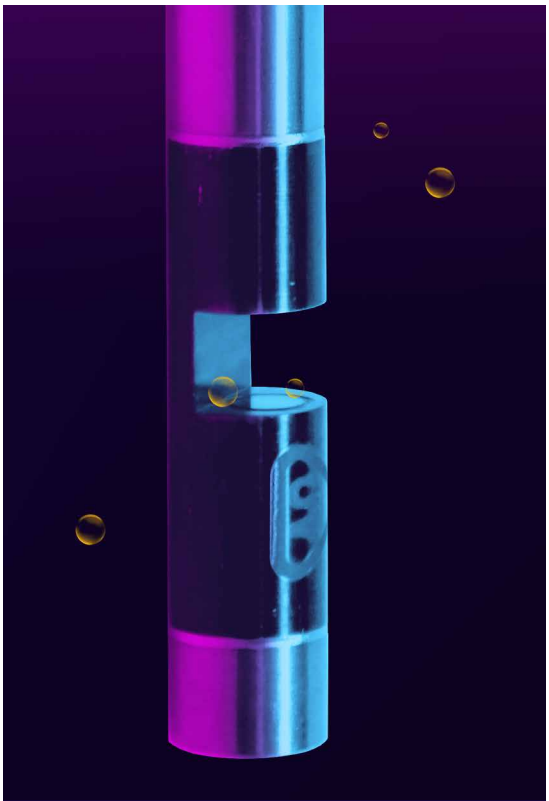
Set up the stir plate under a ring stand or other device that will hold the EXO during this procedure. Place one of the 1L beakers on the stir plate and fill to approximately 800mL with raw sample water. Place the stir bar in the sample water. Turn the stir plate on to speed slightly higher than that of the site environment that keeps all sediments suspended as they would be in the natural water body.

NOTE: YSI recommends removing the wiper brush from the central wiper, if one is installed, during this procedure.

The EXO needs to have the sonde guard installed in order to ensure proper spacing for the turbidity sensor and also to prevent any reflected light from affecting the readings of either the turbidity or NitraLED sensor. Place the sonde into the beaker of raw water and hold in place with the ring stand clamp. Verify that the entire colored part of the NitraLED sensor and the turbidity sensor are submerged.

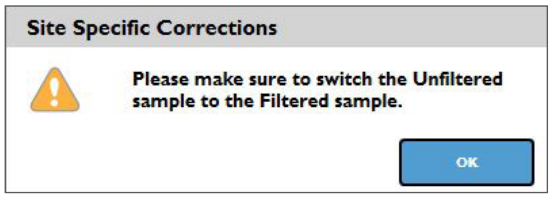


While the sensor LED values are stabilizing, verify that there are no bubbles accumulating on the sensor faces of the NitraLED or turbidity sensors. Be sure to watch the turbidity values for stabilization as well. If turbidity continually rises over time, this is most likely due to bubbles accumulating on the sensor face. Even the smallest bubbles can have an impact on sensor readings; if there are bubbles, remove the sonde from the water briefly and reinstall.

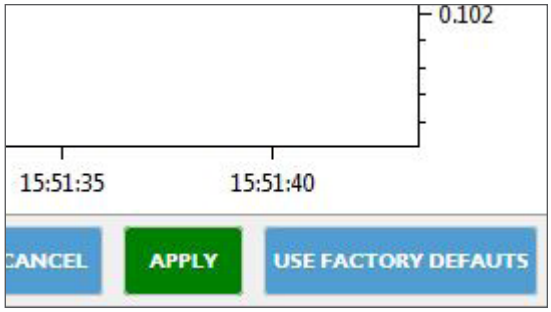


Ensure that there are no bubbles accumulating on the sensor faces, as these can affect readings.

Once the turbidity and absorbance values have stabilized (this can take up to 5-10 minutes), click **Apply**. Before clicking apply, verify that there are no sediments settled on the lens surfaces. If there are, wipe the sensor face with a lint free cloth and quickly reinsert into the sample water. The correction procedure will then proceed to Step 3 and the software will indicate that the sensor should be placed into the filtered water sample.



