ES
EXPERT SOLUTIONS

# TUNABLE DIODE LASER GAS ANALYSIS

ISSUE: 42

THE GAS ANALYSIS MAGAZINE

## COMPACT, FAST-RESPONSE MEASUREMENTS

Discover the SERVOTOUGH Laser 3 Plus range

## REDUCING NOx EMISSIONS

TDL sensing solutions for ammonia slip

## SUPPORTING CLEANER AIR

Combustion control and process efficiency

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# GAS ANALYSIS TECHNOLOGY WITH LASER PRECISION

Welcome to Issue 42 of our Expert Solutions (ES) magazine, which focuses on Servomex's innovative Tunable Diode Laser (TDL) sensing technology, related products, and the applications where TDL analyzers are most effective.

TDL sensing is highly specific to the gas of interest, and can be optimized to measure a range of gases. It powers the revolutionary SERVOTOUGH Laser 3 Plus range, with models designed for combustion monitoring, process control, and environmental measurements of ammonia.

In this issue, we look at each of these analyzers, and highlight some of the key applications where they can provide significant benefits.

You can also learn more about TDL sensing technology and how it works, and find out why measuring gases such as oxygen, carbon monoxide, methane, and ammonia is so important for industrial processes and cleaner air.

There's also a preview of our new unboxing video, in which a Servomex expert explains the features of the Laser 3 Plus analyzer as they unpack it.

If you want to find out more about the Laser 3 Plus range and our TDL sensor solutions, and how they can fit into your process, get in touch with our expert team at: **servomex.com/contact**

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# IN THIS ISSUE

PRODUCT FOCUS

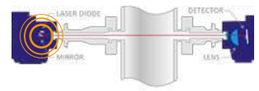
**P05 –** SERVOTOUGH **Laser 3 Process**

**P09 –** SERVOTOUGH **Laser 3 Combustion**

**P15 –** SERVOTOUGH **Laser 3 Environmental**

**P04 –** Gas focus: measuring oxygen

**P06-07 –** Learn more about Tunable Diode Laser sensing




**P8 –** Measuring CO + $CH_4$ for combustion safety

**P12-13 –** Process heaters and furnaces


**P16-17 –** Gas analysis for ammonia slip applications

## SPOTLIGHT ON COMMISSIONING

Get the analyzer performance you expect from the outset, with installation and configuration by highly trained commissioning engineers.

Commissioning ensures that systems and components are designed, tested, operated, and maintained according to requirements.

Our fast, seamless service delivers complete peace of mind that your gas analysis system is working correctly from day one. It helps avoid the costly process inefficiencies and ongoing maintenance costs caused by incorrectly installed or commissioned equipment.

Servomex-commissioned analyzers meet all your safety, compliance, and operational needs, and qualify for an additional six-month warranty period.

Visit: **servomex.com/service**

# MEASURING OXYGEN FOR SAFETY, EFFICIENCY, AND CONTROL

Oxygen ($O_2$) is one of the most prevalent gases on the planet, making up approximately 21% of the Earth's atmosphere, and is essential to human life.

This makes it vital to many medical gas applications, but it is also widely measured in industry, with applications within the production of metals, plastics and power generation.

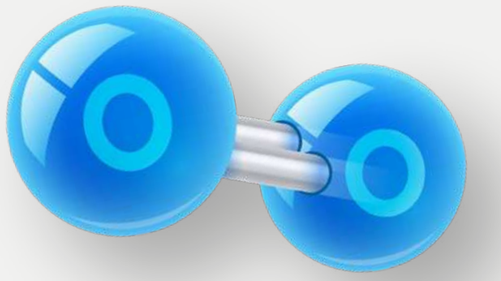
The extensive range of oxide compounds used in many processes means that there are many applications where $O_2$ measurements are crucial for process control, safety, and efficiency.

Since $O_2$ is a widespread component in the atmosphere, it may interfere with other processes, requiring the gas to be monitored as an impurity. While oxygen is not harmful to the environment, it may be necessary to monitor $O_2$ emissions as part of a continuous emissions monitoring system (CEMS).

Servomex provides an extensive choice of best-fit technologies to measure oxygen at percentage, trace, and ultra-trace levels, for safety, efficiency, and control in a vast range of industrial processes.

