

# ES

EXPERT SOLUTIONS

# GAS ANALYSIS APPLICATIONS GUIDE

ISSUE: 28

THE GAS ANALYSIS MAGAZINE

## MEETING P&S CHALLENGES

Solutions for medical, industrial and semiconductor gases

## OUR EXPERT TEAMS

Get all the application knowledge you need

## SOLUTIONS FOR IP&E PROCESSES

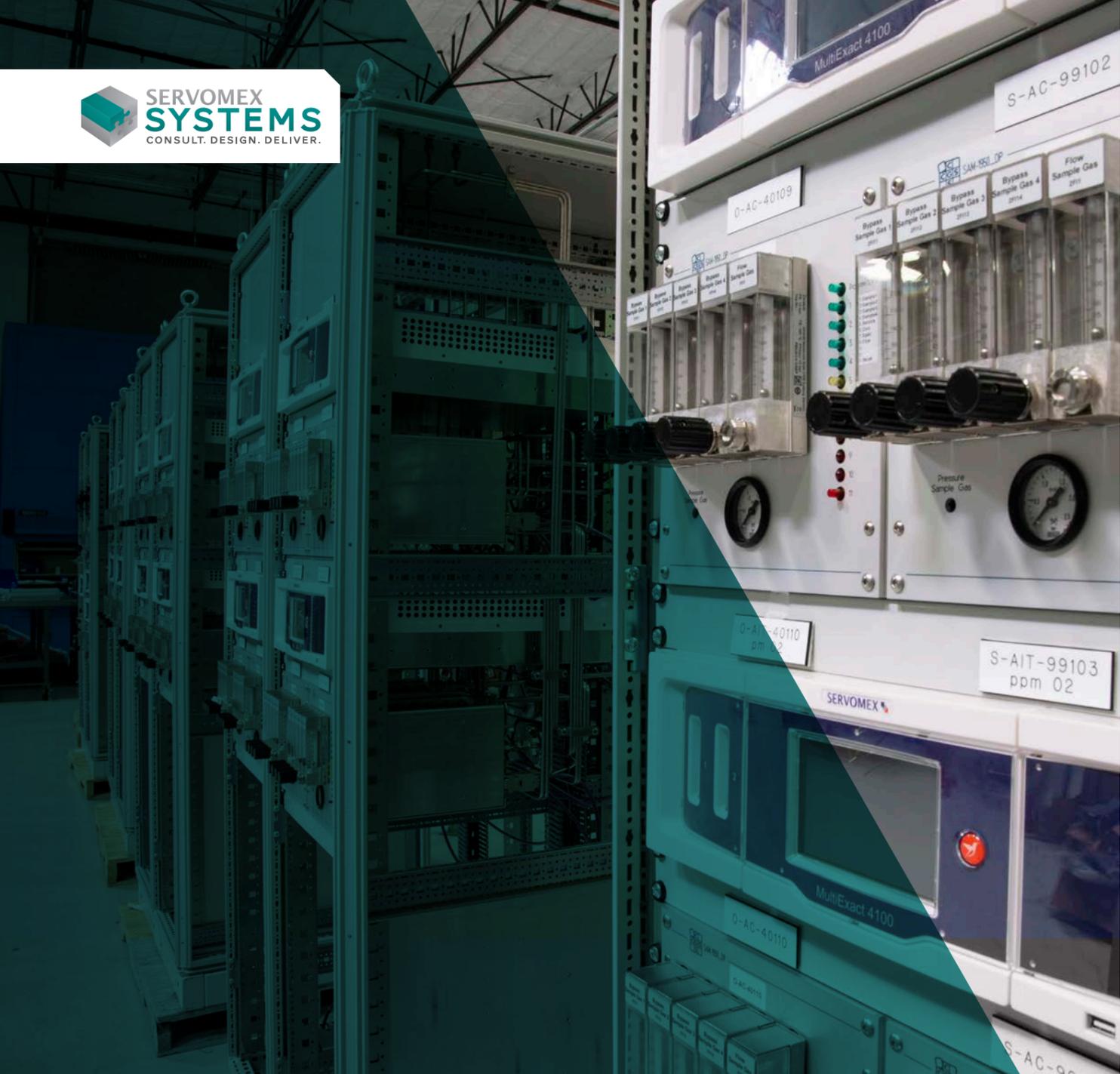
Solving challenges for power, HP and emissions



# YOUR GUIDE TO KEY APPLICATION SOLUTIONS

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**SERVOMEX**   
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# INDUSTRY-LEADING ANALYSIS

## SERVOMEX CONTINUOUS QUALITY CONTROL SYSTEMS

Our sophisticated multi-gas analysis system provides trace measurements for industrial gas applications. Available as a standard system, or configured to your specifications.

Learn more: [servomex.com/systems](http://servomex.com/systems)

## COMPREHENSIVE SOLUTIONS FOR YOUR GAS ANALYSIS APPLICATIONS

Welcome to the latest edition of Expert Solutions magazine, which looks at our gas analysis solutions for industrial applications.

Servomex delivers scalable gas analysis solutions for hundreds of processes in many different industrial sectors, ranging from single analyzers to turnkey application solutions in off-the-shelf and customized designs.

