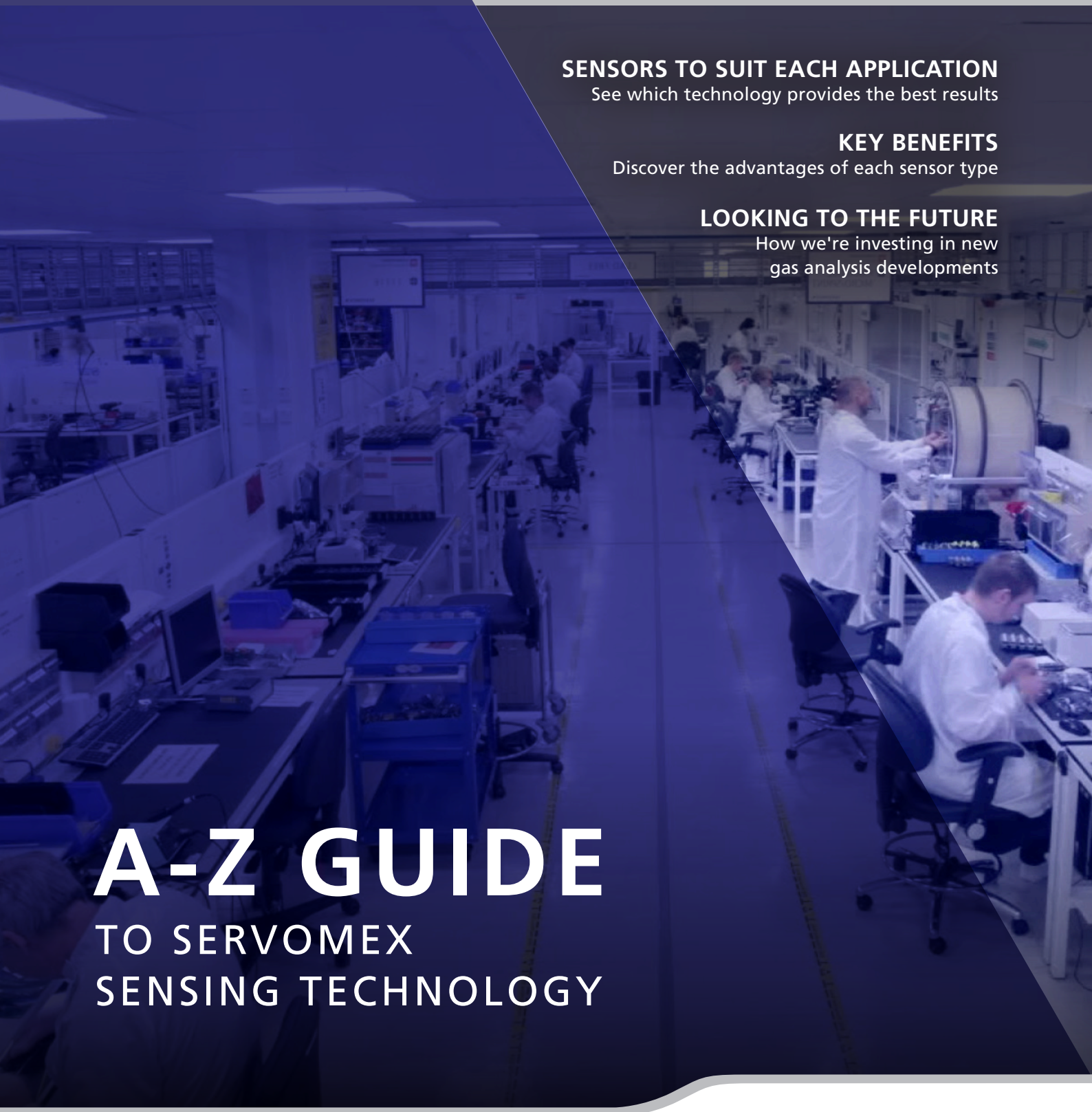
ES

EXPERT SOLUTIONS

SENSING TECHNOLOGY

ISSUE: 26

THE GAS ANALYSIS MAGAZINE



SENSORS TO SUIT EACH APPLICATION
See which technology provides the best results

KEY BENEFITS
Discover the advantages of each sensor type

LOOKING TO THE FUTURE
How we're investing in new gas analysis developments

A-Z GUIDE
TO SERVOMEX SENSING TECHNOLOGY

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a spectris company

YOUR A-Z SENSOR GUIDE

Welcome to the latest issue of Expert Solutions magazine, which focuses on our sensor technologies for a range of gas analysis applications.

These sensors, manufactured in our cutting-edge technical facilities in the UK and USA, are key to the highly accurate and reliable measurements provided by our comprehensive range of gas analyzers.

The variety of sensors to which Servomex has access is one of our major advantages as a supplier of gas analysis solutions. Instead of choosing from just two or three sensing technologies to resolve an application challenge, we can apply the most accurate and cost-effective solution from our entire range.

This issue provides a complete guide to our sensing technologies, from Aluminum Oxide to Zirconia. We also take a look at how we're investing in developing the technologies that may well end up joining our range in the future.

Find the best sensor solution for your process, get in touch at: **servomex.com/contact-us**

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MOISTURE AND DEW POINT ANALYSIS

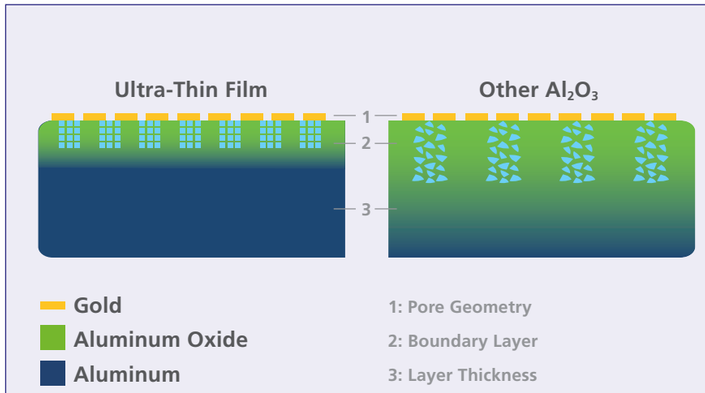
Aluminum Oxide (Al_2O_3) sensors work by measuring the capacitance between the aluminum core and a gold film deposited on the oxide layer. The capacitance varies according to the water vapor content in the pores of the oxide layer.

