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EXPERT PAPER

The next-generation digital oxygen and moisture analyzer for industrial gas applications

Designed specifically to measure oxygen (O_2) in a variety of industrial gas processes, the SERVOPRO MonoExact DF310E is built around the latest innovations in software and hardware, delivering a range of performance and cost-of-ownership benefits.
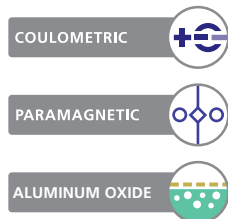
Author: Douglas Barth, Senior Global Product Manager, Servomex

MEASURES:
- Oxygen and Moisture

SENSING TECHNOLOGY

COULOMETRIC

PARAMAGNETIC

ALUMINUM OXIDE

AN ADVANCED INDUSTRIAL ANALYZER PLATFORM

The MonoExact DF310E O_2 analyzer is designed for industrial and package gas customers who need accurate process control and product qualification measurements.

Built around Servomex's advanced user interface, it offers a choice between Coulometric sensing, for part-per-million (ppm) measurements, and Paramagnetic sensing, for percentage readings.

It also offers plug-and-play capability to operate the AquaXact aluminum oxide (Al_2O_3) probe for a dual measurement of O_2 and moisture.

Both O_2 sensor types are non-depleting, lowering maintenance requirements and removing the cost of cell

replacement. They also meet US and European Pharmacopeia compliances. The Coulometric sensor's reliability is underlined by Servomex's best-in-class five-year sensor warranty.

To ensure easy integration, the analyzer offers comprehensive analog and digital communications compatibility:

- 4-20mA
- RS232
- RS485
- Ethernet
- Modbus TCP/IP
- Profibus

Intuitive ease of use is built in to the MonoExact DF310E. A high-brightness

color touchscreen display makes it simple to set up and adjust control parameters, while icon-driven Servomex software delivers a smooth user journey. When connected to an optional moisture sensor, the screen is designed to simultaneously display both oxygen and moisture measurements.

The MonoExact DF310E is backward-compatible with SERVOPRO DF-310E installations, with a backplate design that makes it easy to swap the older device out for a new one. It also means that training requirements are minimized, re-testing and re-qualification problems are avoided, and global supply agreements continue to be met.

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SEAMLESS INTEGRATION WITH OUR MOISTURE SENSOR

The MonoExact DF310E is designed specifically to work with Servomex's AquaXact 1688 moisture transmitter, providing touchscreen control and access to alarms, relays and advanced communications protocols.

It ensures powerful software control for the AquaXact 1688 and allows easy sensor tip replacement, with calibration data loaded into the transmitter via the MonoExact DF310E.

This removes the need to return Al_2O_3 probes for factory calibrations. The headache of logistics, customs paperwork and maintaining additional stock for a revolving door exchange strategy is gone, thereby lowering the cost of ownership for the moisture sensor.

H_2O

Servomex's AquaXact 1688

PERFORMANCE:

Gas measured	O_2 trace (ppm)				O_2 control (%)
Sensor technology	Coulometric				Paramagnetic
Range	High resolution 0-100, 0-100, 0-1,000, 0-10,000ppm				0-25%
Intrinsic error (accuracy)	**High resolution 0-100ppm**	**0-100ppm**	**0-1,000ppm**	**0-10,000ppm**	±0.1% O_2
	±3% of reading or ±10ppb, whichever is larger	±3% of reading or ±50ppb, whichever is larger	±3% of reading or ±250ppb, whichever is larger	±3% of reading or ±2.5ppm, whichever is larger	
T90	<20 seconds at 0.75 liters/min				<10 seconds at 0.2 liters/min
Zero drift/month	Negligible				±0.05% O_2 per week
LDL	3ppb	50ppb	250ppb	2.5ppm	±0.1%

COULOMETRIC OXYGEN SENSING

Servomex Coulometric sensors are industry-proven, and have been the technology of choice for monitoring high-purity gases, delivering trace and ultra-trace O_2 measurements, for 40 years.

They do not need periodic replacement, nor do they produce the false low readings associated with traditional fuel cell sensors, and can handle both flammable and non-flammable samples.

While Paramagnetic and Zirconia solutions are highly effective for percentage O_2 measurements, an electrochemical sensor is required to reach the extremely low detection limits demanded by electronics-grade gas quality control.

Servomex's sensor for the MonoExact DF310E works on a simple Coulometric process – O_2 in the sample gas is reduced through direct contact with the sensor cathode where an electrochemical reaction converts them to hydroxyl ions (OH-).

The electrolyte solution surrounding the sensor cathode and anode is potassium hydroxide (KOH), which assists in the migration of OH- to the high-purity, non-carbon anode where the ions are oxidized completing the reaction.

The reduction-oxidation reaction is driven by a small DC voltage of applied through the sensor electrodes. The current flow that results from the redox reaction is proportional to the O_2 concentration in the sample gas. This provides a direct O_2 measurement, eliminating the errors that inevitably result from indirect measurement technologies.

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The analyzer then displays the O_2 content in parts per million (ppm) to the lowest Lower Detection Limit (LDL) of 3 parts per billion (ppb) with the 0-100 high resolution sensor.

When a traditional micro-fuel cell or galvanic sensor cell experiences a high concentration, it depletes the cell's capacitance. This loss of capacitance reduces the cell's accuracy over the life of the cell, causing drift.

When these events occur, accurately predicting the failure date of the cell

is impossible. Such events require unscheduled recalibrations – which disrupt operations – or a complete sensor replacement, delaying product qualifications up to a full day, because it exposes the entire sample system to atmospheric O_2. Revenue is lost and possible recall of product may occur if any contamination is passed to a customer.

The electrolyte in Servomex's Coulometric cell can be topped up with RSA for continued use, allowing a Servomex Coulometric sensor to

generally last between 5-10 years, much longer than the six months typical of a micro-fuel cell or galvanic sensor cell.

Coulometric sensing from Servomex provides a highly sensitive and accurate O_2 measurement with negligible drift. An operator can manage the process with better monitoring that is predictable and reliable, only using minutes weekly to perform a span calibration and once-a-month top-up of the electrolyte with RSA solution.

PARAMAGNETIC OXYGEN SENSING

Paramagnetic sensing technology is highly specific to O_2, delivering high levels of accuracy and a fast response to changing O_2 concentrations.

Paramagnetic cells each consist of two nitrogen-filled glass spheres, mounted on a thin wire suspension within a strong magnetic field. Light shines on a mirror, centrally located on the suspension, and is reflected onto a pair of photocells.

Because O_2 is naturally Paramagnetic, it is attracted to the magnetic field,

and so displaces the glass spheres, causing the suspension to deflect. This deflection is detected by the photocells which generate a signal to a feedback system. This, in turn, sends a current through the thin wire suspension, creating a motor effect which restores the position of the suspension.

The restoring current produced is directly proportional to the concentration of O_2 within the gas mixture, allowing an accurate and inherently linear

percentage measurement of O_2 gas concentration to be made.

As this technology is non-depleting and requires no reference gas, Paramagnetic cells supplied with a clean dry non-condensing and non-flammable sample gas never need replacement, and the performance does not deteriorate over time, giving significant benefits to ongoing maintenance costs and sensor lifespan.

KEY APPLICATIONS

- Nitrogen production
- Argon production
- Hydrogen production
- Tanker transfill applications
- Specialty gas blending
- Electronic gas verification

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