The world’s safest continuous H₂S analyzer.

» UV-Vis 200-800 nm spectrophotometer
» Solid state with no moving parts
» Analyzes liquid or gas stream
» Zero cross-interference from other chemicals
» Measures up to 5 total stream components
» Xenon light source with 5 year lifespan
» Wide dynamic range — 0-10 ppm to 0-100%
» Direct analysis of hot/wet sample

Multi-Component Measurement:

H₂S

Up to 4 additional software benches
The Notorious H₂S

Hydrogen sulfide is toxic at 10 ppm, entirely lethal at 800 ppm, highly corrosive to equipment, flammable when in excess of 4.3% by volume in air, and unpleasantly odorous at a threshold of less than 1 ppb.

Unfortunately, H₂S occurs abundantly in the world’s fossil fuel reserves and also forms as a by-product in various industrial and biological processes. In order to produce clean-burning fuels, prevent acid rain, protect pipelines and equipment from corrosion, and — most importantly — protect workers from imminent disasters, H₂S levels are highly regulated using scrubbers, scavengers, sulfur recovery units, and other removal technologies.

To properly control the level of H₂S in fuel, wastewater, or emissions, you need a reliable method of measuring the H₂S concentration. Since safety is a major concern, only highly proven solutions are considered. For many years, that meant that customers were stuck with archaic paper tape technology, a maintenance headache with toxic consumables and frequent moving-part hardware failures.

Since its launch in 1994, OMA technology has rapidly replaced the old methods by providing the customer with solid state reliability and superior performance in an affordable package.

What is the OMA H₂S Analyzer?

The OMA is an industrial device which measures a high-resolution absorbance spectrum in a continuously drawn sample from a liquid or gas process stream. Harvesting this rich data, the OMA H₂S Analyzer isolates the H₂S absorbance curve and provides a real-time value for H₂S concentration in your process.

» What is Absorbance Spectroscopy?

One of the ways in which light interacts with matter is absorption: a molecule absorbs specific wavelengths of radiation as a function of its unique electronic and molecular structures. The energies (wavelengths) of radiation that are absorbed match the energy quanta that are required to move that molecule between two quantum mechanical states. This is why each molecule absorbs radiation in a unique, recognizable way.

Absorption is quantified as absorbance, or the difference between intensity of the radiation entering the substance and the intensity of the radiation exiting the substance. Plotting the absorbance against wavelength creates an absorbance spectrum, which allows us to observe the shape (curve) of the absorbance. Each chemical species has a natural identifier in its absorbance curve that can be detected like a fingerprint.

According to Beer-Lambert law, the absorbance of a chemical in a mixture is directly proportional to its concentration. By measuring the height of a chemical’s absorbance curve, an instrument can determine that chemical’s concentration.
OMA Principle of Operation

The optical assembly of the OMA is depicted below, illustrating the complete path of the signal.

The signal originates in the light source and travels via fiber optic cable to the sample flow cell. Passing through the length of the flow cell, the signal picks up the absorbance imprint of the continuously drawn sample fluid. Exiting the flow cell on the opposite end, the signal travels by fiber optic cable to the spectrophotometer, where a holographic grating separates the signal into its constituent wavelengths, focusing each wavelength onto a corresponding photodiode on a 1024-diode array. This is known as dispersive spectrophotometry.

Producing an Absorbance Spectrum

The intensity baseline of the signal is continuously refreshed by the Auto Zero, which stores an intensity spectrum while the flow cell is purged with zero-absorbance fluid (e.g., nitrogen). During analysis, when running process sample through the flow cell, the OMA measures the difference in intensity from this baseline at each wavelength in order to produce an absorbance spectrum:
System Overview

Each version of the OMA uses the same basic components. These components are indicated below inside the model OMA-300 (door removed):
» **nova II™ Spectrophotometer**

The heart of the OMA is the diode array spectrophotometer. This device contains the light source as well as the detector which measures the absorbance spectrum.

A highly evolved device, the nova II has several distinctive features which allow it to excel in demanding OMA applications:

- Solid state build with excellent wavelength stability
- CMOS analog circuitry reduces noise and power consumption
- 1024-element diode array with ~1nm resolution
- Strong light throughput in low UV region
- Very low stray light due to design without mirrors or filters
- Ethernet interface for remote access

» **Human Machine Interface**

The HMI controlling the spectrophotometer and communication provides a simple, touch-screen visual interface. Running our proprietary ECLIPSE software, the HMI offers the user several display choices (e.g. standard numeric display, trendgraph, bar graph).