## TDL SENSING FOR OXYGEN

Several technologies are available for oxygen analysis, and the most appropriate solution depends upon both the application and the measurement range required. Tunable Diode Laser sensing is highly specific to the target gas, and offers a fast, highly stable, continuous cross-stack measurement, ideal for process and combustion control applications.







# FAST, ACCURATE PROCESS CONTROL MEASUREMENTS

The SERVOTOUGH Laser 3 Plus Process is a highly compact gas monitor for in-situ cross-stack applications, delivering exceptional performance benefits in a revolutionary compact design.

Its pioneering design occupies a footprint up to one-tenth the size of competitor products, providing instant benefits for installation and flexibility.

Utilizing the latest Wavelength Modulated Spectroscopy (WMS) measurement techniques with unique Servomex signal processing, it provides the most stable, repeatable results for the measurement of oxygen, with minimal installation and maintenance costs.

### KEY APPLICATIONS

- Oxidation control
- Inerting
- Safety monitoring
- Flare gas monitoring
- Combustion control (<500°C, 932°F)
- Coal to chemical


SERVOTOUGH
Laser 3 Plus Process

### FEATURES AND BENEFITS

- High safety integrity utilizing Servomex's own line lock cuvette technology
- ATEX, IECEx, and North American hazardous area approvals.
- Hardware compliant to SIL 2
- Quick and easy installation by one person with on-board display negating the need for laptop configuration
- Auto-validation capability provides complete assurance of ongoing measurement accuracy

**Download product brochure.**
Or visit **servomex.com/l3process**

### MAINTENANCE REQUIREMENTS

- Annual preventative maintenance and calibration are basic requirement
- Perform measurement validation and check status history
- Validate the purge flows, health of windows, and overall alignment of the analyzer to achieve maximum uptime and measurement accuracy
- Check and replace flange O-rings as required

# SENSING TECHNOLOGY FOR FAST-RESPONSE MEASUREMENTS

Tunable Diode Laser (TDL) technology offers a fast-response, accurate measurement that is highly specific to the gas of interest. TDL sensors use a single-line "monochromatic" spectroscopy technique that provides highly stable calibration, a continuous, fast, in-situ measurement, and the avoidance of 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. 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.

Servomex 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.

This non-contact, non-depleting sensing is used in our innovative, compact SERVOTOUGH Laser 3 Plus range of analyzers.

FIG. 1: CLOSE-UP OF THE LINE LOCK SYSTEM SHOWING THE CUVETTE AND BEAM SPLITTER

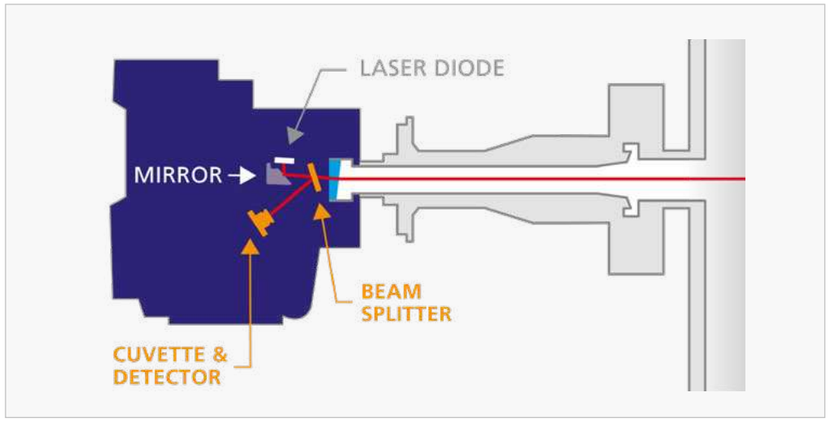
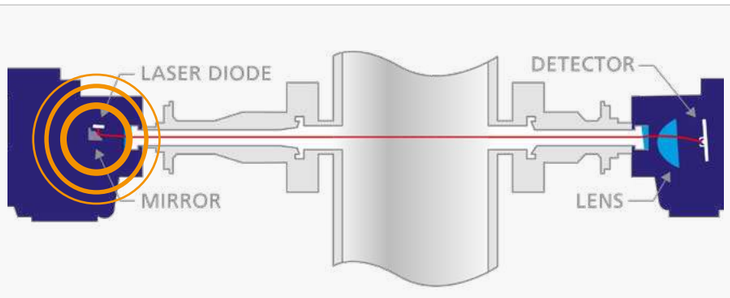



