

Oxygen Consumption Measurement System

This new system is based on a fiber optic fluorescence lifetime measurement of oxygen concentration, the most advanced, efficient and stable technique available. The system reads the oxygen concentration in the medium surrounding the test specimen and, when sealed, yields an accurate measure of the oxygen consumption rate (OCR).

The top loading chamber is constructed of titanium with a glass plug/valve and glass covered stirring bar to eliminate any chemical reaction with the medium as well as oxygen absorption and re-release as the pO₂ falls. Titanium provides a totally inert environment with excellent thermal equilibration characteristics. Chamber volume is less than 200µL to permit analysis of small samples.

The fluorescence lifetime sensor is integral to the chamber and is capable of thousands of determinations without replacement or maintenance. The lifetime technique provides unparalleled stability with virtual immunity to fluorescence amplitude variations over time. Below the chamber is a miniature magnetic stirrer capable of low speed operation to keep the cells in suspension while minimizing damage. Stirring is not a requirement of the sensor.

The single channel system is equipped with a temperature sensor which can automatically compensate for temperature differences between experiments. The system operates from a PC employing the easy to use software provided. It has a graphical display of oxygen levels and permits saving the data to disk in a text file for further analysis using a spreadsheet. A circulating water bath (FO/CWB) is recommended for maintaining constant temperature control of the chamber.



FOL/SYS1-T175 System Components

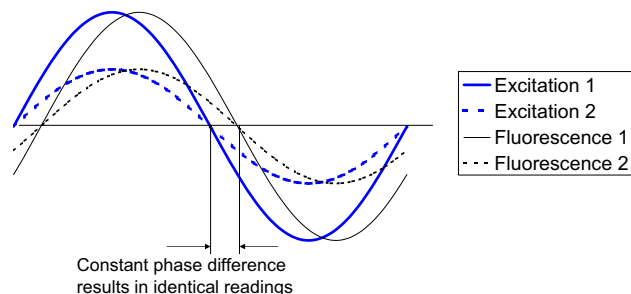
- Fluorescence lifetime readout electronic unit
- 175µL titanium chamber with built in oxygen sensor
- Aluminum chamber block holder with water ports with integral magnetic stirring motor and temperature sensor well
- Coupling fiber
- Temperature probe
- Glass plug/valve
- Glass covered stir bars (2)
- Stirring motor speed controller

Fluorescence Lifetime Measurement Technique

Modulated excitation light from a blue LED is transmitted to the sensor and returned to an optical detector in the readout via a single fiber optic cable.

When oxygen binds to the fluorophore incorporated into the sensor layer, two related phenomena occur. The amplitude of the fluorescence is quenched to a degree proportional to the oxygen concentration in equilibrium with the sensor. Coupled to the decrease in intensity is a change in fluorescence lifetime. By comparing the time relationship between excitation light source and the fluorescence produced, or phase angle, it is also possible to determine the oxygen concentration. While both techniques would seemingly produce the same results, there are important technical differences. The phase discriminating circuitry is virtually immune to changes in amplitude, such as LED intensity, photo bleaching of the dye and fiber transmission changes, as long as there is enough signal to make the determination. (This is similar to the superiority of FM over AM radio.) Ambient light interference is also greatly reduced to the point where no opaque layer is required that would slow the response of the sensor.

Signal is Immune to Amplitude Changes

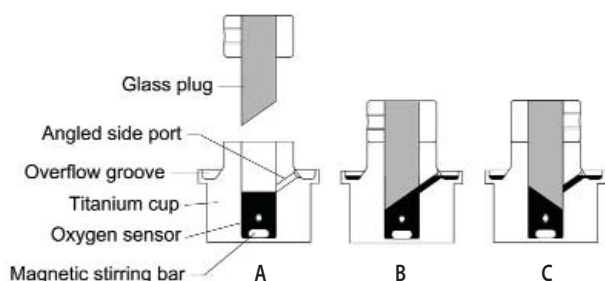


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Since the oxygen comes into equilibrium within the sensor layer, there is no continuing oxygen consumption by the sensor, thus removing the lower volume limit restriction. Neither is there any stirring artifact as seen with polarographic electrodes. Gaseous phase measurements are possible since there is no electrolyte to evaporate.

Chamber Operation

By pushing the glass plug slowly into the chamber, the air rises to the highest point and is expelled through the angled side port. By observing through the plug, no bubbles should be seen. The side port can be used for reagent addition when in the chamber is in position B. Rotation of the cap by 180 degrees seals the chamber, position C. Typically the actual volume of chamber is less than 200 μ L and should be measured by the user.



Ordering Information

Part No.	Description	Unit
FOL/SYS1-T175	FOL oxygen monitoring system, single 175 μ L chamber	ea
FOL/T175	Single 175 μ L FOL chamber with magnetic stirrer	ea
FOL/T175C	Replacement 175 μ L FOL chamber cup with sensor element	ea
FOL/T175CR	Service of 175 μ L FOL chamber cup to replace sensor element	ea
FO/CWB	Haake DC10-B3 circulating water bath	ea

<http://www.instechlabs.com/Oxygen/fiberoptic/fol.php>



System Specifications

Chamber	
Cup material	Titanium-non-reactive
Cup type	Top loading
Chamber cup well	6.35mm ID flat bottom
Sample thermal equilibration	~ 20 sec.
Plug/valve	Precision bevelled glass
Cup mounting block	Aluminum with water ports
Mounting block finish	Nickel - Teflon coating
Magnetic stirring motor	Integral geared 15mm motor
Stirring speed	120-1800 RPM
Motor controller	Instech Model 1060 controller
Overall dimensions	6.9 x 7.6 x 7.9 cm
Weight	0.4 kg

Instrument	
Measurement range	0-22 mg/L (ppm) or 250% of air saturation
Limit of detection	0.15% air saturation or 15 ppb
Accuracy (20C)	\pm 1% @ 100% air saturation
Temperature range	0-50 $^{\circ}$ C
Temperature accuracy	\pm 1 $^{\circ}$ C
Digital interface	RS-232 with adapter cable to 9-pin D-sub
Analog output (Oxygen)	BNC, Programmable
Analog output (Temp)	BNC, Programmable
Acquisition time	1 sec (default), 250 msec (min)
Power Supply	12VDC 550 ma (110-240VAC 50/60 Hz)
Oxygen units (user selectable)	Air sat, O ₂ sat, hPa, Torr, mg/L (ppm), μ mol
Compatibility	Windows 95 through XP Pro
Dimensions	18.5 x 11.0 x 4.5 cm
Weight	0.6 kg

Sensor	
Response time to 90%	<20 seconds when stirred
Stability	<0.4% air sat. over 24 hrs
Sterilization methods	3% H ₂ O ₂ or 5% bleach
Solvent resistance	Methanol and ethanol resistant (other organic solvents should be avoided)
Interfering gases	SO ₂ , Cl ₂
Ionic species	No interference

FO/CWB Circulating Water Bath	
Accuracy	\pm 0.02 $^{\circ}$ C
Volume	3L
Range (no cooling)	35 - 100 $^{\circ}$ C
Range (tap water cooling)	20 - 100 $^{\circ}$ C
Weight	8 kg

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