# TDLAS and QF analyzers application guide

## Accurate and reliable measurement of $H_2O$, $H_2S$, $CO_2$, $C_2H_2$, $NH_3$ and $O_2$

Endress+Hauser
People for Process Automation

# TDLAS and QF process gas analyzers

## Advanced spectroscopic solutions for challenging applications

Tunable diode laser absorption spectroscopy (TDLAS) and quenched fluorescence (QF) analyzers possess unique design and performance characteristics that provide significant advantages over other gas analysis technologies.

- High-resolution lasers provide selective and specific analyte measurement in complex hydrocarbon gas streams
- Continuous flow of sample gas through the measurement cell provides an exceptionally fast response to analyte concentration changes
- Laser and detector components are isolated and protected from process gas and contaminants, avoiding fouling, corrosion, and damage for reliable long-term operation
- Patented differential spectroscopy technique enables detection and quantitation of low ppm and sub-ppm concentrations of $H_2O$, $NH_3$, and $H_2S$ in complex hydrocarbon gas streams
- Laser spectroscopy uses virtually no consumable items, providing lower OPEX and requiring less maintenance and service than other analyzer technologies
- Quenched fluorescence (QF) analyzers measure oxygen ($O_2$) in natural gas streams from ppm levels to percentage levels, and are unaffected by $H_2S$ which causes measurement errors and depletes electrolyte solution in electrochemical $O_2$ analyzers

TDLAS and QF analyzers

This guide provides lists of field-proven applications of Endress+Hauser TDLAS and QF analyzers in specific industries. For more information about a particular application, please visit www.endress.com.

## Natural gas

Measurement of $H_2O$, $H_2S$, $CO_2$, and $O_2$ in natural gas pipelines; at production and gathering sites, custody transfer points, compressor stations, and storage facilities; and in distribution systems is critically important to protect pipelines from corrosion and to meet gas quality specifications. Endress+Hauser TDLAS and quenched fluorescence (QF) oxygen analyzers have a proven track record of reliability in thousands of installations worldwide.

**Natural gas**

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ | $H_2O$ in natural gas production, storage, transportation and distribution | 0 - 100 ppmv<br>0 - 2500 ppmv |
| $CO_2$ | $CO_2$ in natural gas production, storage, transportation and distribution | 0 - 5%<br>0 - 20% |
| $H_2S$ | $H_2S$ in natural gas production, storage, transportation and distribution | 0 - 10 ppmv<br>0 - 5000 ppmv |
| $O_2$ | $O_2$ in natural gas production, storage, transportation and distribution | 0 - 100 ppmv<br>0 - 20% |

*% refers to mol. %.

## Energy transition

As energy sources and gas mixtures continue to shift around the globe, rapid and reliable analysis of contaminants in hydrogen and carbon dioxide streams is vital to ensure safety, process control, and gas quality. Endress+Hauser TDLAS and QF analyzers serve these emerging market needs with fast, accurate, stable process measurements that have no contaminant interferences and nearly zero maintenance.


**Energy transition**

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ & $O_2$ | $H_2O$ and $O_2$ measurements for green hydrogen production | **$H_2O$:** 0 - 10 ppmv (H2 specific build); 0 - 50 ppmv (minimum); 0 - 6000 ppmv (maximum)<br>**$O_2$:** 0 - 10 ppmv (minimum); 0 - 1000 ppmv (maximum) |
| $H_2O$, $H_2S$ & $O_2$ | $H_2O$, $H_2S$ and $O_2$ measurements for carbon capture, utilization, and storage (CCUS) applications | **$H_2O$:** 0 - 50 ppmv (minimum); 0 - 6000 ppmv (maximum)<br>**$H_2S$:** 0 - 10 ppmv (minimum); 0 - 5% volume (maximum)<br>**$O_2$:** 0 - 100 ppmv (minimum); 0 - 20% volume (maximum) |
| $H_2O$ | Carbon capture, utilization, and storage (CCUS) - $CO_2$ dehydration with glycol | **$H_2O$:** 0 - 100 ppmv (minimum); 0 - 2000 ppmv (maximum) |
| $CO_2$ | Carbon capture, utilization, and storage (CCUS) - $CO_2$ purity after amine treatment | **$CO_2$:** 0 - 90% (minimum); 0 - 100% (maximum) |
| $H_2O$, $H_2S$, $O_2$, $CO_2$ | Real-time quality measurements in biogas and biomethane | **$H_2O$:** 0 - 50 ppmv (minimum); 0 - 6000 ppmv (maximum)<br>**$H_2S$:** 0 - 10 ppmv (minimum); 0 - 5% volume (maximum)<br>**$O_2$:** 0 - 100 ppmv (minimum); 0-5% (maximum)<br>**$CO_2$:** 0 - 5% (minimum); 0 - 20% (maximum) |

*% refers to mol. %.