FIG. 2: THE LASER 3 PLUS INSTALLED ACROSS A STACK, WITH LINE LOCK SYSTEM (CIRCLED)




Learn more about TDL sensing: **servomex.com/tunable-diode-laser**



## TUNABLE DIODE LASER

### 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.

### 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.

### WORKS WITH

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

### USED IN

SERVOTOUGH
Laser 3 Plus Range

# MONITORING CO AND $CH_4$ FOR COMBUSTION SAFETY

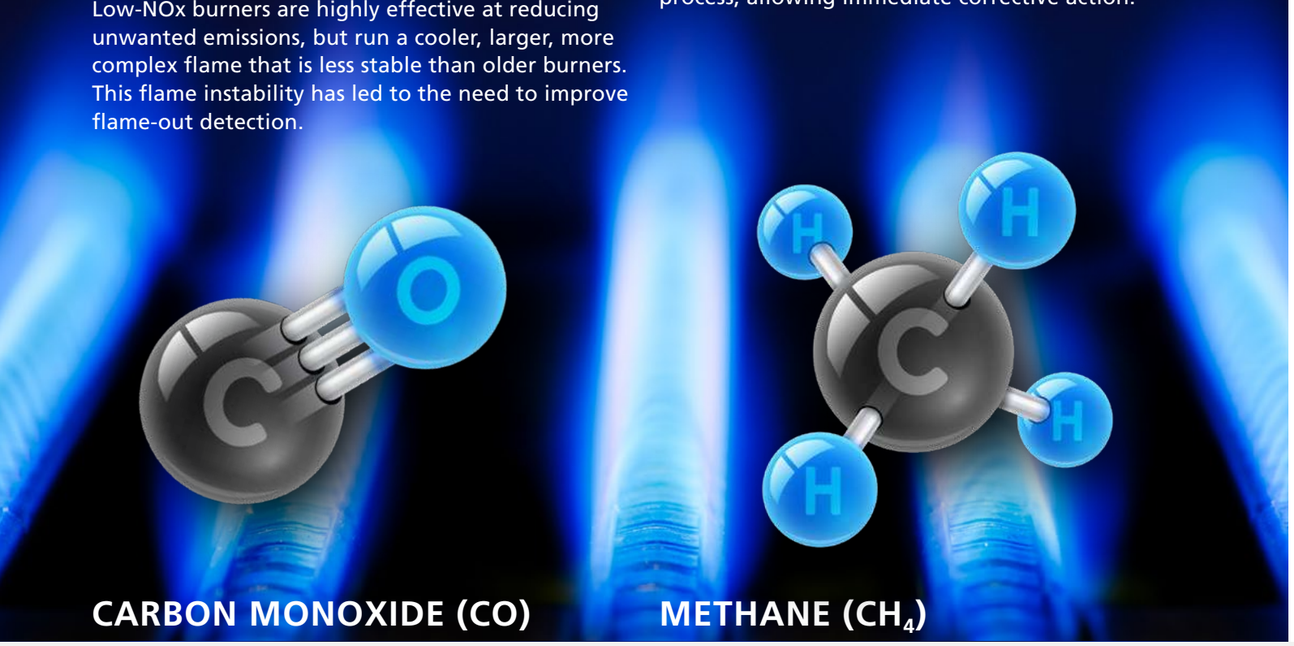
Monitoring carbon monoxide (CO) levels is a key factor in optimizing combustion efficiency. In addition, a fuel-rich environment contains high levels of both CO and methane ($CH_4$).

This is a constant risk and potential source of explosion, carbon monoxide and methane analysis is an essential safety monitoring requirement.

Low-NOx burners are highly effective at reducing unwanted emissions, but run a cooler, larger, more complex flame that is less stable than older burners. This flame instability has led to the need to improve flame-out detection.

Changes to the ambient conditions, fuel composition, or pressure regulation can snuff out the flame or alter its profile to become heavily fuel-rich.

A carbon monoxide and methane analyzer, measuring across the process, will detect any pockets of methane before it can flood through the process, allowing immediate corrective action.




## CARBON MONOXIDE (CO)

CO is a poisonous, flammable gas which is colorless, odorless, and tasteless.

