

DELTA F CORPORATION
APPLICATION NOTE NO.
101



Monitoring Oxygen in a Glove Box

Glove boxes are sealed enclosures used to isolate a particular process from the environment. They are usually equipped with at least one pair of gloves that are attached to the front of the enclosure. The gloves are used to gain access to the inside of the box in order to manipulate the work inside. Normally, a window or viewing port is installed on the glove box which allows the user to view the work he or she is doing. The degree of isolation provided by a glove box is often determined by the application. Isolation is required for reasons of safety, process requirements or for the purpose of ensuring product quality. Typical uses of glove boxes include:

- Light Bulb Manufacturing
- Crystal Growing for Semiconductor Manufacturing
- Production of Lithium Batteries
- Production of Sodium-Sulfur Cells
- Fiber Optic Research
- Sealing of Power Transistors
- Specialty Welding
- Research on Organo-Metallic Compounds
- Processing of Plutonium in Nuclear Physics
- Preparation of Chemical Reagents

Many of the processes conducted within glove boxes must be performed under oxygen-free atmospheres of either nitrogen, helium, argon, etc. to help insure that maximum isolation from the outside environment has been achieved. Oxygen analyzers are frequently used for spot checking of leaks as well as for continuous monitoring of glove box atmospheres.

Conventional Approach to Monitoring Oxygen

Most oxygen sensors used to monitor glove box atmospheres have a relatively short life span of several months. The reason is simple. They operate on a battery principle wherein life expectancy is a function of usage. Furthermore, as these sensors age, they have a tendency to read low due to a loss in sensitivity. For most glove box monitoring applications, false low oxygen readings can produce dire consequences. As a result, analyzers that use battery-type sensors must be recalibrated on a frequent basis, as often as once per day depending on the critical nature of the application. Another major drawback of battery-type sensors, particularly when used for trace oxygen measurements, is their susceptibility to "oxygen shock". If exposed to large concentration of oxygen, these sensors can take several hours to recover. One manufacturer of battery-type oxygen sensors suggests their analyzers be "purged overnight" with a inert gas if accurate readings under 10 PPM are required! The combination of false low readings, frequent recalibrations and slow speed of response has prompted glove box users to look for a better solution.

The Delta F Difference

Delta F has solved the problems associated with battery-type sensors with its unique non-depleting electrochemical sensor. Unlike battery-type sensors, the Delta F Sensor **does not require periodic replacement** and does not produce false low readings due to loss of measurement sensitivity. The sensors operate on simple Coulometric process whereby oxygen in the sample gas is reduced in an electrochemical cell. Sample gas diffuses through Delta F's exclusive Bi-Strata™ diffusion barrier to the cathode which is in contact with the electrolyte solution. Oxygen is reduced at this electrode to hydroxyl ions. Assisted by the potassium hydroxide electrolyte, the ions migrate to the anode, where they are oxidized back to oxygen. Whereas conventional electrochemical sensors use a consumable electrode as the driving mechanism for the reaction, an external EMF of 1.3VDC drives the reaction in the Delta F sensor. The sensor electrodes are non-depleting. Therefore, neither electrode undergoes chemical changes as oxygen is being measured. As a result, much better measurement stability is achieved and periodic sensor replacement is eliminated.

All Delta F Sensors Have A Five Year Warranty.

Measurements in Minutes

Delta F's Trace Oxygen Analyzers have gained an unparalleled reputation for ability to measure trace levels of oxygen within **minutes** after start-up. This feature has proven to be invaluable to users who can't afford to wait hours to determine the suitability of their glove box to sustain process conditions. When equipped with optional NICAD batteries and sample pump, Delta F's Oxygen Analyzers can be used for virtually any portable or fixed monitoring application.

Comparison of DELTA F's Oxygen Analyzers vs. Battery-Type Oxygen Analyzers

<u>ITEM</u>	<u>DELTA F ANALYZERS</u>	<u>BATTERY-TYPE SENSORS</u>
Sensor Electrodes:	Non-Depleting: Neither electrode undergoes chemical change.	Depleting: The depolarizing metal anode reacts to form a metal oxide. This eventually leads to sensor replacement.
Sensor Life:	Typically the life of the instrument.	Average 6 months (Replacement sensors can cost up to several hundreds dollars.)
Sensor Warranty:	5 Years.	6 months (typically).
Initial Calibration:	All analyzers are factory calibrated.	Factory calibration is usually not provided – user must establish initial accuracy.
Field Calibration:	Recommend calibration check once every 3-4 months.	Typical frequency: once every few days depending on the critical nature of the application.
Susceptibility of trace analyzers to "oxygen shock":	None – readings to under 10 PPM from air can be made within minutes.	Yes – exposure to high O ₂ concentrations will shock sensor requiring several hours to establish equilibrium conditions. In some cases, manufacturers recommend "overnight purging" of the analyzer to measure under 10 PPM accurately.
Gas Compatibility:	Optional Stab-EI™ Electrolyte System allows continuous operation with samples	These sensors typically cannot tolerate acid gases. Gas scrubbers are

containing acid gases such as H₂S, CO₂,
C1₂, HC1, SO₂, NO_x, etc. recommended.

Recognized For Quality

Delta F's Quality Management Systems has been certified to ISO-9001 by Lloyd's Register Quality Assurance Ltd. This demonstrated compliance with an internationally accepted standard assures you of the highest quality in product design, manufacturing, and service.

Delta F Oxygen Analyzers can be ordered with a full scale range of 0-2 parts per billion (ppb) to as high as 0-25 percent. For specific product recommendations, contact Delta F Corporation, 4 Constitution Way, Woburn, MA 01801-1087, Tel. (781)935-4600, FAX (781)938-0531, e-mail marketing@delta-f.com.

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