Servomex's ultra-thin Al_2O_3 sensors have three innovative structural improvements that offer better performance than traditional Al_2O_3 sensors, with advantages for sensitivity and stability.

1. A much thinner oxide layer
This results in higher capacitance, since this is inversely proportional to the distance of the capacitor's plates from each other. Higher capacitance results in a more sensitive measurement. The thinner layer also allows water molecules to travel in and out of the pores more quickly, ensuring a faster response.

2. A better-defined barrier layer
The sharply defined barrier means that the sensor's wet to dry capacitance ratio is very high, reducing the effects of any drift due to undesirable factors. It also reduces metal migration, one of the major causes of drift in conventional Al_2O_3 sensors.

3. Unique pore geometry
Holding more water than conventional sensors, the ordered pore geometry increases the change in capacitance for a given change in dew point. This means greater accuracy and a quicker response. It is also more stable, so only annual calibration checks are needed when the sensor is used in clean, non-corrosive gases.



Aluminum Oxide sensor structure

KEY APPLICATIONS

- Air separation units
- Medical gases
- Semiconductors

KEY BENEFITS

✓ Fast response
✓ Highly accurate
✓ Free of drift

IDEAL FOR

Dew point and parts-per-million moisture measurements in a wide range of industrial gas applications.

WORKS WITH:

Paramagnetic and Coulometric sensors for a dual measurement of oxygen and moisture.

LIMITATIONS:

Aluminum Oxide sensing does not reach the ultra-trace levels of detection required for all UHP gases. Laser Moisture technology is often a better fit for this application.

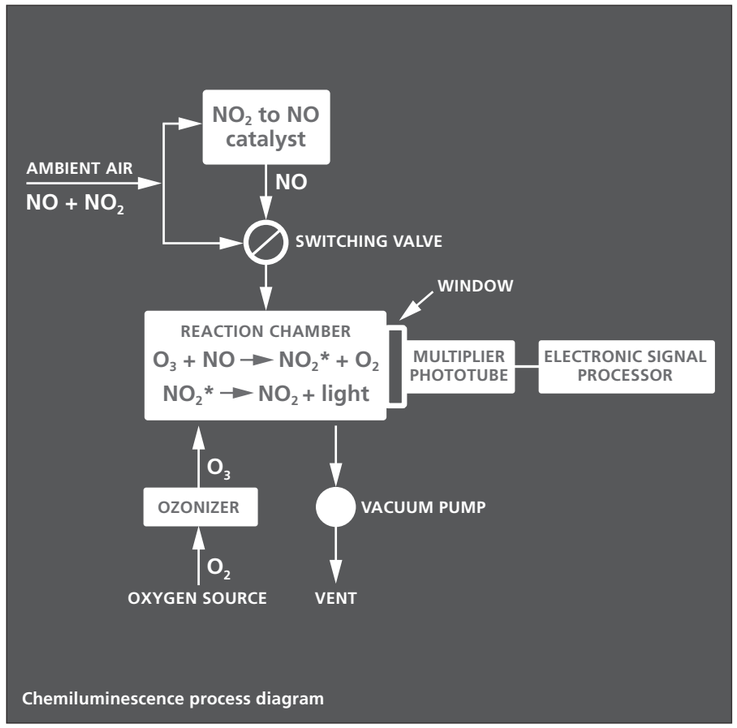
USED IN:

SERVOMEX AquaXact 1688

LIGHT-BASED MEASUREMENTS FOR NOX ANALYSIS

Chemiluminescence detectors take advantage of nitric oxide (NO) and nitrogen dioxide (NO_2) chemical reactions that emit light as part of that process. This is different from fluorescence or phosphorescence, in that the light produced stems from a chemical reaction rather than by the absorption of photons by the molecule. Our Chemiluminescence analyzers use a thermally stabilized photodiode to measure the intensity of the light produced by the reaction of NO with ozone (O_3). The intensity is directly proportional to the concentration of NO that was converted to NO_2 by the reaction.

By converting the NO_2 in the gas stream to NO, then reacting it with the O_3, the total NOx value can be calculated, allowing speciation of NO, NO_2 and total NOx with a single analyzer.



Chemiluminescence process diagram

KEY APPLICATIONS

- Vehicle emissions testing
- Continuous emissions monitoring (CEM)
- Combustion efficiency

KEY BENEFITS

✓ Excellent trace analysis results
✓ Rapid response time
✓ Non-depleting technology keeps cost of ownership low

IDEAL FOR

Rapid-response applications such as vehicle and engine emissions certification testing, CEM, combustion efficiency, and process gas monitoring.

WORKS WITH:

Gfx, Infrared, Paramagnetic and Flame Ionization Detector sensing technologies for a comprehensive CEM solution.

LIMITATIONS:

If the sample gas pressure varies, the amount of light emitted will be affected even if the NOx concentration remains stable. Pressure control of the sample gas is essential for accurate measurement.

USED IN:

SERVOPRO NOx

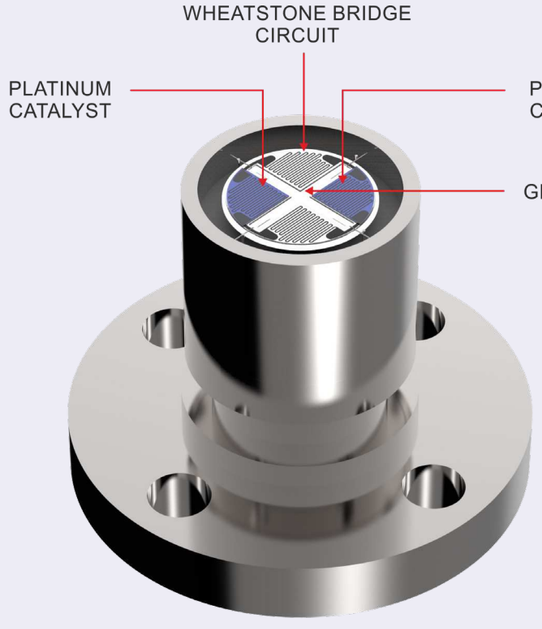
ACCURATE COMBUSTIBLES MEASUREMENTS

The sensor measures carbon monoxide (CO) from its exothermic reaction with oxygen (O_2) over a catalytic platinum surface, which produces carbon dioxide (CO_2) and the heat generated is used to determine the CO concentration.