It has applications in the chemical, food, medical, and metals industries. Measuring CO (along with $O_2$) helps to maintain the combustion reaction at an optimum balance, maintaining safety and reducing fuel costs. CO may also be monitored to avoid impurities in the production of industrial, medical, and UHP gases.

As it is regarded as a criterion pollutant under many environmental standards, any industrial emissions of CO must be monitored to ensure regulatory compliance.

## METHANE ($CH_4$)

The primary constituent of natural gas, $CH_4$ is an extremely flammable hydrocarbon, and can form explosive mixtures with air. It is used in many industrial processes, both as a chemical feedstock and as fuel.

When methane is used in combustion, it is important to measure $CH_4$ levels in the heater, to ensure safety. Pockets of high methane concentration can form during the process, which significantly increases the risk of an explosion. These may not be detected by spot measurements, so a cross-stack analyzer is better suited to this application.

Methane is a greenhouse gas, so many industrial processes must be monitored to ensure $CH_4$ emissions do not exceed environmental regulatory limits.





# A COMPACT, FAST-RESPONSE COMBUSTION ANALYZER

The SERVOTOUGH Laser 3 Plus Combustion is a revolution in TDL Absorption Spectroscopy analysis: a range of highly compact gas monitors measuring oxygen ($O_2$), carbon monoxide (CO), and methane ($CH_4$) in in-situ cross-stack applications, which delivers exceptional performance benefits.

Servomex's innovative approach to design has produced an analyzer that occupies a footprint up to one-tenth the size of competitor products. This provides instant benefits in terms of installation ease and flexibility.

Combining the latest Wavelength Modulated Spectroscopy (WMS) measurement techniques with unique Servomex signal processing, the Laser 3 Plus provides the most stable, repeatable results with minimal installation and maintenance costs, offering a fast response measurement of $O_2$, CO, or a combination of $CH_4$ and CO.

## KEY APPLICATIONS

- Process heaters
- Incinerators
- Power stations
- Furnaces
- ESP protection
- Thermal oxidizers


SERVOTOUGH
Laser 3 Plus Combustion

## FEATURES AND BENEFITS

- High safety integrity utilizing Servomex's own line lock cuvette technology
- Compact size means quick and easy installation by one person with on-board display negating the need for laptop configuration
- ATEX, IECEx, and North American hazardous area approvals.
- Hardware compliant to SIL 2
- Auto-validation feature provides complete assurance of ongoing measurement accuracy

**Download product brochure.**
Or visit **servomex.com/l3combustion**

## MAINTENANCE REQUIREMENTS

- Annual preventative maintenance and calibration are basic requirement
- Perform measurement validation and check status history
- Validate the purge flows, health of windows, and overall alignment of the analyzer to achieve maximum uptime and measurement accuracy
- Check and replace flange O-rings as required


## WATCH AS WE UNBOX THE
# SERVOTOUGH **Laser 3 Plus**

Our new video reveals exactly what you get when you order a SERVOTOUGH Laser 3 Plus. Product Specialist Luke Purdie unboxes this compact, fast-response Tunable Diode Laser analyzer while discussing its features and benefits.

**HE EXPLAINS:**

- What you get in the box with the analyzer, including spare parts and accessories
- The exterior ports and sockets available
- How the analyzer is installed
- The power-up and calibration processes
- The maintenance requirements and service support
- What other resources are available

Watch the full video now: **servomex.com/laser-3-series**



# GAS ANALYSIS THAT SUPPORTS A SUSTAINABLE FUTURE

Servomex takes a 'whole company' approach to sustainability, with a firm commitment to powering and enabling industrial change. This is principally achieved by helping customers to make their industrial processes cleaner and more efficient.

Our efforts are focused on four key UN Sustainable Development Goals: affordable and clean energy; industry, innovation, and infrastructure; responsible consumption and production; and climate action.

Our impact also extends to wider areas including good health and wellbeing, and clean water and sanitation, while our ethical business operations around the world deliver positive results for goals such as no poverty, gender equality, and reduced inequality.

The products we design, develop, and manufacture make dirty, polluting industries clean, and clean industries – like industrial gases and semiconductor manufacturing – pure.

It is widely recognized that switching to alternative fuels and replacing industrial processes with greener options will not be enough to alleviate the ongoing environmental damage from global industry. The only option is to make the processes themselves harmless to the environment.

