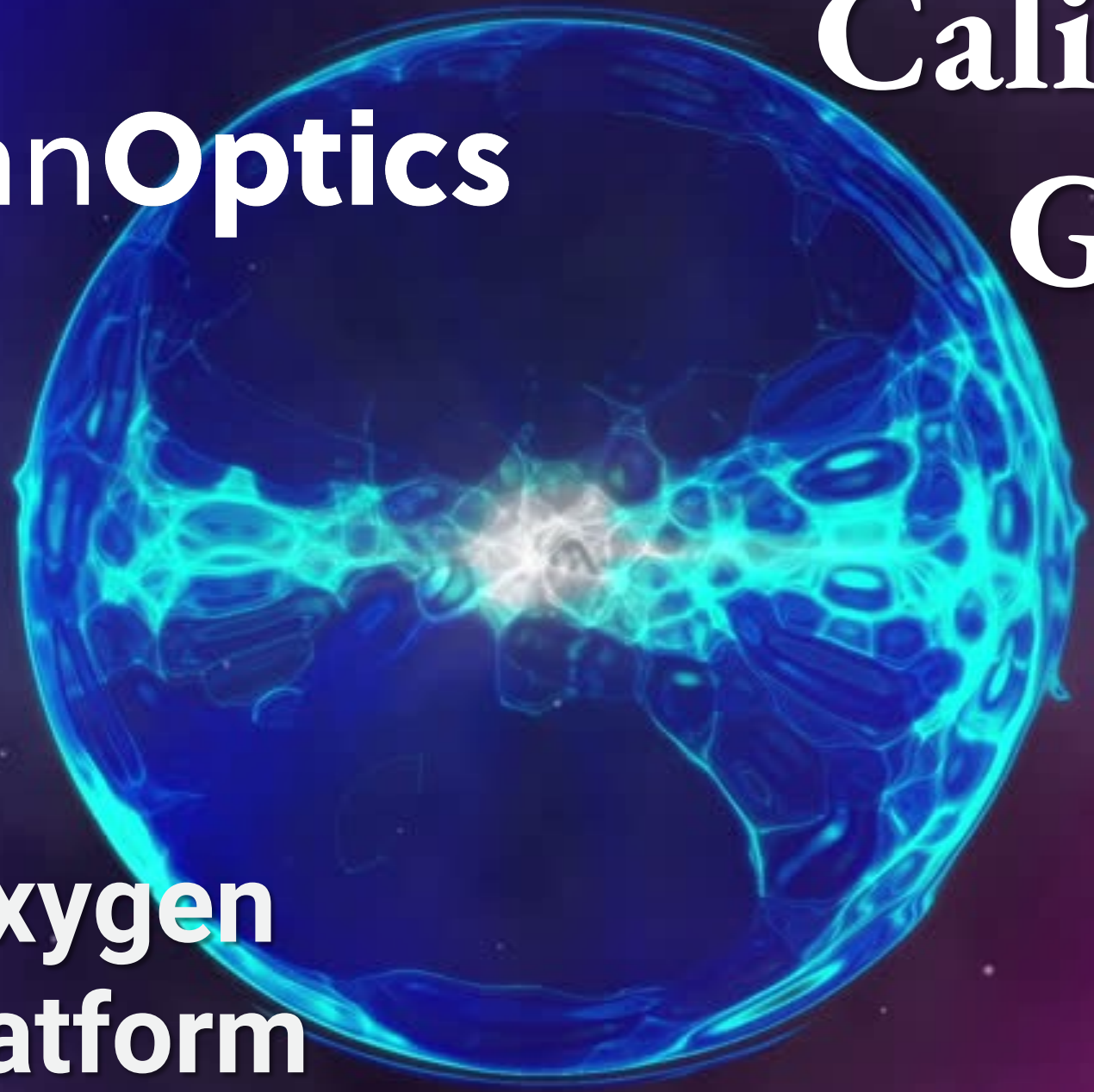
OceanOptics

Calibration Guide



NeoFox Oxygen Sensor Platform

Calibration Guide

Overview

2-Point Calibration

Multipoint Calibration

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2-Point Calibration

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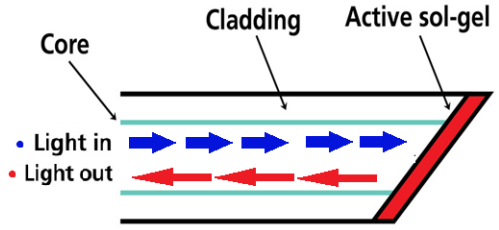
Pro Tip: That red residue is the sensor coating, so cleaning it off will destroy your probe!

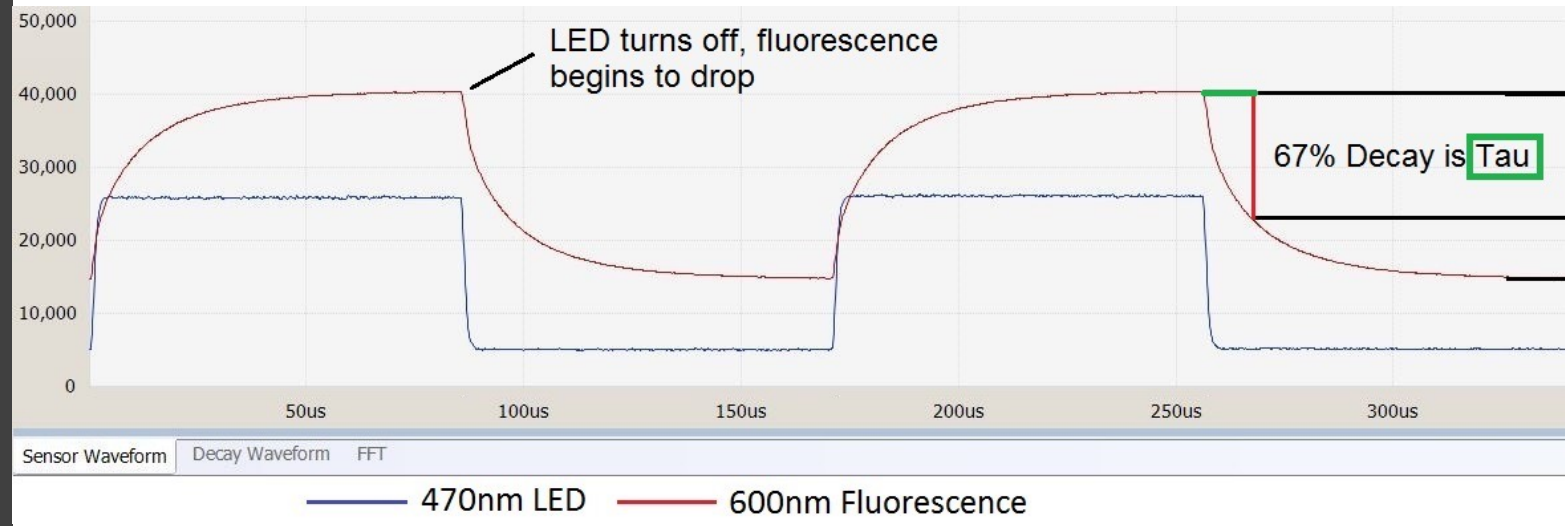
Sensor Coating

A fluorescent coating on your probe or patch is excited with a blue light and responds optically to partial pressure of molecular oxygen.



LED Strobe

A blue LED flashes as a square wave, causing fluorescence to increase and then drop off. 67% of this decay time is the *tau value (µsec)*



Overview

2-Point Calibration

Multipoint Calibration

Gas Sensing

Because it detects partial pressure of oxygen (p_{O2}) you will always know the pressure of oxygen despite total pressure.

