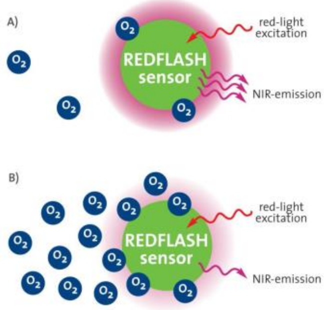
BLUE CAP
OPTICAL DISSOLVED OXYGEN

INTRODUCTION

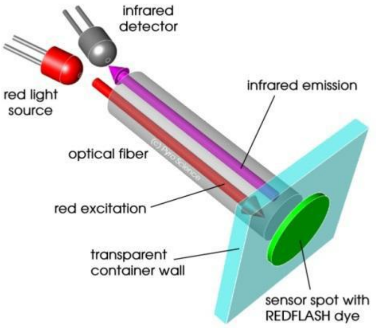
Oxygen optical sensors work according to the principle of dynamic fluorescence quenching. The sensor contains fluorescent dye that is excited by light of a certain wavelength. Depending on the amount of oxygen molecules present, the luminescence response of the optical sensor varies. A polymer fiber transmits the excitation light of the sensor and at the same time also transmits the fluorescence response of the sensor to the measurement device. The oxygen sensitive dye is immobilized in a polymer matrix. This polymer can be applied to carrier material and used as sensor spots or sensor foil. It can also be coated directly onto the optical fiber. Oxygen quenching luminophores have been studied from at least 1939 when Kautsky described quenching of luminescence by oxygen. More recently, as optical sources, detectors, and data processing have become more advanced , the application of luminophores to the measurement of oxygen concentrations in liquids has resulted in bench-top instruments and optodes., with significant advances since 1990,s. Recent advances in blue light –emitting diodes and low-powers high-speed electronics have enabled the miniaturization of oxygen sensitive optodes to the point of field-deployable units. The sensors do not consume oxygen and are stable over long deployment period.

The new REDFLASH technology is based on the unique oxygen-sensitive REDFLASH dyes. In contrast to common techniques using blue-light excitation, the REDFLASH dyes are excitable with orange-red light and show and oxygen-dependent luminescence in the near infrared (NIR). The REDFLASH technology impresses by its high precision, high reliability, low power consumption, low cross-sensitivity, and fast response time. The orange-red light excitation significantly reduces interferences caused by auto-fluorescence samples. Further, the NIR detection technology significantly reduces interference with ambient light, known from the old-blue-light techniques. The new REDFLASH technology is based on the unique oxygen-sensitive REDFLASH indicator showing excellent brightness. The measuring principle is based on the quenching of the REDFLASH indicator luminescence caused by collision between oxygen molecules and the REDFLASH indicator immobilized on the sensor tip or surface. The REDFLASH indicators are excitable with the red light (More precisely orange-red at a wavelength of 610-630nm) and show an oxygen-dependent luminescence in the near infrared (NIR 760-790 nm).



Principle: red light excited REDFLASH indicators show luminescence in the near infrared (NIR), which decreases with increasing oxygen (quenching effect).
A) high NIR emission at low oxygen and **B)** low NIR at high oxygen

Principle: Red light exited the REDFLASH indicators show luminescence in the near infrared, which decreases with the increasing of oxygen (quenching effect). A) High NIR emission at low oxygen and B) low NIR at high oxygen. The measuring principle is based on a sinusoidal modulated red excitation light. This results in a phase-shifted sinusoidal modulated emission in the NIR. The measurement device measures this phase shift (termed dphi in the software) The phase shift is then converted into oxygen units based on the Stem-Vollmer-Theory. The red-light excitation significantly reduces interferences caused by auto-fluorescence and reduces stress in the biological systems. The REDFLASH indicators show much higher luminescence brightness than other optical sensor working with blue light excitation. Further due to the excellent luminescence brightness of the REDFLASH indicator, the actual sensor matrix can be now prepared much thinner, leading to fast response times of the oxygen sensors.