In this issue, we've selected just 13 of the key processes that illustrate how our gas analysis products overcome the challenges of many of the core applications encountered in industry.

To help you find the expertise you need, we've divided these applications into Industrial Process and Emissions (IP&E) – covering power generation, hydrocarbon processing, and emissions monitoring – and Purity and Specialty (P&S) – covering industrial, medical, and ultra-high-purity gases, including semiconductor processes.

We also examine a recent turnkey application solution delivered to the natural gas industry, as an example of how Servomex products are adaptable to meet application needs.

With an extensive array of sensing technologies, we are able to find best-fit solutions for your process, supported by our deep applications knowledge and global service network.

Get in touch with our experts to learn more: [servomex.com/contact](http://servomex.com/contact)

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## SPOTLIGHT ON ANALYZER HEALTH CHECKS

Maintaining the operational efficiency of your gas analyzer is often difficult and time-consuming. The Servomex health check is a thorough evaluation and review of the analyzers and sample systems in your plant, carried out by one of our expert engineers.

The check is conducted on-site and supported by a report that identifies any operational issues and recommends how to maintain the best performance of your device.

We can also provide operator training, advice on maintenance plans, and recommendations over which spares to hold in stock.

Visit: [servomex.com/healthcheck](http://servomex.com/healthcheck)

# PURITY AND SPECIALTY

Servomex's Purity & Specialty (P&S) division delivers gas analysis products, knowledge and service support to market sectors including industrial and medical gases, UHP gases, and semiconductor manufacture.

These are just three of the many applications for which we supply accurate, reliable and stable gas analysis solutions:

### COMPLETE GAS ANALYSIS FOR INDUSTRIAL GASES

We set the standard for accurate, reliable gas analysis in the industrial gas (IG) market, delivering ground-breaking technologies and solutions for unparalleled performance and reduced cost of ownership.

### HIGH-PURITY TRACE ANALYSIS FOR MEDICAL GASES

Our high-performance analyzer solutions and sensing technologies meet pharmacopeia standards for measuring medical gases. Versatile, industry-leading analysis delivers the purity monitoring you need.

### ULTRA-TRACE SOLUTIONS FOR SEMICONDUCTOR GAS APPLICATIONS

Accurate, stable gas analysis that reaches the lowest detection limits is key to producing ultra-high-purity gases for semiconductor manufacturing. We have a unique, single-supplier solution that covers every essential UHP measurement in the sector.

## MEET THE TEAM



**MIKE PROCTOR**  
P&S BUSINESS UNIT DIRECTOR

Mike leads our expert Purity and Specialty team in providing products, knowledge and service to the industrial, medical, UHP and semiconductor gas markets.



**DAN JOHNSON**  
HEAD OF PRODUCT MANAGEMENT, P&S

Responsible for ensuring Servomex is a leading supplier of gas analyzers to the industrial gas and semiconductor markets, Dan has an excellent understanding of our customers' strategic objectives.



**CHEE WEE YAP**  
ASIA SALES DIRECTOR, ASIA SITE LEADER

Based in Singapore, Chee Wee oversees our direct and channel sales teams in the region, and manages all Servomex sites and operations in Asia.

Get in touch to learn more: [servomex.com/purity-and-specialty](http://servomex.com/purity-and-specialty)

# AIR SEPARATION UNIT APPLICATIONS



Accurate gas analysis is essential for air separation unit (ASU) applications, improving process control, safety, and product quality.

The ASU separates atmospheric air into three pure gaseous elements – nitrogen, oxygen and argon. Further separation is required for

quantities of noble gases such as neon, krypton and argon. Accurate gas compositional analysis is essential to ensure purity across the air separation process.

Maintenance of product purity is essential between the separation process and product transportation

by pipeline or vehicle. This requires highly accurate trace measurements for a range of impurities to ensure that quality is maintained at the highest possible standards.

## KEY SOLUTIONS

Our broad range of analytical solutions provide continuous, reliable analysis throughout the process. Solutions including the SERVOPRO MultiExact 4100 multi-gas analyzer, AquaXact 1688 moisture sensor, and the versatile SERVOPRO Chroma provide the complete application measurements required to control the process, ensure product purity and guarantee plant safety.

SERVOPRO MultiExact 4100



AquaXact 1688



SERVOPRO Chroma



Find out more online at: [servomex.com/asu](http://servomex.com/asu)

# MEDICAL GASES



Gases used for medical treatment are regulated under the same rules as medicinal drugs. These regulations – typically covered in a publication called a Pharmacopeia – specify how each gas should be produced and validated, the acceptable purity level, and official measurement records.

For example, under European Pharmacopeia (EP) rules, medical oxygen (O<sub>2</sub>) requires an assay measurement to ensure O<sub>2</sub> purity is better than 99.5%, and impurity measurements of carbon monoxide (CO) and carbon dioxide (CO<sub>2</sub>). The impurities must be less than 5 parts per

million (ppm) of CO and less than 300ppm of CO<sub>2</sub>.

Our high-performance solutions and technologies deliver the measurements required to meet US and European Pharmacopeia concentration limits for medical gas quality using industry-approved sensing techniques.