A four quadrant bridge track is over-glazed to shield the circuit from the sample gas and two quadrants are then coated in platinum catalyst. These quadrants form a Wheatstone bridge circuit, with the disc mounted in a cell heated to 300°C (572°F) or 400°C (752°F).

When the gas sample is added, any CO present in the sample will combust on the catalyst, which will heat the respective quadrant and alter the Wheatstone bridge output voltage.

The output delivered will be directly proportional to the CO gas concentration, providing an accurate measurement.



Wheatstone Bridge

KEY APPLICATIONS

- Process heaters
- Thermal crackers
- Incinerators

KEY BENEFITS

- ✓ Highly sensitive
- ✓ Accurate and stable at low concentrations
- ✓ Reduced ongoing maintenance

IDEAL FOR

Highly sensitive, accurate and stable measurements of CO at low concentrations in combustion applications.

WORKS WITH:

Zirconia oxygen sensing for an all-in-one combustion control solution.

LIMITATIONS:

High levels of sulfur emissions may degrade the catalyst. A sulfur-resistant sensor with scrubber module may be required. Potential cross sensitivity to other combustible gases.

USED IN:

SERVOTOUGH FluegasExact 2700

HIGH-SENSITIVITY MEASUREMENTS OF OXYGEN

Our Coulometric technology enables the measurement of oxygen (O_2) at percent or parts-per-million (ppm) levels. It is non-depleting, so there is no requirement for periodic cell replacement and it avoids the false low readings associated with standard electrochemical sensors.

It operates through a simple Coulometric process where O_2 from the sample gas is reduced to hydroxyl ions at the sensor cathode. The resulting current flow is proportional to the O_2 content in the gas, and the process signal can be displayed in ppm or parts-per-billion (ppb) units of O_2.

Coulometric sensors respond very quickly to changing O_2 concentrations. For instance, a 0-1,000ppm range sensor can be exposed to air and in less than a minute will measure <10ppm on pure nitrogen. This is highly beneficial for users who have upset-prone applications.

Additionally, the performance of the sensor is unaffected by reasonable changes in flow rate. Because the non-depleting sensor is not consumed when exposed to O_2, it has a long lifespan and does not require a purge gas to protect it when not in use.

Hummingbird Coulometric sensor

WORKS WITH:

Laser Moisture sensing for a highly sensitive dual measurement of oxygen and moisture at ppm levels.

LIMITATIONS:

Coulometric sensors cannot be used with gases containing alcohols, aldehydes and solvents. For applications involving these gases, a Paramagnetic or TDL sensor is recommended instead.

KEY APPLICATIONS

- Semiconductors
- Solder reflow ovens
- Reactor process control

KEY BENEFITS

- ✓ Industry-leading lower detection limits
- ✓ Fast response and rapid recovery
- ✓ Non-depleting sensor – long lifespan

IDEAL FOR

Sensitive, parts-per-million measurements of O_2, for example in impurity monitoring for UHP semiconductor gases.

USED IN:

- SERVOPRO DF-500 RANGE
- SERVOPRO DF-560 ULTRA
- SERVOPRO DF-760E
- SERVOPRO DF-760E ULTRA
- SERVOPRO MonoExact DF150E
- SERVOPRO MonoExact DF310E
- SERVOTOUGH DF-140E
- SERVOTOUGH DF-320E
- SERVOTOUGH DF-340E

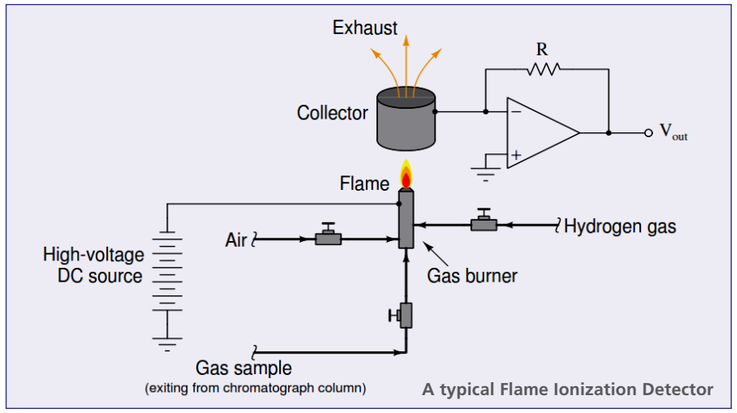
MEASURING HYDROCARBONS DOWN TO ULTRA-TRACE LEVELS

Flame Ionization Detector (FID) sensors are designed to measure flammable Total Hydrocarbons (THC) down to parts-per-billion (ppb) levels.

They work by detecting ions formed in the combustion of organic compounds in a sample, producing charged molecules that cause electrical conduction between two electrodes.

The ions are attracted to a collector plate and induce a current upon hitting the plate. The FID measures this conduction and produces an output which is directly proportional to the concentration of THC in the sample.

This signal is then enhanced by a logarithmic amplifier that reduces drift and thermal noise, delivering an accurate, non-depleting measurement with 100ppb resolution.



A typical Flame Ionization Detector

KEY APPLICATIONS

- Air separation units
- Product pipelines
- Cylinder filling stations

KEY BENEFITS

- ✓ Decreased drift and thermal noise
- ✓ Accurate, non-depleting measurement
- ✓ Resolution of 100ppb

IDEAL FOR

Industrial processes where THC contamination is possible, such as air separation units, product pipelines, and cylinder filling stations.

WORKS WITH:

Gas Chromatography techniques to provide trace gas measurements for a wide range of applications.

LIMITATIONS:

Some carbon-containing compounds, and a number of gases of common industrial interest, fail to significantly ionize in a flame and so are either undetectable or may not be effectively measured by the FID.

USED IN:

SERVOPRO FID

SERVOPRO Chroma

SERVOPRO HFID

HIGH-PURITY ANALYSIS FOR A RANGE OF GASES

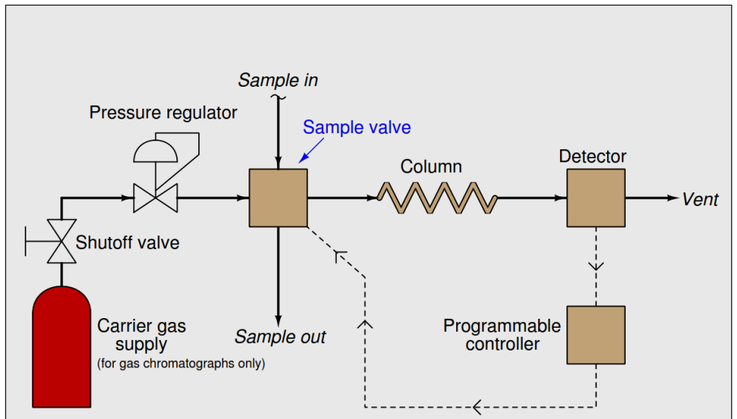
Gas Chromatography (GC) separates out a mixture in the gas phase to determine the presence and concentration of constituent components. Under optimized conditions, it can measure down to parts-per-billion (ppb) levels, making it ideal for high purity control processes.