## Liquefied natural gas (LNG)

The feed gas to liquefied natural gas plants must be treated to reduce $H_2O$ and $CO_2$ levels to 100 ppb and 50 ppm respectively to prevent these contaminants from freezing up in cold box heat exchangers and halting gas liquefaction, LNG loading, and shipments. Endress+Hauser TDLAS analyzers monitor $H_2O$, $CO_2$, and $H_2S$ in the feed gas to baseload LNG plants to ensure continuous, uninterrupted operation of liquefaction trains and on-time LNG loading and shipments.

**Liquefied natural gas**

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ | LNG: $H_2O$ in dry LNG feed gas | 0 - 10 ppmv |
| $H_2O$ | LNG: $H_2O$ in LNG product terminal | 0 - 10 ppmv |
| $CO_2$ | LNG: $CO_2$ in LNG amine unit | 0 - 100 ppmv |
| $H_2S$ | LNG: $H_2S$ in LNG amine unit | 0 - 10 ppmv<br>0 - 20 ppmv |

*Consult factory for alternative measurement ranges

## Natural gas processing

Natural gas processing involves separating methane ($CH_4$) from other hydrocarbons, water, and other contaminants ($H_2S$, $CO_2$, mercury, and nitrogen) entrained in raw wellhead gas to produce pipeline-quality dry natural gas. Endress+Hauser TDLAS analyzers perform on-line measurements of $H_2O$, $H_2S$, and $CO_2$ at critical points in the gas treatment process.

**Natural gas processing**

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ | Natural gas processing: $H_2O$ in molecular sieve dryer vessel outlet | 0 - 10 ppmv |
| $H_2O$ | Natural gas processing: $H_2O$ in natural gas product (product purity/residue gas) | 0 - 10 ppmv |
| $CO_2$ | Natural gas processing: $CO_2$ in amine outlet (sweet gas) | 0 - 100 ppmv |
| $CO_2$ | Natural gas processing: $CO_2$ in raw natural gas feed | 0 - 100 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in raw gas feed (produced gas) | 0 - 500 ppmv<br>0 - 5000 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in natural gas product (purity/residue gas) | 0 - 20 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in amine scrubber outlet | 0 - 20 ppmv |
| $H_2S$ | Natural gas processing: H2S in solid scavenger outlet | 0 - 20 ppmv |

*Consult factory for alternative measurement ranges

# NGL fractionation products

Wellhead natural gas from some geological formations contains commercially valuable and recoverable amounts of natural gas liquids (NGLs): ethane ($C_2H_6$), propane ($C_3H_8$), butane ($C_4H_{10}$) and a mix of $C_5$+ hydrocarbons. Cryogenic processing is used to separate NGLs from methane and fractionate the NGL mixture into distinct fractionation products. Endress+Hauser TDLAS analyzers perform on-line measurements of $H_2O$, $H_2S$, and $CO_2$ in NGL fractionation products to ensure purity specifications are met or their intended use and downstream processing.

**NGL fractionation products**

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ | Natural gas processing: $H_2O$ in Y-grade, NGL fractionation | 0 - 50 ppmv |
| $H_2O$ | Natural gas processing: $H_2O$ in ethane, NGL fractionation | 0 - 10 ppmv |
| $H_2O$ | Natural gas processing: $H_2O$ in ethane/propane mix, NGL fractionation | 0 - 10 ppmv |
| $H_2O$ | Natural gas processing: $H_2O$ in propane, NGL fractionation | 0 - 10 ppmv |
| $CO_2$ | Natural gas processing: $CO_2$ in Y-grade NGL fractionation | 0 - 500 ppmv |
| $CO_2$ | Natural gas processing: $CO_2$ in ethane NGL fractionation | 0 - 100 ppmv |
| $CO_2$ | Natural gas processing: $CO_2$ in ethane/propane mix NGL fractionation | 0 - 100 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in Y-grade NGL fractionation | 0 - 20 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in ethane NGL fractionation | 0 - 20 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in ethane/propane mix NGL | 0 - 20 ppmv |
| $H_2S$ | Natural gas processing: $H_2S$ in propane NGL fractionation | 0 - 20 ppmv |

*Consult factory for alternative measurement ranges

# Petrochemicals

Production of high purity olefins, ethylene ($C_2H_4$), and propylene ($C_3H_6$) involves steam cracking of hydrocarbon feedstocks such as naphtha or ethane followed by a series of unit operations to remove or convert contaminants in the cracked gas. Endress+Hauser TDLAS analyzers perform on-line measurements of contaminants ($C_2H_2$, $NH_3$, $H_2O$, $H_2S$, and $CO_2$) at critical points in olefins plants and polymer production.