## KEY SOLUTIONS

An advanced solution for purity assay and impurity detection, the SERVOPRO MultiExact 4100 offers a combined solution for all three analytes, meeting EP standards and providing the measurement limits required. A multi-gas analyzer capable

of monitoring up to four gas streams simultaneously, it can be fitted with a Paramagnetic cell for a highly stable O<sub>2</sub> reading, and a customized Infrared Gas Filter Correlation (Gfx) sensor for CO and CO<sub>2</sub>.

SERVOPRO MultiExact 4100



Find out more online at: [servomex.com/medical-gases](http://servomex.com/medical-gases)

# ULTRA-HIGH PURITY GASES AND SEMICONDUCTORS



Ultra-high purity (UHP) gases are essential for semiconductor manufacturing and the production of electronics such as LED and LCD displays.

Manufacturing the silicon wafers needed for semiconductor applications requires the use of ultra-pure gases. Even the smallest impurities can cause major defects in a wafer, leading to costly

scrap and waste. Multiple gas purification techniques and other strict procedures are used to ensure that UHP gases are delivered to the manufacturing process. This requires accurate gas monitoring at very low levels of concentration.

Quality control gas measurements must cover all the impurities present – adequate trace oxygen analysis will prevent oxidation

and other reactions from affecting the process, but if trace-level moisture is missed, contamination will still occur.

A comprehensive solution for all impurities is required, but this can lead to integration issues between hardware and software from different sources.

## KEY SOLUTIONS

We provide a single-supplier solution for all UHP measurements in these applications. Our SERVOPRO DF-560E and DF-750 NanoTrace ULTRA oxygen and moisture analyzers offers the lowest detection limits available to the industry, while the multi-gas SERVOPRO NanoChrome ULTRA provides the other trace impurity measurements required. All can be seamlessly integrated into existing systems or supplied as a customer specific turnkey system.

SERVOPRO DF-560E NanoTrace ULTRA



SERVOPRO DF-750 NanoTrace ULTRA



SERVOPRO NanoChrome ULTRA



Find out more online at: [servomex.com/uhp](http://servomex.com/uhp)

# A TURNKEY SOLUTION FOR NATURAL GAS TREATMENT



Servomex has supplied Netherlands energy network operator Gasunie with a gas analysis solution for its new nitrogen facility, which will be used to treat high-calorific natural gas imported from abroad.

Much of the Netherlands' natural gas supply comes from the Groningen Gas Field, and important steps have been taken in recent years to accelerate the reduction of gas extraction from this field.

Gasunie's new installation takes nitrogen from the air and blends it with imported high-calorific gas, replacing the need to extract gas from the Groningen field.

Gasunie and Servomex have worked in partnership for more than 15 years, and the energy network operator has been particularly satisfied with the product quality and service support provided by Servomex.

The nitrogen factory is scheduled to begin operation in April 2022, and will use 23 of Servomex's SERVOPRO MultiExact 4100 analyzers to deliver accurate, multi-component gas analysis at 37 required measuring points throughout the process.

The MultiExact 4100 measures up to four gas streams simultaneously, ensuring a much more cost-effective solution than using individual analyzers for each point.

The analyzers are configured to measure a combination of low oxygen, high oxygen, and carbon dioxide, using Paramagnetic and Infrared sensing technologies. For the most critical measurement points, analyzers with a single sensor were installed.

Servomex's turnkey gas analysis system includes 19-inch rack cabinets with pressure reduction

and valves. Everything is operated through the Profibus protocol, using a one-line digital signal, simplifying the system and ensuring greater accuracy.

Servomex will also provide on-site commissioning for the entire system, and a service support plan.



SERVOPRO MultiExact 4100



Find out how Servomex supports your process: [servomex.com/contact](http://servomex.com/contact)

# INDUSTRIAL PROCESS & EMISSIONS

Servomex's industrial process and emissions (IP&E) division handles gas analysis solutions for applications in the power generation, hydrocarbon processing and emissions monitoring markets.

## COMPLETE GAS ANALYSIS FOR POWER PROCESSES

Our expert solutions help optimize and control your combustion applications, and increase safety and efficiency in power generation operations, while lowering harmful emissions.

## RELIABLE HP APPLICATION MEASUREMENTS

We provide effective solutions for accurate, reliable gas analysis, process control, safety and quality for a range of midstream and downstream hydrocarbon processing applications.

## EFFECTIVE EMISSIONS MONITORING SOLUTIONS

Ensure you operate efficiently and within legislative limits. Our accurate monitoring solutions and process controls help you achieve regulatory compliance and meet increasingly strict standards.

## MEET THE TEAM



**SANGWON PARK**  
IP&E BUSINESS UNIT DIRECTOR

SangWon oversees application development, product management and engineering for our solutions in the power generation, HP, and emissions monitoring sectors.



**MATT HALSEY**  
APPLICATION DEVELOPMENT MANAGER

Matt leads our application development team, enhancing our regional presence and ensuring strong customer relationships.



**HUIYU GUAN**  
IP&E BUSINESS DEVELOPMENT MANAGER, CHINA

Overseeing the business development operations of our IP&E team in China, Huiyu leads our pursuit of large international projects.

Get in touch to learn more: [servomex.com/ip-and-e](http://servomex.com/ip-and-e)

# DIRECT REDUCTION IRON



Accurate gas measurements ensure direct reduction iron (DRI) plants can operate at the highest levels of efficiency, while achieving low emissions targets.