The components of a mixture in the gas phase are separated by introducing a small portion of the sample into a flowing carrier gas (mobile phase), which percolates through a stationary phase consisting of particulates packed within a column. The different gas constituents are separated due their own specific, adsorptive interaction between the stationary phase and the mobile phase. This causes the constituents to exit the column (elute) at different times.

These specific times are detected at the exit of the column.

By comparing times, users can identify analytes by the order in which they exit from the column. Each constituent concentration is determined, after calibration, from the integral of each analyte's detector response over time.

The conditions under which GC technology operates differ for each application and require individual optimizations.



The Gas Chromatography technique

KEY APPLICATIONS

- Semiconductors
- Medical gases
- Air separation units

KEY BENEFITS

- ✓ Measures multiple components down to ppb levels
- ✓ Highly reliable results
- ✓ Works for a wide range of background gases

IDEAL FOR

High-purity processes that require accurate gas detection down to ppb levels, including electronic and medical gases, plus cryogenic air separation processes.

WORKS WITH:

Plasma, FID and TCD technologies in the Chroma and NanoChrome

LIMITATIONS:

GC analyzers do not deliver real-time measurements, so are unsuited to applications where rapidly changing gas concentrations must be monitored.

USED IN:

SERVOPRO Chroma

SERVOPRO NanoChrome

SERVOPRO NanoChrome ULTRA

STABLE, ULTRA-ACCURATE PHOTOMETRIC GAS ANALYSIS

Gas Filter Correlation (Gfx) sensing is an enhanced version of the photometric analysis used in our Infrared technologies. It performs effectively where extremely accurate, low-level measurements are needed, or where background gases may interfere with the measurement.

Gases have the ability to absorb unique light wavelengths – Gfx sensing uses that property to detect the concentration of a selected gas in a mixture. Two gas-filled cuvettes are mounted on a rotating disk, each passing through a beam of light alternately.

One cuvette (the measure cuvette) is typically filled with nitrogen while the other cuvette (the reference cuvette) is filled with a sample of the gas to be measured. Light is passed through the gas to be measured: the difference in absorbance is measured and provides a direct output of the gas concentration.

Offering real-time measurement response, Gfx measurements are unaffected by background gases, and the technique is virtually immune to obscuration of the optics. This prevents sensor drift, reducing calibration frequency.

The Gfx Transducer

KEY APPLICATIONS

- Continuous emissions monitoring
- Ethylene, chlorine and TDI production processes
- HyCO process control

KEY BENEFITS

- ✓ Low cross interface by background gases
- ✓ Immune to obscuration of the optics
- ✓ Low sensor drift, reducing calibration frequency

IDEAL FOR

Providing a lower-cost alternative to more complex technologies when dealing with applications that require the measurement of low-level gases with high levels of interfering background gases.

WORKS WITH:

Single-beam, single-wave Infrared sensing to provide real-time process analysis for a range of industrial applications.

LIMITATIONS:

Only gases with infrared lines can be measured by this technology, so it is not suitable for noble gases, or single element diatomic molecules such as N_2 or O_2.

USED IN:

- SERVOPRO MultiExact 4100
- SERVOPRO 4900 Multigas
- SERVOPRO MultiExact 4200
- SERVOTOUGH SpectraExact 2500

REAL-TIME MEASUREMENTS OF GASES IN A MIXTURE

Our Infrared (IR) sensors focus an IR light source through a sample cell holding a continuously flowing sample of the gas mixture, and onto a detector after wavelength selection. The property of some gases to absorb unique light wavelengths can be used to detect the concentration of a selected gas in a mixture.

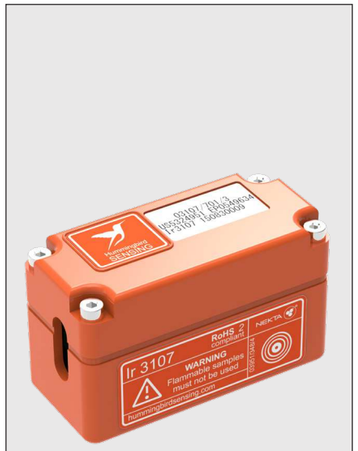
Depending on the intended application, this concept can be applied in two ways:

Single Beam, Single Wavelength (SBSW)

delivers fast, stable and accurate real-time measurements with low maintenance requirements. It is used where a small transducer is required – the IR light source is electronically modulated, removing the need for a motor and rotating filters.

Single Beam, Dual Wavelength (SBDW)

uses a pair of optical filters mounted on a rotating disc, which pass through a beam of IR light alternately. One filter (the measure filter) is chosen to pass light only at a wavelength that the gas to be measured absorbs, while the other filter (the reference filter) has a light passed through it at a wavelength unaffected by the gas to be measured. The difference in absorbance is measured by the detector and provides a direct output of the gas concentration.



Hummingbird Ir3107 sensor

WORKS WITH:

Paramagnetic sensing for dual measurements of oxygen and carbon dioxide in our portable analyzers.

LIMITATIONS:

Infrared sensing cannot be used to detect gases that do not absorb infrared energy, for example hydrogen. In addition, for some applications, there may be more cost-effective solutions available.

USED IN:

- SERVOPRO MultiExact 4100
- SERVOPRO 4900 Multigas
- SERVOPRO MultiExact 4200
- SERVOTOUGH SpectraExact 2500
- SERVOFLEX MiniMP 5200
- SERVOFLEX MiniHD 5200
- SERVOFLEX MiniFoodPack 5200

KEY APPLICATIONS

- Ethylene, chlorine and TDI production
- Continuous emissions monitoring
- ASU process control

KEY BENEFITS

- ✓ Real-time measurement response
- ✓ Low maintenance requirements

IDEAL FOR

Real-time, non-contact measurement applications, particularly where contamination might be an issue for other technologies.