To convert to $\%O_2$, you must know the total system pressure (P_{Total})

$\%O_2 = p_{O2} / P_{Total}$

The NeoFox has a pressure transducer on the board, which can be used for total pressure *if* the electronics are in the same environment as the sensor.

Pro Tip: '100% O_2' means different things to different people! To industrial gas workers 100% means pure oxygen. To wastewater workers 100% means air-saturation, or actually 20.9%

Tech Tip: Explains in more depth how dissolved oxygen units work with partial pressure sensors:

Principles of Optical Dissolved Oxygen Measurements

Liquid Sensing

Because it detects partial pressure of oxygen (p_{O2}) in both gas and liquid phases, conversion is needed for volumetric units *(mg/L, µmol/L)* when measuring dissolved oxygen.

When using these volumetric units in the software, it assumes conversion for pure water. Other conversions can be made based on literature or empirical results.

Overview

2-Point Calibration

Multipoint Calibration

It's This Simple

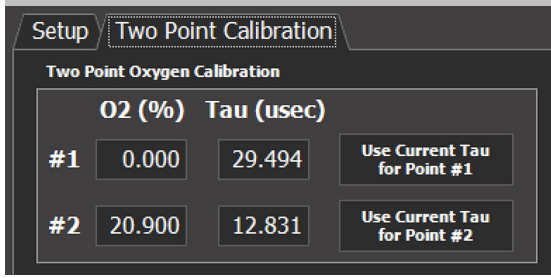
- Open Calibration window, go to 2-Point option
- Expose sensor to 0%-O_2 until tau stabilizes at some maximum value
  - *Take this as the 0% reference*
- Expose sensor to some >0%-O_2 level until tau stabilizes
  - *Take this as the 2nd reference*
- Click *Download* and confirm the update

0%-O_2 References:

- *N_2, Ar, He, anything without oxygen*

>0%-O_2 References:

- *Air at 20.9% (easiest)*
- *Gas standards from AirGas or similar*



Pro Tip: *You can calibrate <u>after</u> your experiment in scenarios where referencing may disturb or contaminate something.*

You can also calibrate <u>before and after</u> to detect and quantify any drift in the system.

Temperature

The 2-Point method assumes relatively isothermal operation, since temperature does have an inverse effect on tau.

Temp ⬆ *= tau* ⬇ *= Reported-O_2* ⬆

Temp ⬇ *= tau* ⬆ *= Reported-O_2* ⬇

The NeoFox-TP temperature probe can still be used with the 2-Point method, but it does not affect oxygen values and rather acts as a temperature logger for post-compensation.

Overview

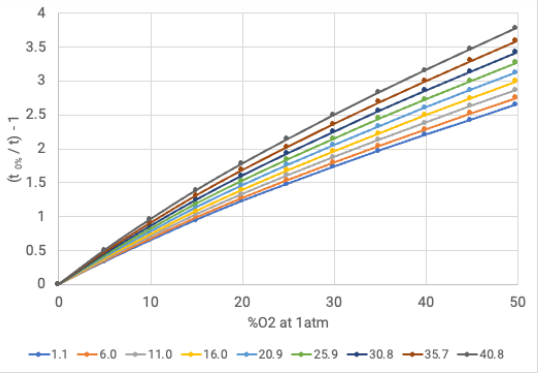
2-Point Calibration

Multipoint Calibration

Gas Calibrations

Gas phase measurements should use gas phase calibration references. Ensure concentrations are true and valid with sufficient flow over the sensor coating. Do not trust that you have hermetically sealed your vessel when taking a static *(non-flowing)* 0%-O_2 reference, because you haven't. Continue to purge with N_2 or other 0%-O_2 gas. This is the most common error during calibration. Your Parafilm does nothing to stop oxygen diffusion.

Pro Tip: *The 2-Point method assumes sensor linearity, which is largely true for 0-25% oxygen. Picking a point above 25%-O_2 risks intermediate inaccuracies due to curvature.*



Liquid Calibrations

Liquid phase measurements should use the same fluid for calibration references, using gas standards bubbled/aspirated through the fluid until tau has stabilized. This accounts for optical effects due to refractive index and dielectric constant.