The Midrex DRI process is a low carbon dioxide emission application in steelmaking using virgin iron ore in an electric arc

furnace. The iron ore is heated as it descends through a shaft furnace, and oxygen (O<sub>2</sub>) is removed from the ore using counterflowing gases with a high hydrogen and carbon monoxide content. This process requires accurate gas monitoring for efficient operation.

Emissions monitoring is also important in the DRI process. The reaction between the counterflow gases and iron oxide in the ore produces metallic iron, water vapor, and carbon dioxide (CO<sub>2</sub>). The process may generate oxides of nitrogen (NO<sub>x</sub>) which must be continuously monitored to ensure environmental compliance.

## KEY SOLUTIONS

The SERVOTOUGH Oxy 1900 provides essential O<sub>2</sub> monitoring in the DRI process. This is an industry-leading Paramagnetic O<sub>2</sub> analyzer designed for hazardous areas. It is supported by the highly flexible SERVOTOUGH SpectraExact 2500 photometric analyzer for the other measurements. The SERVOPRO 4900 Multigas and SERVOPRO NO<sub>x</sub> analyzers provide the required continuous emissions monitoring.



Find out more online at: [servomex.com/dri](http://servomex.com/dri)

# ETHYLENE PRODUCTION

Rapid, accurate gas analysis supports the safe, efficient operation of ethylene plants, bringing control and confidence to every process point.

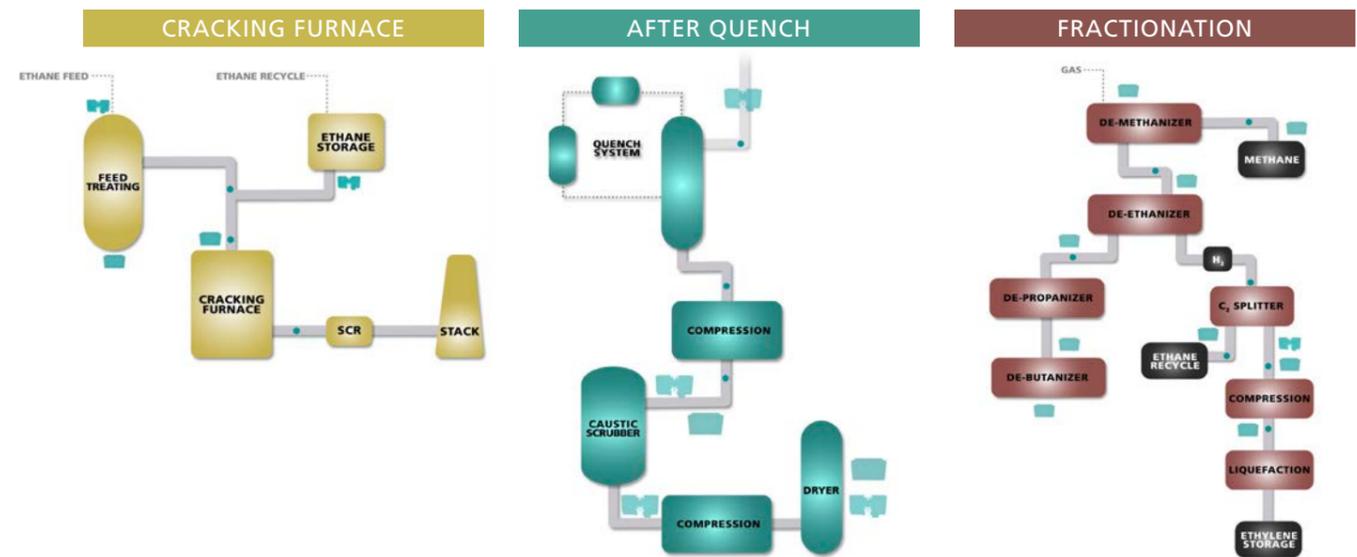
In ethylene production plants, it is essential to reliably monitor process gases, while feed gas

quality is also critical to the overall process. Additionally, it is vital to monitor gas quality throughout the process in order to ensure a high product yield.

Failure to monitor the gas feed throughout the process can significantly reduce the efficiency

of the process. A less pure gas results in a lower ethylene yield once the cracked gas is quenched and cleaned.

There are also issues for safety and emissions if high levels of contaminants enter the wrong part of the process.



## KEY SOLUTIONS

The SERVOTOUGH SpectraScan 2400 and SERVOTOUGH SpectraExact 2500 analyzers provide the accurate gas quality monitoring required at a range of key points throughout the ethylene process. This allows optimization of the process reactions to ensure greater efficiency, delivering a higher yield and better-quality product. We also supply analytical solutions for safety, combustion control and emissions monitoring.