SERVOMEX – INVESTING IN RESEARCH

Servomex has a rich history of fundamental research into gas measurement principles. We have been awarded many patents in this field, and were awarded the Queen's Award for Enterprise (Innovation) in 2016.

Some of the patents awarded include innovations in Paramagnetic sensing, solid electrolyte (Zirconia), infrared source techniques, thick film sensing technologies, signal processing, and Tunable Diode Laser (TDL) absorption measurements.

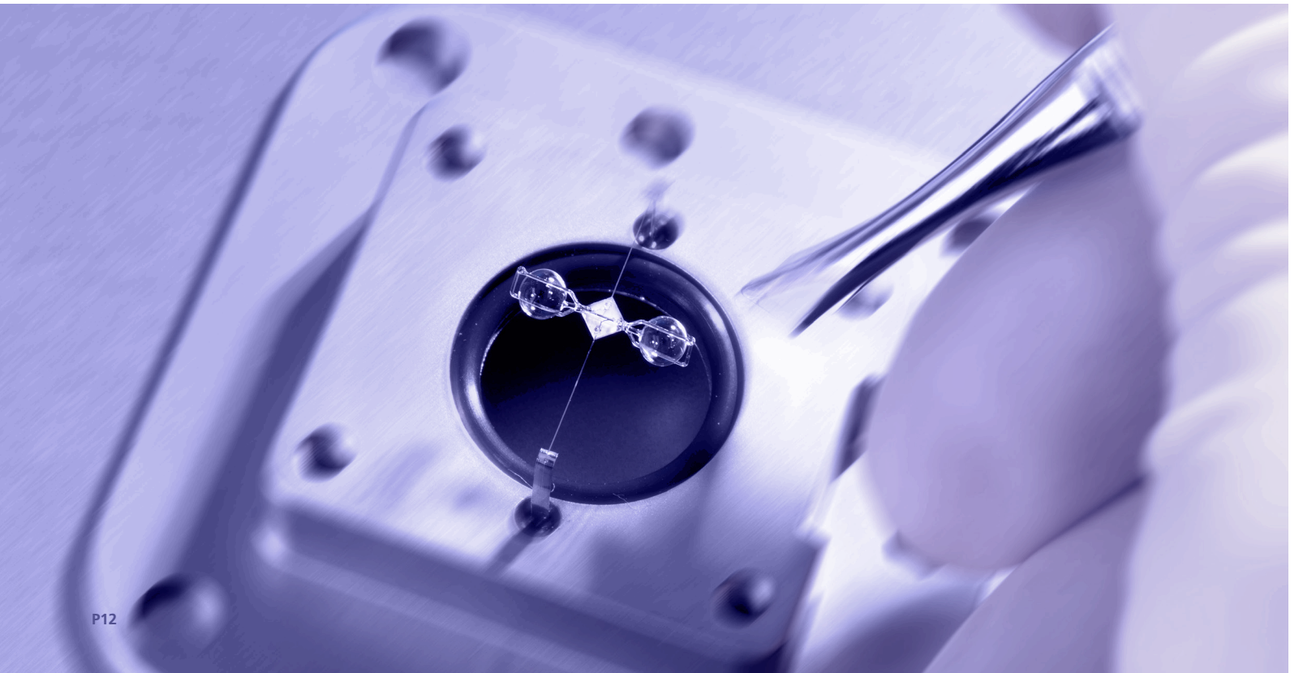
These innovations have had a direct benefit to many customers in a wide variety of applications, including process control and safety improvements in the chemical industry, and patient monitoring and life support in the medical device industry.

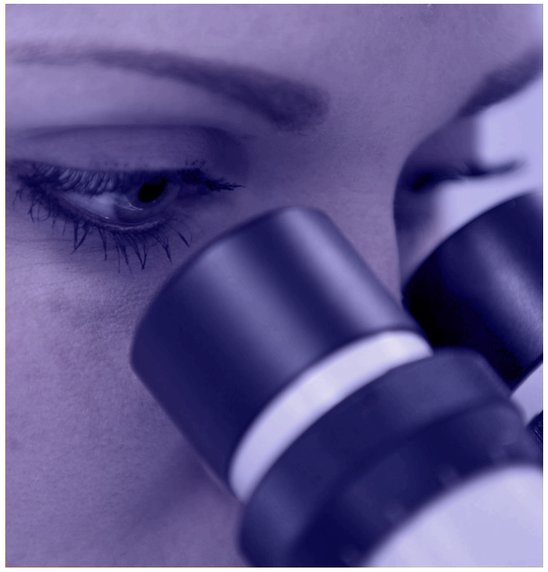
We continue to invest significantly in research, employing a diverse mix of industry-leading scientists and engineers. Our current patent portfolio covers filings across 19 innovations, seven technology types and seven countries.

We also have two patents pending across two different technology types, with more filings scheduled across the next 24 months.

The research function also forms a key part of our Hummingbird business unit, bringing research much closer to the end users and markets. This improves the flow of “voice of the customer” data into our research schedule.

Hummingbird
SENSING TECHNOLOGY





SIMPLE, SENSITIVE MOISTURE ANALYSIS

This moisture analysis technology uses Tunable Diode Laser (TDL) spectroscopy to measure trace moisture in pure gases. It has a simple, robust design, using a single laser source and single detector to measure the sample and reference gases.

TDL has advantages over other measurement techniques, as the moisture sample comes into contact with only a few optical components made from very robust materials. It works according to the fundamental principle of Beer's law; therefore the reading is stable over time and never requires calibration.

To provide a more sensitive measurement, our sensors use a Herriott cell to reflect the laser back and forth numerous times, using mirrors inside the measuring cell. This increases the laser path length, achieving extremely high sensitivity.

TDL moisture sensing delivers exceptional performance capable of measuring down to industry-leading sub-ppb levels, drift-free operation, high accuracy and low maintenance. This is achieved through self-correcting optics and laser line locking onto the water peak, removing all possibility of significant drift.

Semiconductor manufacture relies on ultra-high-purity gases

KEY APPLICATIONS

- Semiconductors
- Ultra-high purity gases
- Specialty gases

KEY BENEFITS

✓ Exceptional performance down to industry-leading sub-ppb levels

✓ Reading is stable over time – never requires calibration

✓ Laser line lock removes possibility of significant drift

IDEAL FOR

Very low-level trace measurements of moisture as a contaminant in ultra-high purity gases.

WORKS WITH:

Coulometric sensing for a highly sensitive dual measurement of oxygen and moisture at parts per million levels.