From this interface, the user can quickly adjust settings like how frequently the Auto Zero is performed, the unit of concentration for each measurement, the analog output range, and much more.

» **Flow Cell**

The sample (gas or liquid) from the process stream continuously cycles through the flow cell via 1/4" Swagelok tube fittings. The standard flow cell is rated up to 3,000 psi / 150 °C and made from stainless steel 316L for corrosion-proof durability.

The path length of the flow cell is specified by our engineers to optimize the measurement for the expected concentration ranges of your analytes.

![2 mm path](image1.png)  
![600 mm path](image2.png)

» **Fiber Optic Cables**

Our fibers are all manufactured in-house to ensure spectroscopic-grade quality. The stainless steel cladding provides proven durability in the field. Before shipment, each fiber is tested to ensure it meets transmission benchmarks. Exceptional UV light transmission is achieved through our presolarization technique.

The fibers connect to the flow cell through rugged steel collimators, and are thus not wetted to the sample fluid. Optional cooling extensions provide further protection from hot samples.
Choose Your Form Factor

The OMA H₂S Analyzer is available in three different models:

**MODEL OMA-300**
**WALL-MOUNTED ANALYZER**
Available in a variety of enclosure materials.

**MODEL OMA-206P**
**PORTABLE ANALYZER**
A rugged copolymer suitcase enclosure.

**MODEL OMA-406R**
**RACKMOUNT ANALYZER**
Designed for a standard 19”rack.

Explosion-Proof Your OMA

The OMA-300 is available in two explosion-proof formats:

Ex p Purged Enclosure (X/Z Purge)  Ex d Cast-Aluminum NEMA 4X Enclosure
**Full-Spectrum Analysis**

A conventional ‘multi-wave’ photometer measures a chemical’s absorbance at one pre-selected wavelength with one photodiode. This ‘non-dispersive’ technique uses an optical filter or line source lamp to remove all wavelengths but the pre-selected measurement wavelength.

By contrast, the OMA uses a dispersive spectrophotometer to acquire a full, high-resolution spectrum. Each integer wavelength in the spectral range is individually measured by a dedicated photodiode.

» **The Accuracy Advantage of Collateral Data**

A single photodiode is susceptible to noise and signal clipping. As accepted in the lab community for decades, the only way to eradicate this source of error is to use many photodiodes measuring at many wavelengths. Compiling the data from all these photodiodes produces an absorbance spectrum instead of a single data point:
While the single-wavelength photometer has only one data point and no contextual curve with which to verify the accuracy of that data point, the OMA uses statistical averaging of all the data points along the curve to immediately detect and ignore erroneous data from a single photodiode. By detecting the actual structure of the curve instead of peak absorbance, the OMA avoids false positives and provides superior accuracy.

» Visualizing the H₂S Absorbance Curve

In calibration, the OMA ‘learns’ the absorbance curve of each measured analyte and how to isolate this curve from the total sample absorbance spectrum. Technically, the calibration procedure stores molar absorption coefficients for each wavelength while running a calibration standard (mixture of known concentration) through the flow cell.

» Massive Dynamic Range

The reason that most photometers measure a limited concentration range is because the signal gets clipped when absorbance gets too low (indistinguishable from noise) or too high (zero light detected).

Through full-spectrum acquisition, the OMA has access to many measurement wavelengths. In order to constantly optimize the signal, the OMA runs parallel analysis models, each differentiated by their wavelength range and each suited for a specific concentration range. This concept is illustrated below, where the the low-absorbance region (235-250 nm) of the curve is used at the high concentration range to avoid low-light signal clipping.
Multi-Component Analysis

The ECLIPSE software is capable of measuring up to 5 chemical species simultaneously by de-convoluting the absorbance curve of each analyte from the total sample absorbance structure.

As illustrated above, each measurement wavelength contributes an equation to a matrix which is continuously solved by the ECLIPSE multi-component algorithm. Due to the resolution of the spectrophotometer, this procedure isolates the absorbance curve of H₂S with very high accuracy and is not susceptible to cross-interference. Each equation takes the form:

\[ A'_{(x+y)} = A'_x + A'_y = e'_{x}bc_{x} + e'_{y}bc_{y} \]

Where \( A' \) is the absorbance at wavelength \( \lambda' \), \( e' \) is the molar absorptivity coefficient at wavelength \( \lambda' \), \( c \) is concentration, and \( b \) is the path length of the flow cell.