## Olefins

### Olefins

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ | Petrochem: $H_2O$ in pure ethylene | 0 - 10 ppmv |
| $H_2O$ | Petrochem: $H_2O$ in UNIPOL™ PE process ethylene feed gas | 0 - 10 ppmv |
| $H_2O$ | Petrochem: $H_2O$ in cracked gas dryer vessel outlets | 0 - 10 ppmv |
| $H_2O$ | Petrochem: $H_20$ in pure propylene (steam cracker) | 0 - 10 ppmv |
| $C_2H_2$ | Petrochem: $C_2H_2$ in mid-bed of back end acetylene converters | 0 - 3000 ppmv |
| $C_2H_2$ | Petrochem: $C_2H_2$ in outlet of back end acetylene converters | 0 - 5 ppmv |
| $C_2H_2$ | Petrochem: $C_2H_2$ in pure ethylene | 0 - 5 ppmv |
| $NH_3$ | Petrochem: $NH_3$ in pure ethylene | 0 - 5 ppmv |
| $NH_3$ | Petrochem: $NH_3$ in pure propylene | 0 - 5 ppmv |
| $H_2S$ | Petrochem: $H_2S$ in caustic wash tower inlets | 0 - 500 ppmv |
| $H_2S$ | Petrochem: $H_2S$ in UOP C3 Oleflex process reactor effluent | 0 - 150 ppmv |
| $CO_2$ | Petrochem: $CO_2$ in caustic wash tower inlets | 0 - 500 ppmv |

*Consult factory for alternative measurement ranges

## Syngas

### Syngas

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $CO_2$ | Syngas: $CO_2$ in GTL syngas (synthol process) coal liquefaction (CTL/Benfield outlet) | 0 - 100 ppmv |

*Consult factory for alternative measurement ranges

# Refining

Refinery gas streams contain contaminants that can adversely affect operational efficiency, process yields, and refinery operating margins. Endress+Hauser TDLAS analyzers perform on-line measurements of $H_2S$ and $H_2O$ in process gas streams to help refineries control these contaminants, optimize unit operations, and comply with environmental regulations.

**Refining**

| Analyte | Application note title | Typical measurement range(s)* |
|---|---|---|
| $H_2O$ | Refining: $H_2O$ in hydrogen recycle for refinery catalytic reformer $H_2$ recycle streams | 0 - 50 ppmv (control)<br>50 - 500 ppmv (trend) |
| $H_2O$ | Refining: $H_2O$ in continuous catalytic reformer $H_2$ recycle streams | 0 - 50 ppmv |
| $H_2O$ | Refining: $H_2O$ in propane/propylene mix | 0 - 10 ppmv |
| $H_2O$ | Refining: $H_2O$ in alkylation feedstock | 0 - 50 ppmv |
| $H_2O$ | Refining: $H_2O$ in n-butane feed gas to UOP Butamer process | 0 - 5 ppmv |
| $H_2O$ | Petrochem and refining: $H_2O$ in instrument air | 0 - 100 ppmv |
| $H_2S$ | Refining: $H_2S$ in propane/propylene mix | 0 - 10 ppmv |
| $H_2S$ | Refining: $H_2S$ in flare gas | 0 - 10 ppmv<br>0 - 300 ppmv |
| $H_2S$ | Refining: $H_2S$ in fuel gas | 0 - 320 ppmv |
| $H_2S$ | Refining: $H_2S$ in hydrogen recycle for catalytic reformer | 0 - 50 ppmv<br>0 - 300 ppmv |
| $H_2S$ | Refining: $H_2S$ in amine treatment unit outlet hydrogen recycle gas | 0 - 50 ppmv<br>0 - 100 ppmv<br>0 - 300 ppmv |

*Consult factory for alternative measurement ranges

**Get more details for a specific measurement by downloading the application note.**

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PU01459C/66/EN/03.23

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