LIMITATIONS:

While Laser Moisture sensing offers the best low-level detection of moisture, it may be more cost-effective to use Aluminum Oxide sensing where ultra-low measurements are not required.

USED IN:

- SERVOPRO DF-700 Range

- SERVOPRO DF-750 ULTRA

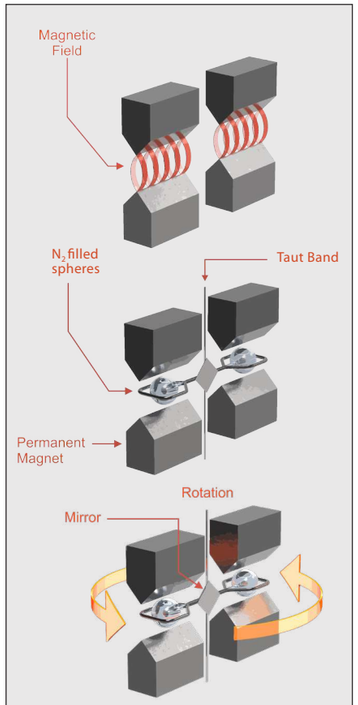
- SERVOPRO DF-760E ULTRA

AN INNOVATIVE SOLUTION FOR PERCENTAGE OXYGEN

Our groundbreaking magnetodynamic Paramagnetic technology provides fast, accurate and sensitive measurements of percentage levels of Oxygen (O_2). The Paramagnetic cell consists of two nitrogen-filled glass spheres, mounted within a magnetic field, on a rotating suspension, with a centrally-placed mirror. Light shines on the mirror and is reflected onto a pair of photocells.

O_2 is naturally Paramagnetic, so is attracted to the magnetic field, displacing the glass spheres and causing suspension rotation which is detected by the photocells. Current is applied through a feedback coil present in the magnetic field to provide sufficient torque to return the suspension to its original position. The magnitude of this current is directly proportional to the O_2 present in the sample gas mixture.

Unlike electrochemical sensing technologies, a Paramagnetic cell never needs changing and its performance never deteriorates over time, reducing ongoing maintenance requirements and delivering a long operational life.



Inside a Paramagnetic cell

WORKS WITH:

Infrared sensing for dual measurements of O_2 and carbon dioxide in our portable analyzers.

LIMITATIONS:

Paramagnetic sensing can be affected by significant levels of movement and vibration. It also requires careful sample conditioning to protect the sensor and ensure an accurate measurement.

USED IN:

- SERVOTOUGH Oxy 1800
- SERVOTOUGH Oxy 1900
- SERVOTOUGH OxyExact 2200
- SERVOPRO MultiExact 4100
- SERVOPRO 4900 Multigas
- SERVOPRO MonoExact DF310E
- SERVOPRO MultiExact 4200
- SERVOFLEX Micro i.s 5100
- SERVOFLEX MiniMP 5200
- SERVOFLEX MiniHD 5200
- SERVOFLEX MiniFoodPack 5200
- GAS DETECTION OxyDetect

KEY APPLICATIONS

- Oxidation control reactions
- EO, PTA and EDC manufacturing
- Industrial and medical gas production
- Medical/patient monitoring

KEY BENEFITS

✓ Fast, accurate measurements specific to O_2

✓ Non-depleting, with a long operational life

IDEAL FOR

O_2 measurement in flammable or corrosive gas mixtures.

A HIGHLY SPECIFIC AND STABLE GAS MEASUREMENT

A discharge process occurs when sufficient energy is provided to ionize a gas stream. The resulting plasma consists of free electrons, ions, neutral molecules, and high-energy photons in a continuous state of ionization and recombination.

When energized by an external alternating high voltage field, gases flowing in a Dielectric Barrier Discharge (DBD) glow plasma produce intense emission spectra which relate directly to their unique molecular bonds.

The optical emission spectroscopy (OES) method combines precision optical filters and detectors to provide a highly selective gas measurement.

Our DBD plasma sensor consists of a custom quartz cell with transparent windows fitted with electrodes powered by a controlled radiofrequency (RF) electromagnetic field. Multiple OES detector assemblies surrounding the quartz cell make selective measurements of emitted spectra of multiple gas species at the same time.

This highly sensitive and selective speciation of gases enables measurement of trace parts per billion (ppb) of gases.

Each gas produces unique gas spectra

KEY APPLICATIONS
- Semiconductors
- Medical gases
- Air separation units

KEY BENEFITS
- ✓ Safer and more stable than competing technologies
- ✓ Reliable, gas-specific selectivity
- ✓ No sensor maintenance requirements

IDEAL FOR
Safe, stable trace-level analysis of hydrocarbons as impurities in Pure Gas (P-Gas) for semiconductor fabs.

WORKS WITH:
Gas Chromatography technology to deliver measurements down to ppb levels.

LIMITATIONS:
The sensitivity of the Plasma measurement means it is only suitable for trace analysis applications.

USED IN:

SERVOPRO Chroma

SERVOPRO NanoChrome

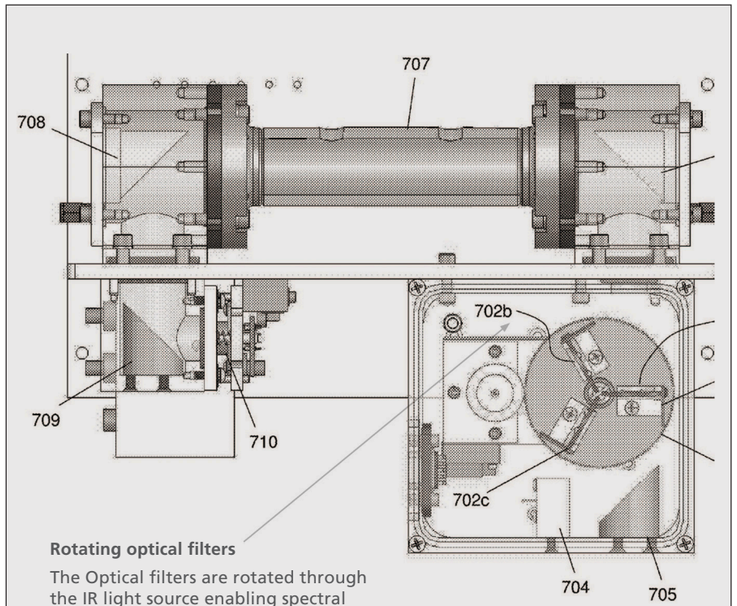
SERVOPRO Plasma

REVOLUTIONARY SENSING FOR LIGHT HYDROCARBONS

Our Spectroscopic technology combines innovative Infrared absorption spectroscopy, using advanced spectral scanning, with chemometrics.