Photometers that offer multi-component analysis will often use crude techniques like rotating “chopper” filter wheels or a group of line source lamps. These solutions implement moving parts that are prone to malfunction and multiple light sources that all require replacement, while delivering inferior accuracy.

Through the power of rich data, the OMA provides robust multi-species measurement using a solid state design and a single light source.

» Benefit Summary

- Measure up to 5 chemical species simultaneously with a single OMA
- Add or remove analytes at any time
- Full subtraction of background absorbance (for avoidance of false positives)
The Safety of OMA

The major safety flaw of many \( \text{H}_2\text{S} \) analyzers is that they bring the toxic sample fluid into the analyzer enclosure for analysis. Not only does this expose system electronics to higher corrosion effects, it also poses a lethal threat: if there is any leak in the instrument, especially inside a shelter, the human operator is placed at enormous risk.

Applied Analytics design centers on inherent safety. The key difference between the OMA and other optical \( \text{H}_2\text{S} \) analyzers is the use of fiber optic cables: we bring the light to the sample instead of bringing the sample to the light. The toxic sample fluid is only required to circulate through the dedicated flow cell, and never enters the analyzer electronics enclosure.

» Wetted Parts

The flow cell is sealed on each end by an extremely solid one-piece collimator inserted into an o-ring. No other parts of the analyzer assembly ever come into contact with the sample.

» Safety Benefits

- No danger of leaks inside the analyzer because the sample fluid does not enter the analyzer enclosure
- Standard SS316 flow cell is rated up to 3000 psi and pressure-tested at factory
- Custom fiber length up to 7 meters allows for distance between analyzer and flow cell
- User can safely perform service on the analyzer while process is running

This OMA system was installed outside of the enclosed area that contained the sampling point. The wall separates the analyzer from the flow cell and the fiber optics are wired through the wall. This system is being used to safely monitor \( \text{H}_2\text{S} \) and odorants at a natural gas custody transfer station.
Experienced Applications

The OMA has been used in many distinct H$_2$S applications since its launch in 1994. Below we highlight some of our most experienced, time-tested applications:

» H$_2$S in Crude Oil

Our highly proven solution for H$_2$S monitoring in crude oil uses an advanced headspace sample conditioner. Since oil is too opaque to transmit the OMA’s light signal, this system exploits Henry’s Law to produce a highly representative headspace vapor sample by heating the crude.

» H$_2$S in Offshore Environment

The offshore model OMA is specified for corrosive maritime conditions with NEMA 4X SS316 enclosures and super duplex steel wetted parts.
» H₂S in Flue Gas / Emissions

The ‘close-coupled’ OMA H₂S Analyzer is an elegant hybrid of cross-stack and extractive methods which combines the best of both. The system is mounted on the stack via a sintered metal probe which draws the sample.

» H₂S in Natural Gas

The most common H₂S application for the OMA is natural gas analysis, e.g. in pipeline corrosion prevention, wellhead, custody transfer stations, and more. The SCS design varies by specific application.

» H₂S in Water

The OMA is ideal for measuring H₂S in water specifically because H₂O has no absorbance in the 200-300 nm UV measurement wavelength range, allowing for direct ‘wet’ analysis.

Applied Analytics™

We are a global manufacturer of industrial process analysis equipment. Our customers depend on our systems to keep a vigilant watch over the quality of their product, illuminate hidden phenomena occurring in their process, reduce their harmful emissions into the environment, and ensure the safety of their workers in hazardous industrial environments.

We are proud to serve the industries that keep the world running — the oil refineries, the power plants, the wastewater treatment facilities, the chemical producers, the pharmaceutical innovators, the breweries, the environmental protection agencies — and meet their analysis needs with modern, automated solutions.

