



# RDO Sensor Calibration

## Calibration Instructions for the Rugged Dissolved Oxygen Sensor

In-Situ, Inc.

### CALIBRATION

#### OVERVIEW

Calibration of the RDO Optical Dissolved Oxygen sensor has two parts:

**Foil Coefficients:** Twenty constants (“coefficients”) unique to each batch of sensing foil describe the sensor’s behavior with respect to oxygen concentration and temperature. These coefficients are pre-loaded in a new sensor and need to be changed only when the foil *is changed*. Since changing the foil is not expected to be a frequent occurrence, this aspect of the calibration is covered in the operation manual in the RDO chapter; see the section “Sensor Care & Handling.”

**Calibration Constants:** The sensor in combination with the sensing foil has four calibration constants (called “phase coefficients”) that are automatically calculated when a two-point calibration is performed using two controlled oxygen concentrations. These phase coefficients are stored in the sensor. After changing or moving the foil a new calibration must be performed to obtain the best accuracy.

#### Nominal vs. Stable

To shorten the calibration time, you have the option to accept the calibration when “Nominal” stability is achieved. If the early value is accepted, the calibration point will be designated “USER SET” in the calibration report. If the calibration report indicates that calibration was performed through to stability then the instrument will operate as intended by In-Situ’s quality standards. For more on calibration reports, see Section 10 of this manual.

#### CALIBRATION SOLUTIONS

**100% D.O.** calibration is performed in water saturated with air. We recommend a container of clean water aerated with **In-Situ’s bubbler accessory** or an aquarium pump.

**0% D.O.** calibration is performed in an oxygen-depleted solution using **sodium sulfite** or bubbled nitrogen.

Sodium sulfite ( $\text{Na}_2\text{SO}_3$ ) is available from In-Situ Inc. Bubbled nitrogen may also be used; in this case allow plenty of time for the oxygen to be completely purged from the water.

#### RECOMMENDED CALIBRATION FREQUENCY

Calibration frequency is more predictable than with electrochemical D.O. sensors, since the sensor does not drift appreciably and is not affected by fouling (except biofouling from organisms that generate or consume oxygen). If the foil is not mechanically damaged or moved, calibration can last a year or more.

**Question:** *Why is there no Quick Cal option for the RDO Optical D.O. sensor ?*

**Answer:** *Quick Cal is used to calibrate sensors that are known to drift and otherwise lose measurement accuracy on a time scale shorter than desired for field use. Thus a Quick Cal presents the operator with a simple and potentially less accurate means to calibrate the sensor but in so doing will improve the sensor accuracy as compared to the state to which it may have drifted. It is less accurate but also less costly than removing the instrument to a laboratory setting to perform traditional multi-point calibrations. Because the RDO Optical D.O. sensor does not appreciably drift during long-term applications in media void of bio-fouling, there is nothing to be gained from a Quick Cal. A traditional two-point laboratory calibration once a year will result in long-term accurate measurements. If biofouling is detected, thorough cleaning and subsequent calibration may need to be done more frequently.*

**TIP:** *New RDO sensors have been factory-calibrated at 0% and 100% dissolved oxygen. A field calibration at oxygen saturation (100%) should be done on a new sensor. For best results, a 0% calibration is also recommended.*



**TIP:** For best results, recalibrate the RDO Optical DO sensor once a year.

**TRADITIONAL TWO-POINT CALIBRATION**

The optical D.O. sensor should be calibrated under stable and controlled conditions, such as are found in a laboratory setting.

One or both calibration points can be taken, in any order. If only one point is taken, the software retains the results of a previous calibration for the other point.

A 2-point calibration (100% and 0%) is recommended:

- When you expect to measure very low D.O. values (< 5 mg/L),
- When required by Standard Operating Procedures,
- After replacing the sensing foil,
- Once a year if the sensing foil has not been replaced.

**OXYGEN SATURATION POINT**

1. Submerge the RDO sensor in a container of clean water aerated with an aquarium pump or In-Situ's bubbler accessory.

**IMPORTANT:** Insure the sensor is completely submerged. If calibrating in the bubbler accessory, the water must be at the very top of the cup.

Allow 5-10 minutes for temperature and oxygen equilibration.

2. Connect the MP TROLL 9000 to a PC and establish a connection.
3. Select the MP TROLL 9000 in the Navigation tree.

The software will automatically detect and display the installed sensors.

4. Select Rugged Dissolved Oxygen in the Parameters list.

Information on the RDO sensor is shown, including its serial number (SN), the foil batch number, and recent calibration information, as shown in the large screen at the bottom of the page.

5. Select Calibrate.
6. Place the probe in calibration medium for Oxygen Saturation. Click or tap Run.

**TIP:** The equilibration time depends on the condition of the water with respect to temperature and exposure to air.

**TIP:** To see all of the information pane, you can click the "Full Screen"

button on the Win-Situ toolbar.