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BLUE CAP DESCRIPTION

The external part of the Blue Cap Oxygen Optical Sensor is a titanium support with a 11,7mm diameter, where at its centre is placed a 3mm fiber optics well sealed to guarantee 700 bar operations. The length of the support is about 44mm (without the Blue replaceable membrane cap installed); two 2-12 Parker O-rings seal the support onto the probe housing. The measuring membrane cap is simply fitted inside the titanium support till it stops and is provided with a friction system (groves) to prevent unwanted removal or accidental loss. The membrane cap is made of blue plastic to better shield the external light and is very like the pH hydrating cap. The only difference is that a hole at its bottom allows the factory installation of the glass window on its inside. The black sensor spot which allow the oxygen measurement is centrally placed on the outside of the glass window. The other side of the optical fiber remains indie the CTD housing and is fitted in a unique miniaturized transducer whose optics and electronics transform the optical signal into RS485 output.

SPECIFICATIONS

Measuring range:	0-500% O2 (0-44 mg/l)
Resolution:	0.25% O2 (0.025 mg/l)
Accuracy:	±1% O2 (±0.1 mg/l)
Temperature range:	0 to 50°C
Response time (t90) gas/water:	3s (Standard Membrane) or 1s (Fast Membrane)
No cross-sensitivity:	pH 1-14, CH4; CO2, H2S, any ionic species
Cleaning procedures:	3 % H2O2, ethanol, soap solution
Storage time:	>3 years in darkness at room temperature.
Calibration:	single point
Optical Isolation:	the sensor spots are covered with a final black layer to minimize influence of strong external illumination

CONFIGURATION

Through the CTD configuration menu and the external sensor setup: CNES, command from the CONFIGURATION MENU, it is possible to configure the optical dissolved oxygen sensor.
In case the sensor configuration is lost and it does not appear in the list of acquired sensor contact IDRONAUT to receive assistance on how setup your CTD.

CALIBRATION

Calibration is carried out by using the command available under the CALIBRATION MENU.
Two calibrations must be carried out. Calibration of the %_Saturation and ppm.
When the list of calibration sensors appears on the ITERM window select in sequence first the Saturation Optical dissolved oxygen sensor **OPT_O2%** and then the PPM optical dissolved oxygen sensor **OPT_O2**.
Both calibrations are carried out in air with the blue cap membrane and temperature sensor well dry.

O2% SATURATION CALIBRATION

Once selected the OPT_O2% sensor from the list the below message appears on the ITERM window:

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```
OPT_O2% sensor calibration
Gently wipe O2 membrane and Temperature sensor
Type <any key>To continue, <ESC>To leave
```

Using a soft paper gently wipe and well dry the O2 membrane and the temperature sensor as suggested. At the end of the calibration procedure the below diagnostic messages appear.

```
Calibration completed:
Signal Intensity (300 - 500): 358.162000
```

The signal intensity should be, for optimal sensor operation between 300 and 500. If the value is below the limit (300) the membrane cap can be replaced with a new one and then calibration can be repeated.

O2 PPM CALIBRATION

Once selected the OPT_O2 sensor from the list the below message appears on the ITERM window:

```
OPT_O2 sensor calibration
OPTICAL OXYGEN - Calibration
Scale factor from uMol/l to ppm:0.032
```

The optical dissolved oxygen sensor measuring unit calculates the dissolved oxygen concentration in µmol/L and in % of saturation.
The concentration value can be shown using measuring units by modifying the scale factor showing concentration value in mg/L or mL/L.

Dissolved O2 concentration *mg/L = ppm*	Scale factor: [mg/L]	= [µmol/L] x **0.032**
Dissolved O2 concentration *mL/L = ppm*	Scale factor: [mL/L]	= [µmol/L] x **0.02241**

BLUE CAP MEMBRANE STORAGE

A black cap is provided to protect the membrane from light. When the CTD is not used protect the membrane by installing the black cap.

OPTICAL DISSOLVED OXYGEN DEPLOYMENT

A black cap is provided to protect the membrane from light. PLEASE remove the black cap before calibration and before deploying the CTD in water.

BLUE CAP CLEANING

At the end of the OCEAN SEVEN 3xx general cleaning, remove the blue cap and clean the membrane using a 3 % H2O2, ethanol or a soap solution. Gently wash the membrane using a soft brush.

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