Applied Analytics has been operating in the greater Boston area since our incorporation in 1994. All of our products are designed and manufactured in the USA.
## Comparison of H₂S Measurement Technologies

<table>
<thead>
<tr>
<th></th>
<th>Lead Acetate Tape</th>
<th>Tunable Diode Laser</th>
<th>Gas Chromatograph</th>
<th>OMA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interference from moisture in sample?</td>
<td>NONE</td>
<td>HIGH</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>Response time?</td>
<td>SLOW</td>
<td>FAST</td>
<td>SLOW</td>
<td>FAST</td>
</tr>
<tr>
<td>Dynamic range?</td>
<td>LIMITED</td>
<td>LIMITED</td>
<td>WIDE</td>
<td>WIDE</td>
</tr>
<tr>
<td>Moving parts?</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Additional chemical measurements?</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Pressure range in the sample?</td>
<td>LOW</td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>Temperature range in the sample?</td>
<td>HIGH</td>
<td>LOW</td>
<td>LOW</td>
<td>HIGH</td>
</tr>
<tr>
<td>Consumables? (other than zero gas)</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Maintenance cost?</td>
<td>HIGH</td>
<td>LOW</td>
<td>HIGH</td>
<td>LOW</td>
</tr>
</tbody>
</table>

- **Interference from moisture in sample?**
  - Lead Acetate Tape: NONE
  - Tunable Diode Laser: HIGH
  - Gas Chromatograph: NONE
  - OMA: NONE

- **Response time?**
  - Lead Acetate Tape: 20-180 seconds. Actual response time depends on H₂S level.
  - Tunable Diode Laser: <10 seconds
  - Gas Chromatograph: 5-10 minutes
  - OMA: <10 seconds

- **Dynamic range?**
  - Lead Acetate Tape: Only suitable for low level H₂S. Tape saturation occurs above 1000 ppm and requires error-prone dilutions.
  - Tunable Diode Laser: Designed for levels under 500 ppmv. Signal saturation occurs at higher levels w/ no alternate wavelengths.
  - Gas Chromatograph: Designed for levels under 500 ppmv. Signal saturation occurs at higher levels w/ no alternate wavelengths.
  - OMA: 0-10 ppm and 0-100% in the same system.

- **Moving parts?**
  - Lead Acetate Tape: YES
  - Tunable Diode Laser: NO
  - Gas Chromatograph: YES
  - OMA: NO

- **Additional chemical measurements?**
  - Lead Acetate Tape: NO
  - Tunable Diode Laser: NO
  - Gas Chromatograph: YES
  - OMA: YES

- **Pressure range in the sample?**
  - Lead Acetate Tape: Sample must be at atmospheric pressure
  - Tunable Diode Laser: Typical: 20 psig max.
  - Gas Chromatograph: Sample must be at atmospheric pressure
  - OMA: Sample must be at atmospheric pressure

- **Temperature range in the sample?**
  - Lead Acetate Tape: Significant error due to temperature sensitivity; sample temperature cannot exceed 50-60 °C.
  - Tunable Diode Laser: Significant error due to temperature sensitivity; sample temperature cannot exceed 50-60 °C.

- **Consumables? (other than zero gas)**
  - Lead Acetate Tape: Each paper tape reel lasts 1 month and must be manually replaced.
  - Tunable Diode Laser: Copper nanoparticle H2S scrubber replaced each 18 months; high-volume cell consumes a lot of process fluid.
  - Gas Chromatograph: Carrier gas, separation columns, and detectors.
  - OMA: Xe light source has an average 5 year lifetime.

- **Maintenance cost?**
  - Lead Acetate Tape: New tape reel needed each month; frequent tape drive jams; manual dilutions for overload
  - Tunable Diode Laser: Optics require cleaning.
  - Gas Chromatograph: Famously expensive to operate and maintain.
  - OMA: Optics require cleaning once per month -- 60 second procedure.

*Note: specifications found in product literature from mainstream manufacturers.*
Technical Specifications

Note: All performance specifications are subject to the assumption that the sample conditioning system and unit installation are approved by Applied Analytics. For any other arrangement, please inquire directly with Sales.