**Status indicators:**

**NOT TESTED** is displayed until you begin the calibration by selecting Run.

**UNSTABLE** indicates the sensor response does not meet the criteria for a valid calibration point.

**NOMINAL** indicates the deviation meets early stabilization criteria.

The **Accept** button becomes available when nominal stability is achieved. You may accept the early value, or wait for complete stability. If you accept the early value, the status will be designated "USER SET" in the calibration report. (For more on calibration reports and the difference between Nominal and Stable, see Section 10 of this manual.)

**STABLE** is displayed when the readings have stabilized sufficiently to take a valid calibration point.

7. When readings have stabilized, the screen display "Stable" for both temperature and phase degree.

At this point, you have several choices:

**Select Next** to display the Zero Oxygen Point screen. Continue with step 8 on this page.

**Select Next, then Next again** to finalize the calibration if you are performing a one-point calibration. Go to step 11.

**Select Run** to run the oxygen saturation point again if the temperature did not appear stable, or you believe the sensor values did not "bottom out." Go back to step 6.

**ZERO OXYGEN POINT**

8. Immerse the RDO sensor in an oxygen-depleted medium:

**Sodium sulfite** (Na<sub>2</sub>SO<sub>3</sub>) solution is generally reliable if some-what messy. Use a laboratory beaker or In-Situ's special zero-point cal cup. Be sure the small well in front of the sensing foil is filled with solution.

**Nitrogen bubbling** requires considerable time for oxygen to be completely purged from the water.



**IMPORTANT:** Insure the sensor is completely submerged. If calibrating in the supplied calibration cup, solution must be at the very top, with sensor fully inserted.

Check to be sure that there are no air bubbles on the sensing foil.

Allow up to 15 minutes for temperature equilibration. A titanium sensor will reach equilibration before an acetal sensor.

- When you are ready to take the calibration point, click or tap Run in the Zero Oxygen Point screen.

The display will continuously update as readings are taken and compared against the stabilization criteria.

Controls and status indicators are the same as for the Oxygen Saturation calibration point (step 6).

- When readings have stabilized, the screen will appear similar to the one shown in step 7, and you have several choices:

Select Next to finalize the calibration. Continue with step 11.

Select Back to calibrate the Oxygen Saturation point. Return to step 6.

Select Run to run the zero oxygen point again if the temperature did not appear stable, or you believe the sensor values did not “bottom out.” Go back to step 9.

- The final calibration screen will appear. To finalize the calibration click Finish.

The values will be written to the sensor and you will be asked if you want to see the calibration report.

The RDO sensor is now calibrated and ready to take readings. To confirm this, take a reading by selecting the RDO sensor in the Navigation tree and click the Read button.

### DEGREES OF PHASE ANGLE

The phase (degrees) values calculated during calibration of the RDO sensor can be expected to fall within these ranges:

Oxygen Saturation 25 – 35 degrees

Zero Oxygen 50 – 70 degrees

### UNITS AND CALCULATED MEASUREMENTS

Four units are available for dissolved oxygen:

- Oxygen concentration in milligrams of oxygen per liter of water

- (mg/L). Since a liter of pure water weighs 1000 grams, and a milligram is 1/1000 of a gram, this is equivalent to ppm (parts per million).
- Oxygen concentration in micrograms of oxygen per liter of water (µg/L).
- Oxygen concentration in microMolar (µmol/L), = mg/L x 31.25

Oxygen saturation in % —100% D.O. being the maximum amount of oxygen that can be dissolved in water at a given atmospheric pressure, water temperature, and salinity. % saturation output is automatically corrected using the TROLL 9000’s temperature, conductivity, and barometric pressure values (from a baro sensor on vented cable or from a user-entered input). If no conductivity sensor is present, salinity is assumed to be zero.

### DEPLOYMENT RECOMMENDATIONS AND CAUTIONS

The amount of oxygen that can be dissolved in water decreases at higher temperatures and decreases with increasing altitude (i.e., as barometric pressure drops) and salinity. In other words, as water becomes warmer and saltier, it can hold less and less dissolved oxygen.

**TIP:** *Rinse the sensor and front end of the instrument very thoroughly after calibrating in sodium sulfite solution to avoid cross-contamination.*

*The solution may be poured back into the bottle, tightly capped, and reused.*

*If you suspect the power of the sodium sulfite is beginning to deteriorate, note the phase degrees calculated during a zero-point calibration. If this number changes significantly on your next calibration, then the solution is probably old and weak, and should be replaced.*

**TIP:** *To change unit preferences: In Win-Situ, select Preferences on the Options menu. In Pocket-Situ, select the Home site, then tap Setup in the command bar. TIP: Sodium sulfite consumes oxygen aggressively. If performing the oxygen saturation point next, be sure to rinse the TROLL 9000 and RDO sensor thoroughly to avoid cross-contamination.*

**TIP:** *If the units for the reading are not what you expect, it is easy to change the units selection: In Win-Situ, select Preferences on the Options menu. In Pocket-Situ, select the Home site, then tap Setup in the command bar.*