If the turbidity values of the deployment location are likely to remain low, a user can choose to use the default coefficients programmed into the sensor. The default coefficients are the kaolin coefficients; again, for more information on these coefficients, refer to Corrections for Turbidity and NOM. If this option is selected from the Step 2 screen, the user will immediately be directed to Step 4. The software will indicate that the sensor should be placed into the filtered water sample.



3

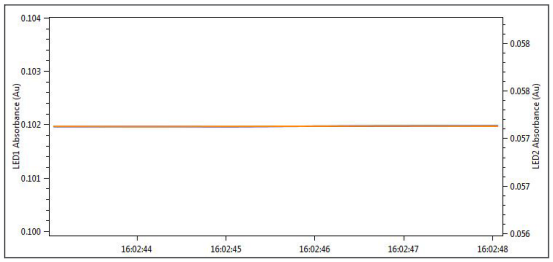
Filtration should be performed with a 0.45µm filter. This procedure can be completed with either a peristaltic pump and capsule filter, or a vacuum pump and filtration flask. 800mL to 1L of sample water should be filtered.

Next, place one of the 1L beakers on the stir plate and fill to approximately 800mL with filtered sample water. Place the stir bar in the sample water. Turn the stir plate on again to keep the sample properly mixed.

Before placing the sonde and sensors into the filtered water sample, use a lint-free cloth to remove all of the raw sample water from the previous step.

When the sensors are in the filtered water, observe the turbidity reading. The filtered sample water should ideally have turbidity less than 1.0 FNU. If the turbidity of the filtered sample is higher than this, stabilization may take a slightly longer period of time and additional error may be introduced, so filtering a second time through a smaller pore size filter would be beneficial to the process.

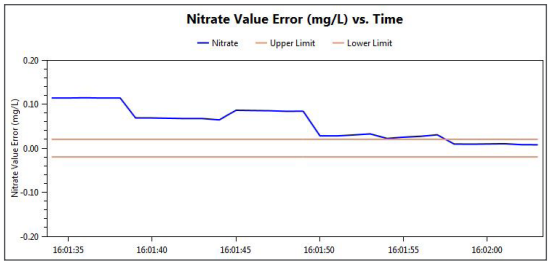
Once the absorbance values are stabilized, click **Apply**. This process should not take as long in filtered water as it may have in the raw water sample.

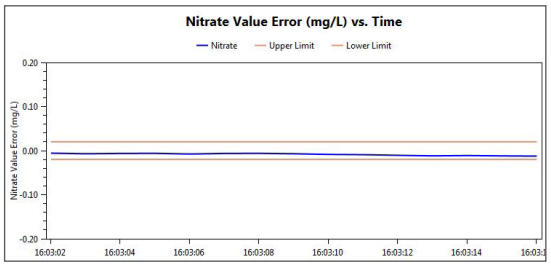


4

The sensors should remain in the filtered water sample for this step. Continue to ensure that there are no bubbles accumulating on the sensor faces during this step.

In this step, the user is minimizing nitrate error by adjusting the NOM coefficient programmed into the sensor. By using the slider bar or manually typing a value into the box, the user will see adjustments to the nitrate value and error in the upper half of the box. In the bottom half of the box, a user will see two orange error bar lines. While watching the numbers in the upper half of the box, the lower half should be watched for stability. When the blue line is stable within the orange lines, click **Apply**.





5

The results from the process are shown in this step. These values are saved as a Calibration Report separately from the two-point standards calibration in Kor. There is guidance in Kor software as to what typical value ranges for the LED and NOM coefficients are.

	Summary
Nitrate Concentration	0.67 mg/L NO3-N
Unfiltered LED1 Absorbance	0.157 AU
Unfiltered LED2 Absorbance	0.103 AU
Unfiltered Turbidity	4.89 FNU
Unfiltered Temperature	22.000 °C
Filtered LED1 Absorbance	0.102 AU
Filtered LED2 Absorbance	0.057 AU
Filtered Turbidity	0.59 FNU
Filtered Temperature	22.000 °C
Filtered Nitrate Sensor Value	0.67 mg/L NO3-N
Filtered Nitrate Value Error	0.00 mg/L NO3-N
LED1 Coefficient	-0.0111637
LED2 Coefficient	-0.0094460
NOM Coefficient	-1.5700

For additional information, please contact our Technical Support team at info@ysi.com

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