This is of great importance to developing economies, where there remains a heavy reliance on coal and other heavy-pollutant fuels. Driving greater efficiency also reduces the amount of fuel needed, so these finite fossil fuel resources last longer, as well as cause far less environmental damage.

Our focus is not just on reducing emissions, but on introducing a sustainable approach to our people and operations.

This commitment is supported at the corporate level, ensuring our actions have the full weight of the Spectris leadership team behind them.

We have partnered with leading expert organizations such as EcoAct and EcoVadis to validate the effectiveness and veracity of the activities within our sustainability program, recently attaining a gold rating from EcoVadis. In addition, our Net Zero targets have been validated by the Science Based Targets initiative (SBTi).

As part of a Spectris Group-wide process, we have undertaken a climate risk assessment scenario analysis as required by the Taskforce for Climate-related Financial Disclosure (TCFD) to understand the risks and opportunities present in our business related to climate change.

It is clear to us that operating responsibly at a global level has global repercussions. To ensure a positive impact, we adhere to an established code of ethics, anti-slavery regulations, and equality policies.

For us, sustainability also means strongly supporting the local community and, to this end, we continue to back charities in our area, forge partnerships with local sports clubs, and deliver STEM outreach programs to nearby schools.

Like Servomex, most of our customers have sustainability front and center of their strategies. What we are doing is aligning with them to help them achieve their sustainability goals, leading the way in empowering sustainability for industries around the world.

GOLD 2022 ecovadis Sustainability Rating

SCIENCE BASED TARGETS
DRIVING AMBITIOUS CORPORATE CLIMATE ACTION

Learn more: **servomex.com/sustainability-at-servomex**

# EFFICIENT CONTROL FOR PROCESS HEATERS

Process heaters are designed to burn a fuel source in the presence of oxygen, generating heat for use elsewhere in a process.

They consume large quantities of fuel, produce unwanted emissions, and are a potential safety hazard for personnel and plant alike. These properties make process efficiency a key concern.

The key to combustion control, and reducing harmful emissions, is to optimize the air-to-fuel ratio within process heaters.

Using excess fuel – referred to as fuel-rich conditions – is inefficient, costly, and unsafe, while using excess air is safer, but more inefficient.

To reduce NOx emissions, contributing to cleaner air, newer heaters use burners that operate under narrow process conditions, requiring even greater gas analysis accuracy and reliability than before.

By continuously monitoring the amount of oxygen and combustibles in the flue gas, the operators can adapt to continually changing process conditions.

The introduction of Tunable Diode Laser (TDL) technology, which has been proven to deliver advanced combustion control, is a major development in gas analysis for process heaters.

The application and heater conditions will affect the choice of Zirconia or TDL analyzers for oxygen analysis, and Servomex experts can advise on the best choice for an individual process.

However, TDL delivers greater advantages over combustibles sensors, providing a more accurate indication of carbon monoxide and methane breakthrough. It has a faster response, and offers an average path measurement across all the burners on a process heater.

This is important, because normal burner operation can change during operation. Carbon monoxide and methane breakthrough can cause a build-up of flammable gas, leading to potentially hazardous conditions, including a possible explosion.

By measuring across the entire heater, the TDL analyzer is much more likely to detect any build-up of hazardous gases, compared to single-point analysis devices.

So, in a typical fired heater, the optimum analytical methods for process control, efficiency, safety and emissions reduction are a mixture of Zirconia and TDL technologies, applied to specific locations.

# ZIRCONIA OR TDL ANALYZERS FOR OXYGEN ANALYSIS

SERVOTOUGH FluegasExact 2700


SERVOTOUGH Laser 3 Plus Combustion

Watch our application video at: **servomex.com/process-heaters**

# MEASURING AMMONIA FOR EFFICIENCY AND EMISSIONS REDUCTION

Ammonia ($NH_3$) is a colorless gas with a pungent odor, and is highly soluble in water. It is widely used in various industrial processes due to its unique properties and versatility.

In power plants and various other combustion processes, the removal of waste NOx is typically achieved by DeNOx processes, where $NH_3$ is injected into the flue gas flow from combustion, reacting with NOx to form water ($H_2O$) and nitrogen ($N_2$).

Unreacted $NH_3$ is commonly referred to as ammonia slip, and is generally held to <2 parts per million (ppm) to optimize the process.

Additionally, US EPA PS18 sets out the standard for reliable CEMS monitoring of $NH_3$ as a precursor to harmful particulates.