Find out more online at: [servomex.com/ep](http://servomex.com/ep)

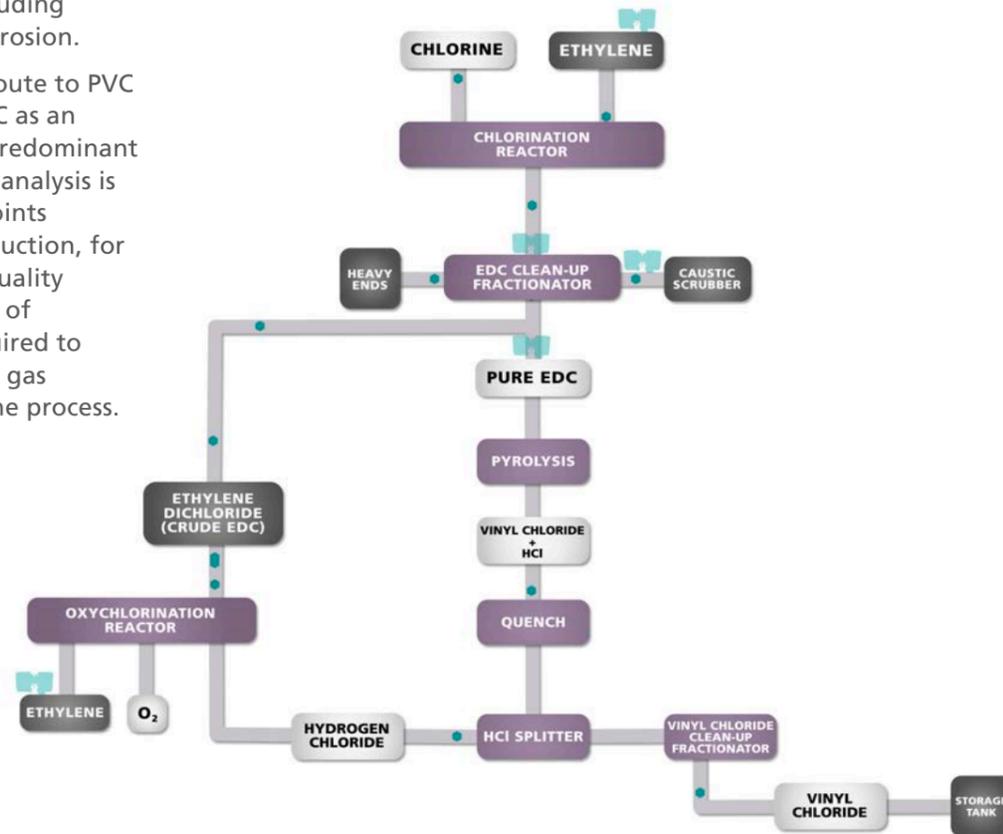
# ETHYLENE DICHLORIDE PRODUCTION

Ethylene dichloride (EDC) is a key intermediate for the production of polyvinyl chloride (PVC). We deliver the industry-leading gas analysis solutions that overcome process problems including condensation and corrosion.

The ethylene-based route to PVC production, using EDC as an intermediate, is the predominant method globally. Gas analysis is required at several points throughout EDC production, for process control and quality monitoring. A variety of technologies are required to measure the range of gas components within the process.

Analyzer systems must contend with challenging process conditions, including condensation and corrosion. Large amounts of hydrogen chloride, EDC and

residual water can increase the corrosion damage, so a resilient analyzer that can make accurate moisture measurements in the EDC stream is required.



## KEY SOLUTIONS

Our rugged, highly flexible SERVOTOUGH SpectraExact 2500 photometric gas analyzer delivers many of the key measurements required in the EDC process, including residual water levels in

the EDC stream. Capable of single and multi-component analysis, it can also be used to monitor ethylene, sodium hydroxide, and hydrogen chloride in the EDC production process.

SERVOTOUGH SpectraExact 2500



Find out more online at: [servomex.com/edc](http://servomex.com/edc)

