

Economical Respirometer

for

**Sludge, Waste Water, Bioremediation,
Bioleaching, Biotoxicity, Compost,
Fermentation, Fruits/Vegetables
and Soil Monitoring**



Oxymax ER Laboratory Model

Patents: U.S. No. 4947339, European No. 0372429, Japanese No. 2117492

Columbus Instruments has adapted our patented Micro-Oxymax[®] technology into an affordable multi-chamber/multi-gas economical respirometer. Our new Oxymax ER series provides performance suitable for the majority of applications in environmental monitoring and research. This new line of economical respirometers employs state of the art gas phase monitoring to provide oxygen and carbon dioxide sensing in one to ten chambers.

All systems can operate in stand-alone mode or tethered to a personal computer by RS-232 for real-time acquisition and include software for the Windows 98/2000 operating systems. Special instrument packaging is available that allows unattended "in the field" operation by battery for prolonged monitoring. Data retrieval may occur periodically by direct pc connection, phone modem or radio-modem.

How it works ...

Columbus Instruments Oxymax ER family of economical respirometers operates by periodically monitoring the changes in concentration of oxygen and, optionally, carbon dioxide within the head space of a chamber. Measurements are performed in a closed-loop fashion whereby the sampled gas is returned to the chamber. This technology was perfected and patented by Columbus Instruments and was adapted from our successful line of Micro-Oxymax respirometers. Rates of gas exchange are computed following each measurement with data saved locally for later retrieval and/or transmitted to a host pc. When not being monitored, chambers are continuously purged with either atmospheric air or a gas of user specified composition. Chambers may take many forms with shape and design suited to the application.

Oxymax ER supports two types of measurement methodologies: Fixed Interval and Dynamic Interval. The Fixed Interval (FI) method measures concentrations at a user specified interval and reports rate figures at the conclusion of each measurement. FI is the most common method of operation and is employed when testing warrants respiration data at defined intervals. The Dynamic Interval (DI) method employs variable intervals that are triggered when the gas composition within the head space reaches a user defined threshold. DI allows Oxymax ER to be employed when the expected respiration of the sample is unknown or can vary over orders of magnitude during an experiment. DI capability expands Oxymax ER into applications that are beyond the useful limit of manometric based products.

Gas Sensor Technology

All Oxymax ER systems employ a gas phase electrochemical cell for sensing oxygen. The cell is housed in a thermally stable and pressure controlled environment that assures consistent and reliable operation. The optional carbon dioxide sensor is of the non-dispersive IR type and is also maintained in a controlled environment. The maintenance of a precisely controlled sensor environment is crucial to operation when the instrument is employed in hostile conditions that can arise in the field. Unlike systems that employ dissolved oxygen probes, Oxymax ER's oxygen sensor is not prone to fouling or other DO probe related problems.

Multiple Channel Capability

Oxymax ER systems with more than one channel employ a pneumatic multiplexing system that uses tight sealing valves with elastomeric seats. The valves remain functional under conditions of mild debris assuring maximum 'up time'. These same valves are used throughout the instrument making it tolerant of non-laboratory conditions. In the event of accidental debris ingress, each input port is protected by an easily replaced 25 micron filter.

Diagnostics

Comprehensive diagnostic tools are available to confirm system integrity and validate performance. Meaningful error messages provide troubleshooting guidance. Oxymax ER self calibrates at the start of an experiment.

Data Collection/Presentation

Oxymax ER systems are user configured by way of a host pc via RS-232 connection running the Windows 98 or 2000 operating system. Software included with the system provides automated calibration and the establishment of an executable experiment. During experiment execution, Oxymax ER provides real-time tabulation and plotting of all data via the capabilities of an attached PC. Alternatively, Oxymax ER can execute an experiment without a PC and retain in excess of 14 days of data in non-volatile memory. Data may be uploaded for later analysis using software supplied with Oxymax ER. The resulting ASCII data file is available for analysis by any spreadsheet or statistical program.

Experiment data from Oxymax ER systems is corrected to STP (0°C, 760mmHg). Rates and accumulated values may be presented in user selected units of microliters, milliliters, micrograms, milligrams or micromols. Rate figures may be referenced to minutes or hours (e.g.: mgO₂/hr). An attached temperature sensor and internal barometer account for variation in conditions and adjust results accordingly.

Material Compatibility

Oxymax ER systems are manufactured of materials that maintain compatibility with all areas of customary application. All wetted surfaces are either stainless steel, Nylon, glass or PVC with pump diaphragms and other flexible components made of Viton or silicone.

Why it's better ...

True Gas Monitoring

Historically, low cost solutions to respirometry have relied on manometric principles. These include either replacement of oxygen by way of pressure sensing and an electrolytic process or simply monitoring the pressure drop and inferring oxygen utilization. Such methods are antiquated when contrasted with today's sensor technology. Columbus Instruments Oxymax ER employs dedicated gas sensors designed specifically for the monitoring of oxygen and carbon dioxide.