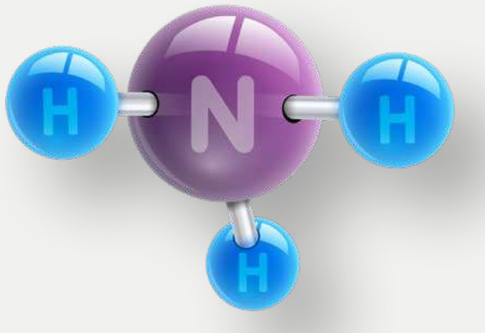
There are also a number of chemical manufacturing processes where monitoring ammonia levels is essential for safety, efficiency, and quality control.

Accurate monitoring helps reduce emissions, enhance efficiency, maintain product quality, and prevent potential risks associated with ammonia handling.

## TDL SENSING FOR AMMONIA

The SERVOTOUGH Laser 3 Plus Environmental measures $NH_3$ at ppm levels for ammonia slip and emissions monitoring applications.

Its Tunable Diode Laser (TDL) sensing technology provides a comprehensive solution for accurate ammonia slip control.








# IDEAL FOR CEMS AND AMMONIA SLIP MONITORING

Using Tunable Diode Laser (TDL) spectroscopic techniques, the SERVOTOUGH Laser 3 Plus Environmental is a highly compact gas monitor for in-situ cross-stack applications, delivering exceptional performance benefits for clean air processes.

Installed directly into process ducts, it is ideal for monitoring ammonia slip during NOx reduction processes such as Selective Catalytic Reduction (SCR) or Selective Non-Catalytic Reduction (SNCR), controlling the level of ammonia slip to between 2-3 parts per million.

It also meets all uptime and performance requirements for the US EPA PS18 standard, for reliable CEMS monitoring of $NH_3$ as a precursor to harmful particulates.

## KEY APPLICATIONS

- Process heaters
- Incinerators
- Power stations
- Furnaces
- Thermal oxidizers


SERVOTOUGH
Laser 3 Plus Environmental

### FEATURES AND BENEFITS

- High measurement reliability utilizing Servomex's own line lock cuvette technology
- ATEX, IECEx, and North American hazardous area approvals
- A compact analyzer specifically optimized for the fast, accurate, and responsive measurement of $NH_3$
- Auto-validation feature provides complete assurance of ongoing measurement accuracy
- Meets the US EPA PS18 standard for CEMS monitoring of $NH_3$

**Download product brochure.**
Or visit **servomex.com/l3environmental**

### MAINTENANCE REQUIREMENTS

- Annual preventative maintenance and calibration are basic requirement
- Perform measurement validation and check status history
- Validate the purge flows, health of windows, and overall alignment of the analyzer to achieve maximum uptime and measurement accuracy
- Check and replace flange O-rings as required

# A RELIABLE SOLUTION FOR AMMONIA SLIP MONITORING

Reducing emissions of oxides of nitrogen (NOx) is a key objective for meeting environmental legislation, and an area of growing importance for power generation and hydrocarbon processing markets.

It is important to effectively control NOx to meet legislative requirements and avoid fines; in addition, effective management has important benefits for the effectiveness and efficiency of a combustion process.

In power plants and various other combustion processes, the removal of waste NOx – referred to as a DeNOx process – is typically achieved by selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR).

Both processes use ammonia ($NH_3$), or $NH_3$ in the form of urea, to react with NOx in the flue gas flow to form water ($H_2O$) and nitrogen ($N_2$). Temperature control is important, as low temperatures can cause a surplus of unreacted $NH_3$, commonly referred to as ammonia slip.

Accurate measurement of ammonia slip is important for the operation of DeNOx equipment. High levels of unreacted $NH_3$ are wasteful and costly, while ammonia slip may also have a significant impact on deposition and catalyst plugging. It can also affect potential corrosion of downstream equipment.

Excessive ammonia slip in a coal-fired power plant can create fly ash with high levels of $NH_3$, rendering it unfit for sale as a mineral filler in asphalt or cement plants.

The level of ammonia slip also provides diagnostic information on the proper function of the SCR/SNCR system and the NOx reduction process.

By holding ammonia slip to <2 ppm, the process can be optimized, delivering operational and cost benefits. However, it is difficult to control without direct measurement using an ammonia analyzer.