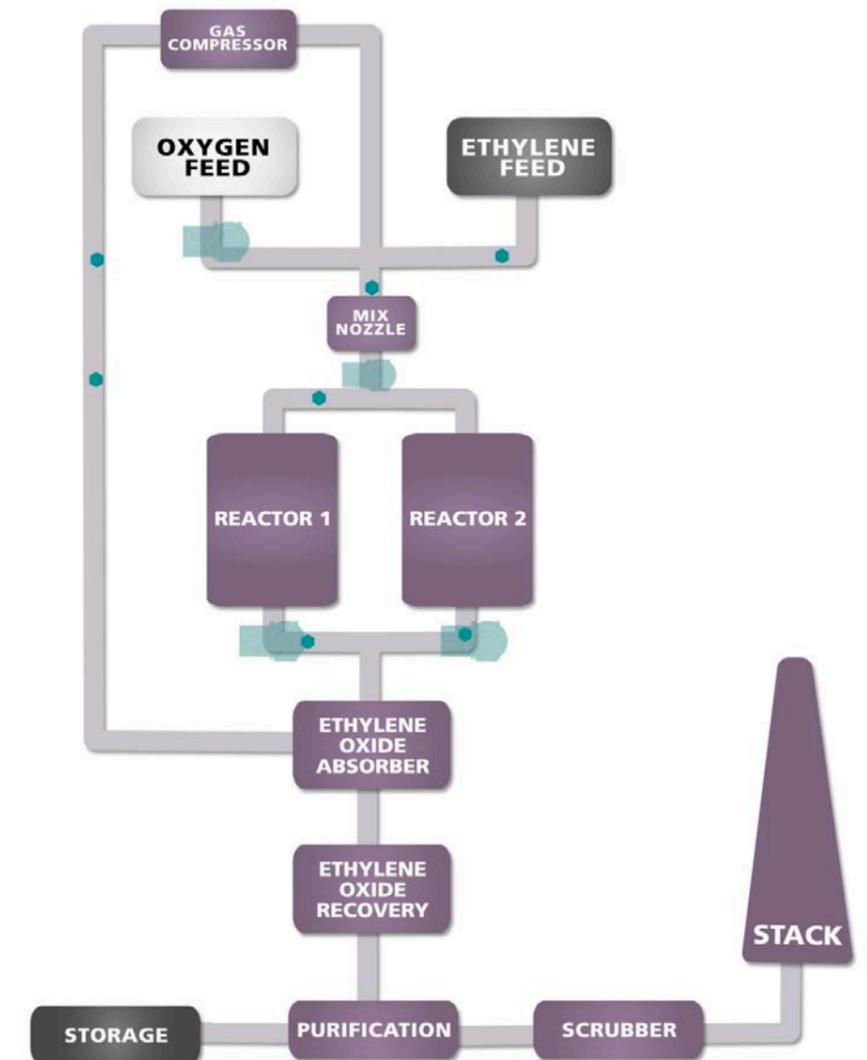
# ETHYLENE OXIDE PRODUCTION

The production of ethylene oxide (EO), a versatile chemical building block, relies on precise gas analysis measurements to ensure process safety and high productivity.

EO is formed in a reaction between oxygen and ethylene, and requires highly accurate monitoring of oxygen levels to protect the process against a risk of explosion. Quality and process control measurements are also made to support efficiency.

The exothermic nature of the EO process means safety is an essential concern, especially around the process reactors where hazardous flammable samples containing ethylene, oxygen, ethylene oxide and methane may be present. Failure to control oxygen levels at this point can create highly hazardous conditions.

Servomex has extensive experience in supplying solutions to the ethylene oxide process, with our safety integrated system (SIS) installations operating in more than 40 plants worldwide, and solutions across the process.



## KEY SOLUTIONS

To provide safety-critical oxygen analysis, Servomex supplies a dual or triple-redundancy gas analysis system using SERVOTOUGH OxyExact 2200 analyzers. Specifically

designed for hazardous area operation, these Paramagnetic analyzers deliver the accurate, reliable measurements needed as part of a SIS.

SERVOTOUGH OxyExact 2200



Find out more online at: [servomex.com/eo](http://servomex.com/eo)

# MARINE VAPOR CONTROL



Servomex has more than 30 years of experience in this sector, providing fixed and portable gas analysis products to marine terminals and tanker vessels involved in the transfer and transportation of crude oil and refined products.

Strict regulations are in place to control the systems used to monitor marine vapors. These govern the performance levels of the analyzer and its suitability to the hazardous environment. Analyzers used in these systems must be approved by the relevant regulatory body.

The vapors produced during loading are either returned to the plant and used for fuel or raw materials, or taken to a safe area and incinerated. In either case, it is essential to monitor the return lines for air ingress, in order to prevent explosive conditions from occurring.

## KEY SOLUTIONS

Regulations for this application specify at least two Paramagnetic oxygen analyzers, to ensure redundancy within each system. Our proven solution uses either the SERVOTOUGH Oxy 1900 or SERVOTOUGH OxyExact 2200 analyzers, depending on application conditions. Both offer the enhanced reliability of non-depleting sensor technology, and are approved by regulatory bodies.

SERVOTOUGH OXY 1900



SERVOTOUGH OxyExact 2200



Find out more online at: [servomex.com/mvc](http://servomex.com/mvc)

# PROCESS HEATERS AND FURNACES



Process heaters and furnaces are integral to many hydrocarbon processing and power generation applications. They allow fuel and air to react together and produce extremely high gas temperatures. In doing so, they use large quantities of fuel, generate emissions and can create a safety hazard for plant and personnel alike.

Our accurate, responsive gas analysis technologies and extensive applications knowledge can help make process heaters and furnaces safer and more efficient.

Optimization of the air-to-fuel ratio is key to controlling combustion in process heaters and furnaces. Post combustion excess

oxygen (O<sub>2</sub>) in the flue gas reduces process temperatures leading to reduced efficiency and increased emissions. Low O<sub>2</sub>, fuel rich conditions are dangerous and pose an explosion risk.

Keeping the combustion reaction at the optimum point ensures safe operation while reducing both fuel costs and emissions.

## KEY SOLUTIONS

Using close-coupled extractive sampling, the SERVOTOUGH FluegasExact 2700 combines proven Zirconia sensing for oxygen and Thick Film Catalytic sensing for combustibles, delivering an effective solution in a single analyzer. The SERVOTOUGH Laser 3 Plus Combustion uses Tunable Diode Laser (TDL) technology for in-situ measurements of oxygen, carbon monoxide, or both carbon monoxide and methane. This provides an average measurement across the flue, and is especially effective in supporting safety.

SERVOTOUGH FluegasExact 2700



SERVOTOUGH Laser 3 Plus Combustion



Find out more online at: [servomex.com/process-heaters](http://servomex.com/process-heaters)

# PROPYLENE OXIDE PRODUCTION



Propylene oxide (PO) is an important intermediate for the manufacture of propylene glycol, which can be used as an antifreeze agent or to create polyurethane plastics.