Improved Flexibility

Old manometric based respirometry relied on an extremely stable sample environment. This was paramount to obtaining meaningful data from a system that employs pressure as the measured quantity. The need for constant temperature prevented the application of respirometry to situations where temperature was a variable in the assessment of respirometric performance. Oxymax ER removes this constraint and allows measurements to take place under circumstances that would not be possible using manometric techniques.

Sensor Scanning

Each chamber in a manometric system must have its own electrolytic source and/or pressure sensor. The use of multiple sources/sensors can put into question the ability with which data can be compared across chambers. Oxymax ER employs one sensor for a given gas and employs it across all chambers. The use of a single, stable, sensor assures equivalent and reliable performance for all samples.

Fully Automated Operation

Oxymax ER systems are designed for unattended automatic operation. A simple set-up process is the only required intervention. Once configured, the system executes the experiment without further operator action. Data is saved internally and can be observed on the easily read LCD display or sent to an attached PC by RS-232. The included software fully automates data collection by the PC and provides an ASCII formatted data file that can be imported by virtually any program for analysis or review.

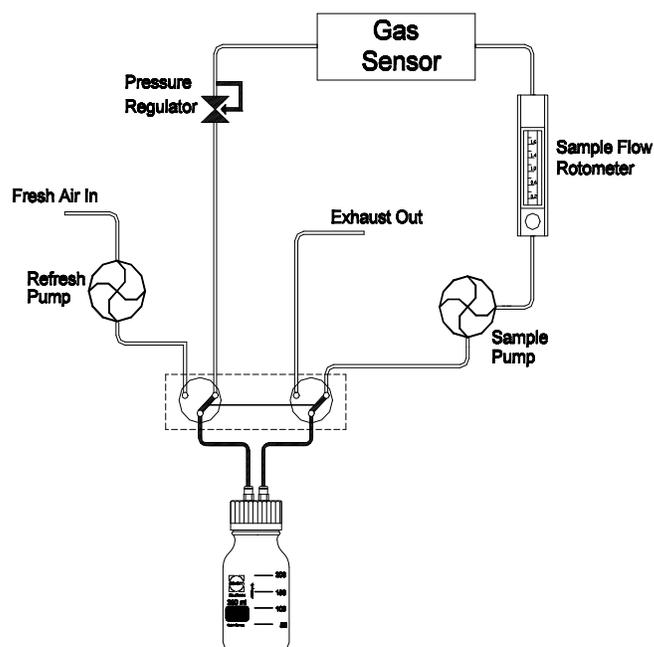
Ruggedized Case and Battery Operation

Oxymax ER systems can be equipped with an optional battery power source and rugged NEMA case when unattended long-term field measurements are required. This completely self-contained capability eliminates frequent visits to sites for the purpose of performing field tests or taking samples that might otherwise degrade during transport to a lab based respirometer.

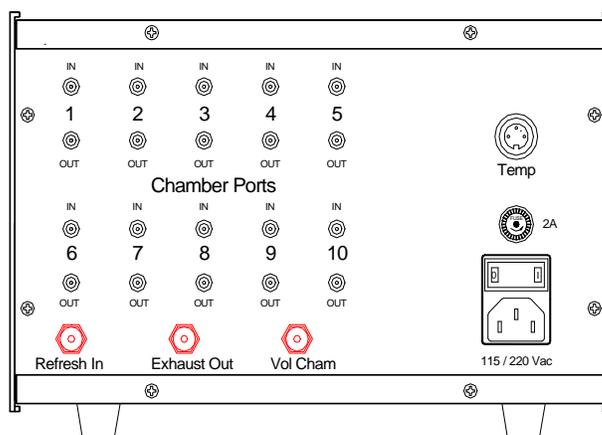
Features ...

- ◆ **High Sensitivity:**
 - 50ppm change in O₂ & CO₂ Concentration**
 - 2 µl/min at 10 Minute Fixed Interval**
 - 2.8 µgO₂/min at 10 Minute Fixed Interval**
- ◆ **Real-Time Graphical Data Presentation**
- ◆ **Does Not Require Specialized Glassware**
- ◆ **Optional NEMA 4 Enclosure for field applications**
- ◆ **Supports Up to 10 Chambers**
- ◆ **Fully Automated Operation**

Oxymax ER Flow Schematic



Oxymax ER Lab Unit Rear Panel



Tabular Data Output

Experiment Configuration
File Name: C:\Program Files\ER-10 Eco-Respirometer\Data\soil.dat