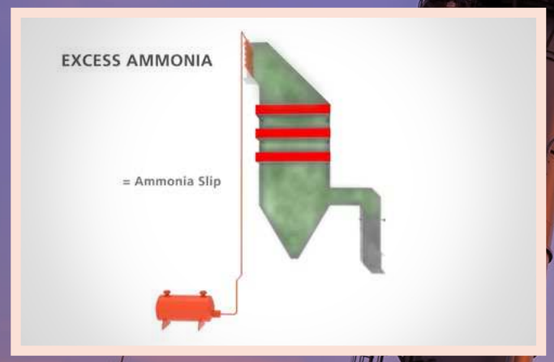
Advanced Tunable Diode Laser (TDL) technology presents a complete and effective solution for accurate ammonia slip control.

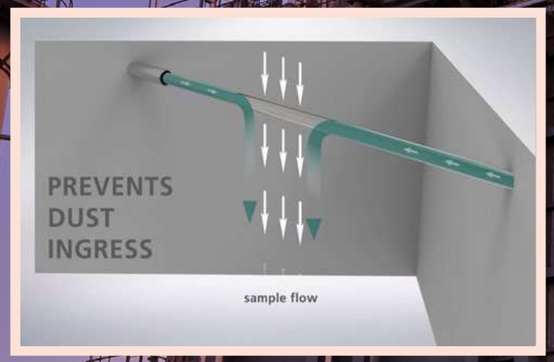
Consisting of a TDL light source, transmitting optics, receiving optics, and detector, this technology is suitable for in-situ, cross-duct measurements. Because the analyzer is installed across a duct or stack, it produces an average concentration reading rather than a point reading that is obtained from an extractive sample, so $NH_3$ concentration levels can be measured with much greater certainty.

The $NH_3$ sample also never leaves the process, so the complications experienced with sample transports in extractive methods are avoided, as well as contaminant problems posed by the dust, heat, and water.

This means not only is the measurement considerably more accurate, but plant operators avoid much of the downtime required for cleaning of extractive systems.


SERVOTOUGH
Laser 3 Plus Environmental




Watch the video at: **servomex.com/ammonia-slip-and-emissions**

# GLOBAL SERVICE SUPPORT

SERVOMEX SERVICE NETWORK

Servomex support doesn't end with the supply of your analyzer or system. Our service team delivers expertise directly to your plant, with service plans that deliver protection, peace of mind, and partnership for your gas analysis.

Global coverage is provided by service centers and mobile engineers worldwide, allowing the Servomex Service Network to ensure that your processes run efficiently, safely and profitably.

Support offered includes service plans, spares, on-site support, commissioning, health checks, training, and equipment rental. We also provide expert support from our extensive network of service centers, or on-site at your facility.

Pick your service plan at: **servomex.com/service**

# INTEGRATED SYSTEMS

SERVOMEX SYSTEMS CONSULT. DESIGN. DELIVER.

In addition to individual Servomex analyzers, we also supply complete system solutions designed and built to order for your project.

Our state-of-the-art systems engineering centers in the US, China, India, and Europe provide a global service, offering scalable solutions that range from simple utilities panels to fully-contained air-conditioned shelters.

The Servomex difference is clear from the start, as we consult, design, and deliver your solution.

Our team's proven experience ensures the optimum level of efficiency, safety, and cost-effective operation for your application.

Learn more at: **servomex.com/systems**



# GET THE RESOURCES YOU NEED TO SUPPORT YOUR PROCESS SOLUTION

## EXPERT PAPERS

For an in-depth look at our gas analyzers and the technologies they use, download our expert papers. Written by our knowledgeable team, they examine how our sensing technologies work and explain why certain products deliver the best solution for key applications.


## PRODUCT BROCHURES

For the best available information about our products, you'll want to read our product brochures. They outline how the analyzer works and which applications it's best suited to. It also explains the main features and their benefits, and lists all the certifications it has.


## MANUALS

Whether you need to replace a lost product manual, need a quick online reference, or just want to see how the product works before you order, we've got you covered. All our existing product instruction manuals are available to download, for quickstart, installation, operation and certification.


## VIDEOS

Our extensive array of videos are ready to view on our website now. Some focus on our products, including expert 'unboxings'. Others look at applications and how our products deliver the solutions you need. We also feature our experts discussing key areas of gas analysis, and how Servomex can help customers in a range of markets.

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