It can be manufactured through hydrochlorination – converting propene to propylene chlorohydrin

and then dechlorinating – or, more commonly, through oxidation of propylene with an organic peroxide. Both methods require gas analysis for safety and quality control.

Manufacturing propylene oxide through the oxidation process requires oxygen levels to be

monitored in the oxidation reactor for quality and safety. This analysis must be performed under hazardous conditions, since propylene oxide is volatile and highly flammable.

Servomex's solutions deliver key measurements across all processes used for PO production.

## KEY SOLUTIONS

The SERVOTOUGH Oxy 1900 delivers accurate measurements of oxygen in the oxidation reactor. This hazardous area device provides safety-enhanced oxygen analysis, using stable,

non-depleting Paramagnetic sensing technology. A heated sample compartment provides unrivalled stability and simplified sampling.

SERVOTOUGH OXY 1900



Find out more online at: [servomex.com/po](http://servomex.com/po)

# PURIFIED TEREPHTHALIC ACID PRODUCTION



The production of purified terephthalic acid (PTA) requires expert gas analysis for process control, efficiency and safety, as well as quality monitoring and environmental compliance. Servomex provides accurate, reliable solutions to these challenges.

Oxygen (O<sub>2</sub>) analysis is critical to maintaining safety in the

PTA process, and to supporting productivity. In addition, some operators use an oxygen enrichment process on their PTA plants – this requires a specialist O<sub>2</sub> monitoring solution for both safety and efficiency.

The enriched oxygen process involves adding O<sub>2</sub> to the air being fed to the reactors, bringing the

O<sub>2</sub> level up to 25%. This ensures a more efficient reaction, reducing catalyst consumption, and improving reactor performance. A reliable and accurate monitoring solution is required to maintain the O<sub>2</sub> concentration at the most efficient level while ensuring it does not exceed safe levels.

## KEY SOLUTIONS

Servomex's SERVOTOUGH OxyExact 2200 high-specification Paramagnetic oxygen analyzer delivers effective, reliable measurements of enriched O<sub>2</sub> samples in hazardous

environments, with a resilient enclosure for the transmitter unit, providing an effective solution for this application.

SERVOTOUGH OxyExact 2200



Find out more online at: [servomex.com/pta](http://servomex.com/pta)

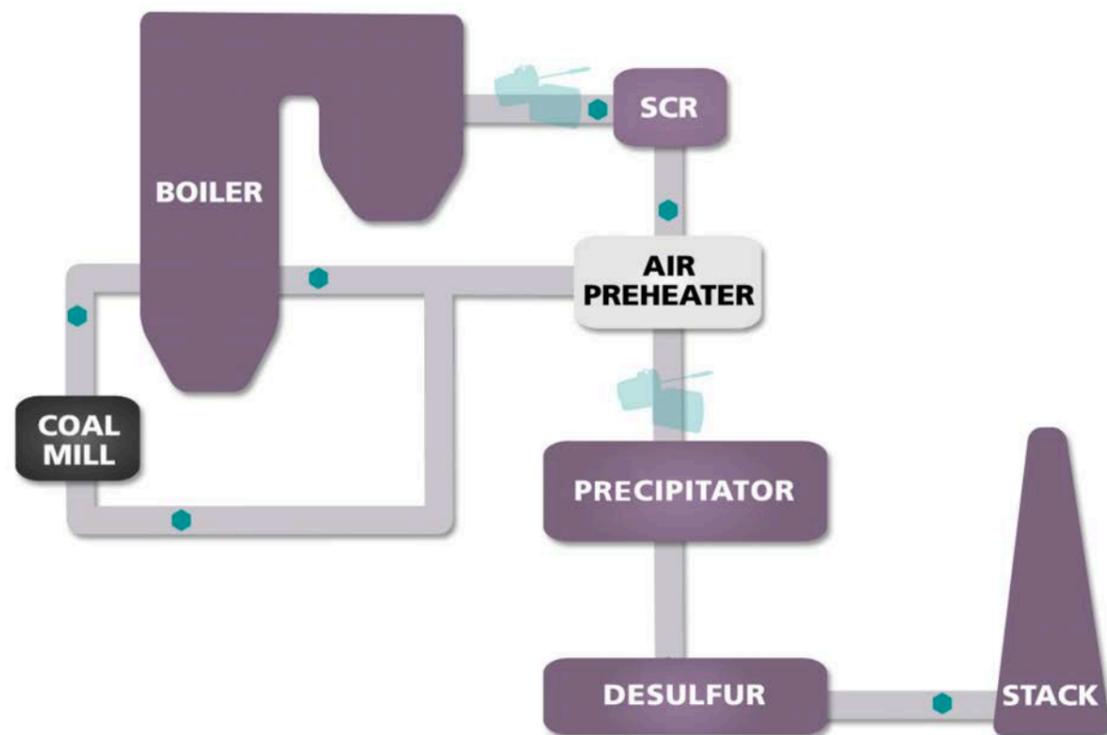
# THERMAL POWER – COAL

In coal-fired power generation, pre-heated air and pulverized coal are fed into the boiler where combustion takes place. This demanding industry requires operators to deliver the most efficient process while maintaining safe operation, controlling fuel costs and meeting stringent targets for emissions.