Overview

2-Point Calibration

Multipoint Calibration

Requirements and Limitations

- Requires at least 3 temperatures and 3 oxygen concentrations *(including 0% for all temps)*
- Accommodates up to 99-points, such as 9-temperatures and 11-O_2 levels *(or vice versa)*
- More points improves accuracy, especially when chosen relevant to the measurement
- Requires NeoFox-TP temperature probe for live temperature readings *(static input possible)*

Important: Numerical temperature values in the table must be identical for each temperature level, since the software will group data based on this. For example, for 25°C do not use 24.9 for one point and 25.1 for another as these will be considered two different data sets.

It's This ~~Simple~~ Involved

Use Excel or similar spreadsheet to create a table such as below:

Temperature (°C)	Oxygen	Tau (µsec)
…	…	…
…	…	…
…	…	…

Use a water bath, environmental chamber, or other clever setup to achieve stable temperatures for the various references

- Gas phase measurements can use a coiled metal tube submerged in a water bath to alter gas temperatures, confirming with a temperature probe
- Liquid phase measurements can similarly place a small vial of reference fluid into such a water bath

Acquire stable tau values across various temperatures and oxygen levels, filling in the table appropriately

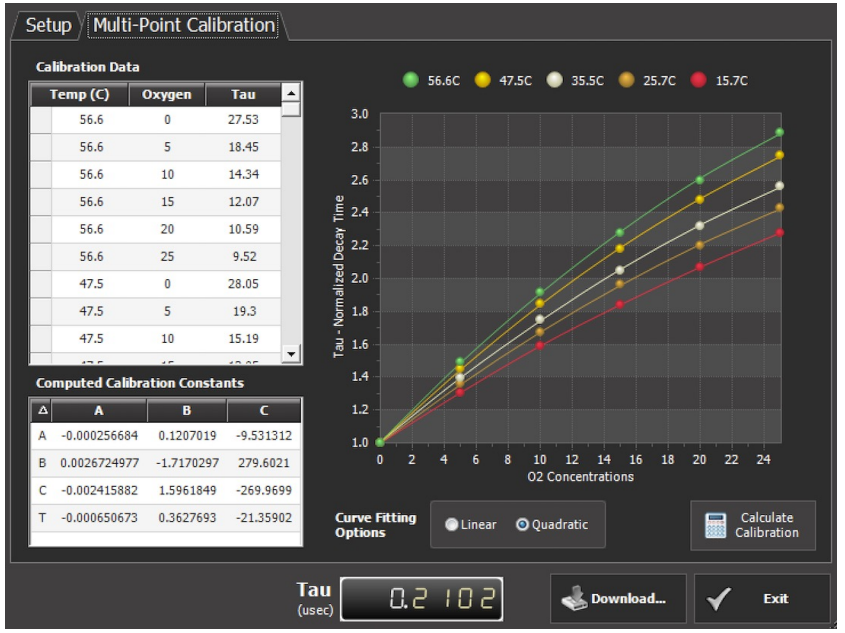
Overview

2-Point Calibration

Multipoint Calibration

Got Your Table? Great!

- Select and copy <u>only the numerical values</u> from your table (not headers or labels)
- Open Calibration window, go to Multipoint option



- Click on the *Temp (°C)* header in the calibration window
  - *Do not click in the first cell as this will put everything into that one cell. Click the header to generally-select the entire table*
- Press CTRL+V to paste values
- Click *Calculate Calibration* to generate a plot
  - *Confirm trends do not overlap*
- Click *Download* and confirm the update
- Save file for future use in the *Setup* tab

***Pro Tip**: The system does not know or care what oxygen units you are using during calibration, so feel free to use any units you prefer. It will report back whatever numbers you gave it during referencing with linear interpolation.*

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