A flow-through cell, incorporating patented spectrometer design, gives a high-quality optical measurement for a highly stable and accurate measurement. A precise separation into constituent components is then achieved using an advanced Tunable Filter Spectroscopy Analysis algorithm.

Optimized with cross-interference modeling, spectral non-linearity compensation and peak shifting compensation, this breakthrough chemometric algorithm delivers industry-leading interference compensation with a permanent span calibration, low cross-interference (<0.2%), high baseline stability and a linear response throughout the scanning range.



Rotating optical filters
The Optical filters are rotated through the IR light source enabling spectral coverage of selected areas rather than just a narrow band "point" measurement.

Tunable Filter TFS Spectrometer

KEY APPLICATIONS
- Natural gas quality and composition
- BTU/Wobbe content measurements
- LNG production and custody transfer

KEY BENEFITS
- ✓ Interference compensation for high accuracy
- ✓ Fast-response measurements for light hydrocarbons
- ✓ Low maintenance

IDEAL FOR
Real-time measurements of light hydrocarbons C1-C6 in a wide range of gas processing, transportation and storage applications.

WORKS WITH:
The H2scan hydrogen process analyzer to measure recycled and waste gases.

LIMITATIONS:
Unsuitable for hydrocarbons >C6. Limited to gases which absorb in the infrared.

USED IN:

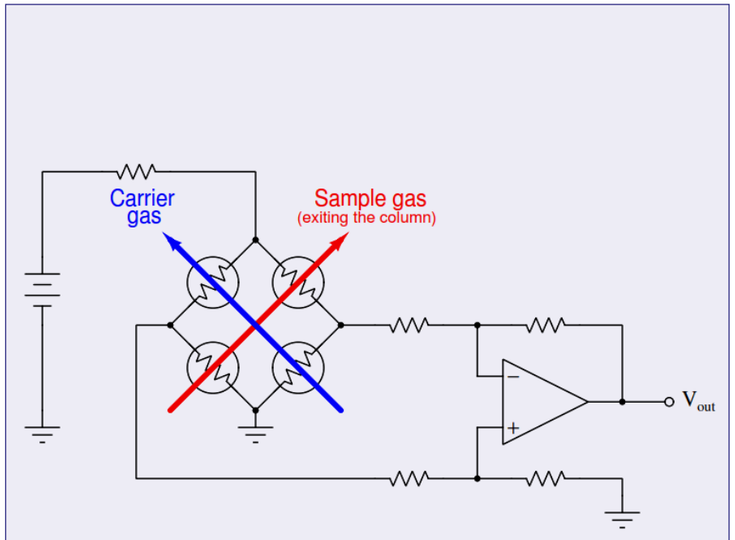
SERVOTOUGH SpectraScan 2400

MEASURING INERT GASES IN A BINARY MIXTURE

The Thermal Conductivity Detector (TCD) consists of an electrically heated Wheatstone bridge in a temperature-controlled cell. For GC-TCD applications, the carrier gas (helium) is passed over the reference arm of the bridge and the column effluent passes over the analyte arm under the same conditions for flow rate and temperature.

When no impurities are eluting from the column, the heat loss from the analyte arm matches that from the reference arm. When an analyte elutes from the column, it affects the Thermal Conductivity, changing the electrical resistance, which is measured as a signal.

Thermal Conductivity is a robust technique for determining the concentrations of gases in a binary mixture. The Thermal Conductivity detector is a universal sensor. Analytical methods involving a TCD can be used where the constituents of the binary gas are known, such as in GC-TCD.



The Thermal Conductivity sensor

KEY APPLICATIONS

- Medical gases
- Air separation units
- Specialty gases

KEY BENEFITS

- ✓ A robust method for binary mixture analysis
- ✓ Universal detector for Gas Chromatography analysis
- ✓ Measures from very low concentrations up to percentage levels

IDEAL FOR

Binary gas mixture measurements, for medical and industrial gases.

WORKS WITH:

Gas Chromatography to deliver measurements down to ppb levels for industrial and medical gases.

LIMITATIONS:

TCD sensing has a relatively low sensitivity to changes in flow rates, which requires larger sample sizes. Additionally, more cost-effective solutions may be available for some applications.

USED IN:

SERVOPRO Chroma

FAST IN-SITU CROSS-STACK MEASUREMENTS

Tunable Diode Laser (TDL) analyzers use a single-line "monochromatic" spectroscopic technique that offers highly stable calibration, a continuous, fast, in-situ measurement, and the avoidance of optical cross-interference from other gases.

The TDL system consists of a laser light source, transmitting optics, an optically accessible absorbing medium, receiving optics and detector(s). The signal information is held in the gas absorption line shape, which is obtained by scanning the laser wavelength over the specific absorption line. This causes a reduction of the measured signal intensity, which is detected by a photodiode and used to determine the gas concentration and other properties.

Our TDL analyzers use a second harmonic detection (2f) modulation technique that delivers greater accuracy, sensitivity and reliability of measurement, especially in low ppm-level measurements.

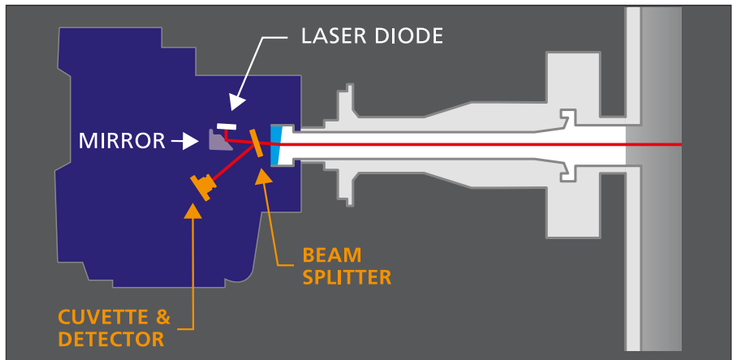


Fig. 1: Close-up of the line lock system showing the cuvette and beam splitter

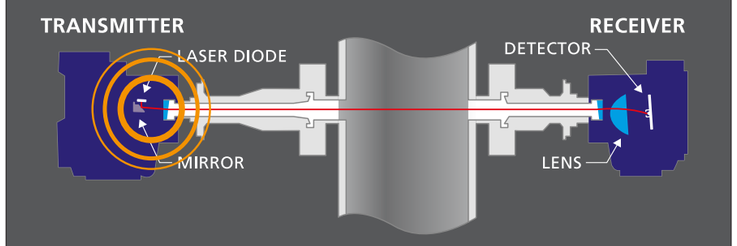


Fig. 2: The Laser 3 Plus installed across a stack, with line lock system (circled)

KEY APPLICATIONS

- Process and combustion control
- Ammonia slip DeNOx measurements
- Safety monitoring

KEY BENEFITS

- ✓ A fast response to changing gas concentrations
- ✓ Highly specific to the gas being measured
- ✓ Line lock system prevents signal drift

IDEAL FOR

Cross-stack measurements in process and combustion control applications in hydrocarbon processing and power generation industries.

