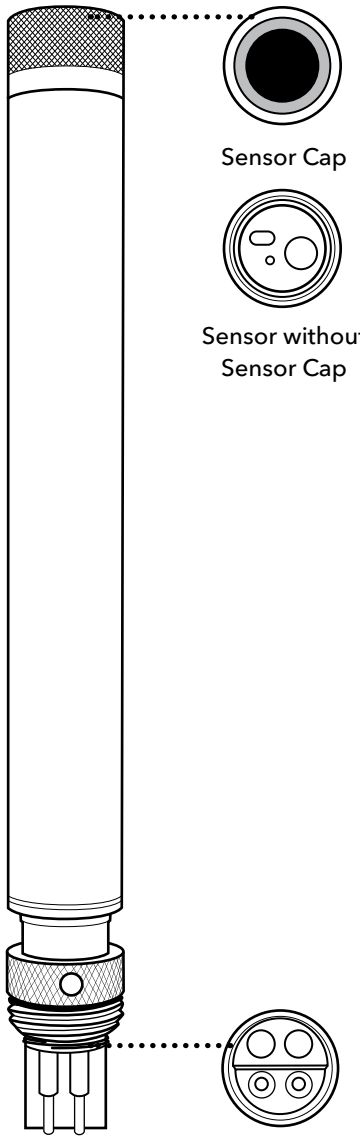
4.11 Dissolved Oxygen

Sensor Overview

The principle of operation of the EXO optical dissolved oxygen sensor is based on the well-documented concept that dissolved oxygen quenches both the intensity and the lifetime of the luminescence associated with a carefully chosen chemical dye. The EXO DO sensor operates by shining a blue light of the proper wavelength on this luminescent dye which is immobilized in a matrix and formed into a disk. The blue light causes the immobilized dye to luminesce and the lifetime of this dye luminescence is measured via a photodiode in the probe. To increase the accuracy and stability of the technique, the dye is also irradiated with red light during part of the measurement cycle to act as a reference in the determination of the luminescence lifetime.



599100-01;
599110 sensor cap

When there is no oxygen present, the lifetime of the signal is maximal; as oxygen is introduced to the membrane surface of the sensor, the lifetime becomes shorter. Thus, the lifetime of the luminescence is inversely proportional to the amount of oxygen present and the relationship between the oxygen pressure outside the sensor and the lifetime can be quantified by the Stern-Volmer equation: **((Tzero/T) – 1) versus O_2 pressure**

For most lifetime-based optical DO sensors, this Stern-Volmer relationship is not strictly linear (particularly at higher oxygen pressures) and the data must be processed using analysis by polynomial non-linear regression. Fortunately, the non-linearity does not change significantly with time so that, as long as each sensor is characterized with regard to its response to changing oxygen pressure, the curvature in the relationship does not affect the ability of the sensor to accurately measure oxygen for an extended period of time.

(continued)

Specifications

Units	% Saturation, mg/L
Temperature *Operating* *Storage*	 -5 to +50°C -20 to +80°C
Range	0 to 500% air sat. 0 to 50 mg/L
Accuracy	0-200%: ±1% reading or 1% air sat., whichever is greater; 200-500%: ±5% reading 0-20 mg/L: ±1% of reading or 0.1 mg/L; 20-50 mg/L: ±5% reading
Response	T63<5 sec
Resolution	0.1% air sat. 0.01 mg/L
Sensor Type	Optical, luminescence lifetime

Variables that Affect DO Measurements

Variables that could affect dissolved oxygen measurements include temperature, salinity, and barometric pressure. Temperature and salinity are compensated for during instrument calibration and field use with the use of additional sensors and/or instrument software settings.

Barometric pressure relates to the pressure of oxygen in the calibration environment, and barometric pressure changes due to a change in altitude or local weather. Generally the effect of barometric pressure is overcome by proper sensor calibration to a standard pressure.

If DO % local is being measured, it may be necessary to recalibrate the instrument after significant changes in barometric pressure or altitude in order to keep the DO% Local value at 100% in a fully saturated environment.

If DO % EU is being measured, the reading is corrected in real time by live barometric pressure readings in order to maintain a value at 100% in a fully saturated environment regardless of local pressure changes.
Note that this process is only achievable when connected to an EXO Handheld or EXO GO, as live barometric pressure is required for real time compensation.

ODO % Sat = Raw DO reading corrected with temperature and local barometric pressure at the time of calibration: (local mmHg / 760 mmHg) x 100 = %Sat

ODO % Local = Raw DO reading corrected with temperature and % Sat output fixed to 100% regardless of barometric pressure entry. (The entered local barometric pressure is used by KorEXO software for mg/L calculations.)

ODO % EU = ODO % Sat reading corrected with live barometric reading (available only when the sonde is connected to the EXO Handheld or EXO GO). Fixes the % Sat output to 100%, and conforms to British and EU standards.