Excess air is needed to ensure complete combustion, but if this excess is too high, combustion efficiency will fall through heat loss. However, if the process is run with excess fuel, not all the fuel will be burnt. Precise monitoring and control of flue gas in the process is essential to optimize combustion efficiency,

which will minimize fuel costs and reduce harmful emissions.

Servomex is your expert gas analysis partner for this application. Supported by our expertise and experience, our total analytical solution delivers benefits for costs, process efficiency, safety and emissions across the process.



## KEY SOLUTIONS

Our SERVOTOUGH FluegasExact 2700 combustion analyzer continuously monitors oxygen and combustibles in the flue gas, enabling operators to achieve optimum combustion

conditions. This helps to reduce carbon and NOx emissions, improve process safety, and save fuel – the FluegasExact 2700 has been proven to cut fuel costs by up to 4%.

SERVOTOUGH FluegasExact 2700



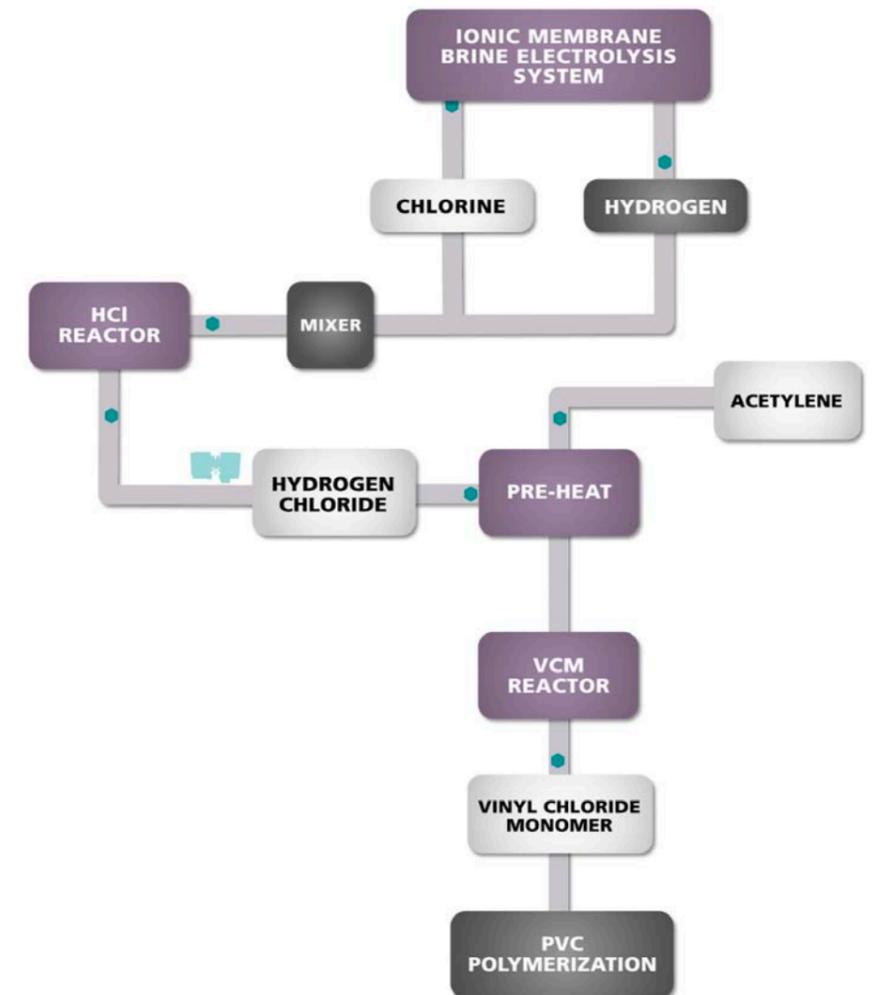
Find out more online at: [servomex.com/thermal-power](http://servomex.com/thermal-power)

# VINYL CHLORIDE MONOMER PRODUCTION

Vinyl chloride monomer (VCM) is an important intermediate product for the production of polyvinyl chloride (PVC). It is created by reacting hydrogen (H<sub>2</sub>) and chlorine (Cl<sub>2</sub>) together to form hydrogen chloride (HCl), which in turn is combined with acetylene to produce VCM.

Gas analysis measurements are required across the process, including monitoring moisture in the Cl<sub>2</sub> stream to avoid compressor corrosion, safety measurements for both HCl and Cl<sub>2</sub>, and oxygen measurements in the acetylene stream.

Challenging process conditions, such as condensation and corrosion, can affect the gas analysis equipment used in this process. The analytical systems used must not only deliver reliable measurements for process control and safety, but have to be able to do so without being impaired by the conditions themselves.



## KEY SOLUTIONS

The rugged SERVOTOUGH SpectraExact 2500 accurately provides single and multi-component analysis at key process points, including measurements for moisture in Cl<sub>2</sub>

to protect the compressor from corrosion damage. It can also make the necessary measurements for HCl and Cl<sub>2</sub> concentrations between the HCl reactor and preheater stages of the process.

SERVOTOUGH SpectraExact 2500



Find out more online at: [servomex.com/vcm](http://servomex.com/vcm)

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