WORKS WITH:

Zirconia sensors in combustion applications, providing complementary carbon monoxide and methane measurements.

LIMITATIONS:

Susceptible to a range of environmental factors that must be compensated for, including path length variation, window purge gas effects, optical interferences and temperature and pressure changes.

USED IN:

SERVOTOUGH Laser 3 Plus range

A TRUSTED AND ACCURATE OXYGEN MEASUREMENT

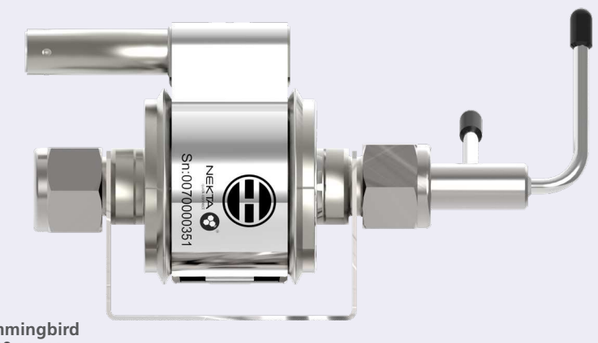
Our Zirconia sensor consists of a cell made of ceramic zirconium oxide, stabilized with an oxide of yttrium to form a lattice structure. The measure and reference sections of the cell are covered with catalytic, porous, electrically conductive coatings that serve as electrodes on both sides of the lattice barrier between sample and reference gas volumes.

At elevated temperatures, the lattice permits the passage of negatively charged oxygen ions, formed at the catalytic electrodes at a rate determined by temperature and the difference in the O_2 partial pressures of the sample gas and the reference gas.

The passage of the ions produces a voltage across the electrodes – the magnitude of this is a logarithmic function of the ratio of the O_2 partial pressures of the sample and reference gases.

Since the partial pressure of the reference gas is predetermined, the voltage produced by the cell indicates the O_2 content of the sample gas.

There are two variants of our sensor: a higher-temperature variant for percentage O_2 in flue gas, and a lower-temperature variant with modified catalytic electrode properties for parts-per-million (ppm) O_2 measurements in purity applications.



Hummingbird Zr700 sensor

KEY APPLICATIONS

- Process heaters
- Thermal crackers
- Incinerators

KEY BENEFITS

- ✓ Measures O_2 concentrations in ppm or up to 100%
- ✓ Extractive sampling equipment is not required
- ✓ Suitable for high-temperature measurements

IDEAL FOR

Measuring O_2 in in-situ combustion processes, where the measuring probe can be directly installed into the flue for high-temperature combustion gas analysis, eliminating the need for extractive sampling equipment.

WORKS WITH:

Calorimetry sensing for an all-in-one combustion control solution.

LIMITATIONS:

Measurement errors may result if the sample gas uses a flammable gas. Depending on the application, a Paramagnetic or TDL sensor may be recommended for the oxygen measurement instead.

USED IN:

SERVOTOUGH FluegasExact 2700

A RANGE OF GAS ANALYZERS TO SUPPORT YOUR PROCESS NEEDS

SERVOTOUGH HAZARDOUS AREA

Built to meet the extreme challenges of measuring gases in hot and hazardous environments, the SERVOTOUGH process and combustion analyzers integrate Servomex's exceptional analytical performance into a highly robust and resilient design.

Optimized for hazardous area use, and utilizing both extractive and in-situ analysis techniques, common gas measurements receive higher-level analysis for light hydrocarbons and combustibles; this makes SERVOTOUGH analyzers ideal for extensive use within most hydrocarbon processing applications.

Manufactured to the highest specifications using custom-designed stainless steel enclosures, SERVOTOUGH analyzers are certified to the uppermost safety standards.

SUPPORTING

- PROCESS CONTROL
- PROCESS SAFETY
- EMISSIONS MONITORING
- COMBUSTION CONTROL
- PRODUCT QUALITY

SERVOPRO SAFE AREA

The SERVOPRO range makes Servomex's reliable, stable and accurate gas measurements available to a diverse range of safe area applications.

An extensive range of non-depleting Servomex gas sensing technologies – including Paramagnetic, Zirconia, Flame Ionization Detection, Plasma and Gas Chromatography – are integrated into flexible analyzers. These either meet specific measurement requirements, such as for syngas, hydrocarbons or trace gas mixtures, or provide multi-gas monitoring capabilities for applications including ASU production and Continuous Emissions Monitoring Systems (CEMS).

Designed for benchtop use, or mounting in a 19" rack, all SERVOPRO analyzers feature extensive functionality, remote communication options and can be operated directly via intuitive onboard software.

SUPPORTING

- PROCESS CONTROL
- PROCESS SAFETY
- EMISSIONS MONITORING
- PRODUCT QUALITY

SERVOFLEX PORTABLES

With the precision sensing technology of Servomex fixed analyzers in a compact, easy to use package, SERVOFLEX analyzers deliver high performance portable gas analysis for safe or hazardous area use.

Utilizing Servomex's non-depleting Paramagnetic and Infrared sensor technology, SERVOFLEX analyzers provide stable and reliable measurements for oxygen, carbon monoxide and carbon dioxide.

Ergonomically designed for easy handling, and powered by resilient lithium-ion batteries to ensure long usage with every charge, each analyzer offers an extensive range of features that includes audible alarms, data-logging and RS232 outputs.

Certified to a range of safety requirements, Servomex's SERVOFLEX analyzers make the grade wherever they are used.

SUPPORTING

- PROCESS CONTROL
- PROCESS SAFETY
- COMBUSTION CONTROL

Discover our full analyzer range at **servomex.com**

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