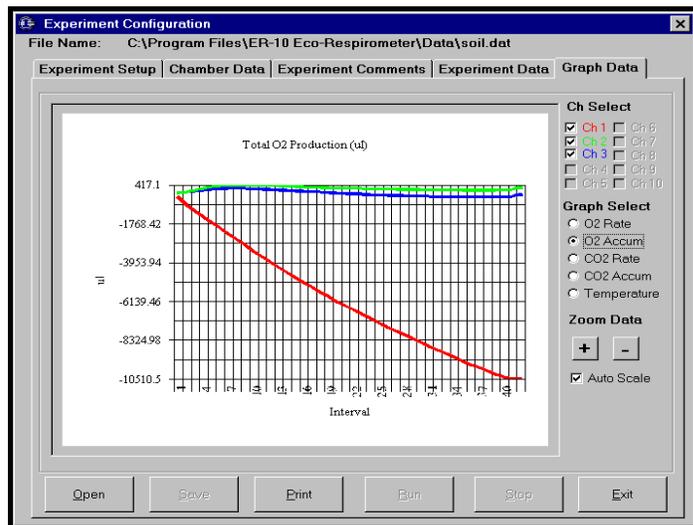
Experiment Setup | Chamber Data | Experiment Comments | Experiment Data | Graph Data

Start Time: Nov 4 99 16:52:29
Interval: 1
 Scroll Live Data

Ch.	Time Min.	Cham Temp.	Oxygen Sensor			CO2 Sensor			System Info	
			Gas %	Rate ul/min	Total ul	Gas %	Rate ul/min	Total ul	Sensor Press.	Ref Temp.
1	7.88	26.1	20.82	-33.15	-261.4	0.45	101.10	797.0	799.7	32.5
2	15.75	26.5	20.94	-1.61	-25.4	0.19	1.56	24.6	799.8	33.5
3	23.62	26.8	20.96	0.07	1.5	0.17	3.67	86.7	799.7	34.4

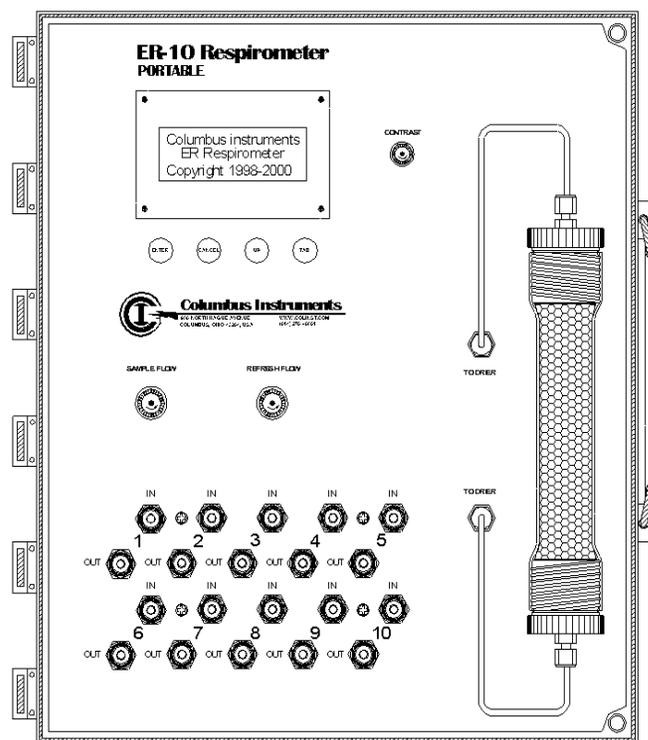
Open Save Print Run Stop Exit

Graphical Data Output



Specifications ...

- Measurement Range:**
 Min: 2 μ l/min
 2.8 μ gO₂/min
 (250ml Head Space Volume @ 10min, Fixed Interval Operation)
 Max: Unlimited ...
 Determined by relationship of head space volume to sample size.
 (Dynamic Interval Operation)
- Computer Interfacing:**
 RS-232 (to 10 meters)
 RS-485 (to 1000 meters)
 9600/19200 Baud
- Cabinet:**
Lab Unit:
 Height: 7.5" [19cm]
 Width: 11.5" [29cm]
 Depth: 14" [36cm]
 Weight: 20 lbs [9Kg]
- Field Unit:**
 Type: NEMA 4
 Height: 15" [38cm]
 Width: 13" [33cm]
 Depth: 9" [23cm]
 Weight: 30 lbs [14Kg]
- Standard Gas Sensors:**
 O₂ Range: 19-21%
 CO₂ Range: 0-1%
- Accuracy:**
 +/-2% of Reading
 (250ml Head Space Volume @ 10min, Fixed Interval Operation)
- Head Space Volume:**
 Standard Range
 25-1000ml
- Computer Requirements:**
 Windows 98/2000
- Electrical Requirements:**
 120 VAC 60 Hz <1 Amp
 220 VAC 50 Hz <1 Amp
- Plumbing Connections:**
 1/8" [3.2mm] OD Tubing
- Environment:**
Lab / Field Unit:
 15-30 °C / 5-45 °C



Oxymax ER in Field Case

Ordering Information:

- 12001 Oxymax ER-1 Economical One Channel ER Respirometer with O2 sensor
 12005 Oxymax ER Economical Respirometer Add-on Channel
 12010 Oxymax ER-10 Economical Ten Channel Single Gas (O2) Respirometer
 12011 Oxymax ER CO2 measuring option for O2 and CO2 measurements
 12025 Oxymax ER-10 Ten Channel Condensing Air Dryer
 12204 Oxymax ER Field Case and Battery Option