<table>
<thead>
<tr>
<th>General</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement Principle</td>
<td>Dispersive UV-Vis absorbance spectrophotometry</td>
</tr>
<tr>
<td>Detector</td>
<td>nova II™ diode array spectrophotometer</td>
</tr>
<tr>
<td>Spectral Range</td>
<td>200-800 nm</td>
</tr>
<tr>
<td>Light Source</td>
<td>Pulsed xenon lamp (average 5 year lifespan)</td>
</tr>
<tr>
<td>Signal Transmission</td>
<td>Standard: 600 µm core 1.8 meter fiber optic cables</td>
</tr>
<tr>
<td>Sample Phase</td>
<td>Gas or liquid</td>
</tr>
<tr>
<td>Sample Introduction</td>
<td>Standard: stainless steel 316L flow cell with application-dependent path length</td>
</tr>
<tr>
<td>Sample Conditioning</td>
<td>Custom design if needed</td>
</tr>
<tr>
<td>Analyzer Calibration</td>
<td>If possible, analyzer is factory calibrated with certified calibration fluids; no re-calibration required after initial calibration; measurement normalized by Auto Zero.</td>
</tr>
<tr>
<td>Reading Verification</td>
<td>Simple verification with samples or neutral density filters</td>
</tr>
<tr>
<td>Human Machine Interface</td>
<td>Industrial controller with touch-screen LCD display running ECLIPSE™ Software</td>
</tr>
<tr>
<td>Data Storage</td>
<td>32GB Solid State Drive</td>
</tr>
<tr>
<td>Available Certifications</td>
<td>CSA Class I, Division 1; CSA Class I, Division 2; ATEX Exp II 2(2) GD. Please inquire for other certifications.</td>
</tr>
</tbody>
</table>

Measuring Parameters

<table>
<thead>
<tr>
<th>Accuracy</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>H₂S (liquid phase)</strong></td>
<td>0-10 mg/L: ±0.1 mg/L 0-100 mg/L: ±1% full scale or 0.1 mg/L*</td>
</tr>
<tr>
<td><strong>H₂S (gas phase)</strong></td>
<td>0-10 ppm (@10 bar): ±0.1 ppm 0-10 ppm (@1 bar): ±1 ppm 0-100 ppm: ±1% full scale or 1 ppm*</td>
</tr>
<tr>
<td></td>
<td>0-10,000 ppm: ±1% full scale 0-100%: ±1% full scale</td>
</tr>
</tbody>
</table>

Sample Conditions

<table>
<thead>
<tr>
<th>Sample Temperature</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Using immersion probe</td>
<td>-20 to 150 °C (-4 to 302 °F)</td>
</tr>
<tr>
<td>Using standard flow cell</td>
<td>-20 to 150 °C (-4 to 302 °F)</td>
</tr>
<tr>
<td>Using optional sample cooling</td>
<td>up to 1000 °C (1832 °F)</td>
</tr>
<tr>
<td>Sample Pressure (max)</td>
<td></td>
</tr>
<tr>
<td>Using immersion probe</td>
<td>100 bar (1470 psig)</td>
</tr>
<tr>
<td>Using standard flow cell</td>
<td>206 bar (3000 psi)</td>
</tr>
</tbody>
</table>

Ambient Conditions

<table>
<thead>
<tr>
<th>Analyzer Environment</th>
<th>Indoor/Outdoor (no shelter required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient Temperature</td>
<td>Standard: 0 to 35 °C (32 to 95 °F)</td>
</tr>
<tr>
<td></td>
<td>With optional temperature control: -20 to 55 °C (-4 to 131 °F)</td>
</tr>
<tr>
<td></td>
<td>To avoid radiational heating, use of a sunshade is recommended for systems installed in direct sunlight.</td>
</tr>
</tbody>
</table>

Utility Requirements

| Electrical             | 85 to 264 VAC 47 to 63 Hz                                                                  |
| Power Consumption      | 45 watts                                                                                    |

Outputs/Communication

1x galvanically isolated 4-20mA analog output per measured analyte (up to 3; additional available by upgrade)
2x digital outputs for fault and SCS control
Optional: Modbus TCP/IP; RS-232; RS-485; Fieldbus; Profibus; HART; more

Physical Specifications

<table>
<thead>
<tr>
<th>Model OMA-300</th>
<th>Model OMA-206P</th>
<th>Model OMA-406R</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analyzer Enclosure</td>
<td>Standard: wall-mounted, carbon steel NEMA 4 enclosure</td>
<td>Ultra High Impact structural copolymer suitcase</td>
</tr>
<tr>
<td>Analyzer Dimensions</td>
<td>24” H x 20” W x 8” D (610 x 508 x 203 mm)</td>
<td>16.87” H x 20.62” W x 8.12” D (428 x 524 x 206 mm)</td>
</tr>
<tr>
<td>Analyzer Weight</td>
<td>32 lbs. (15 kg)</td>
<td>25 lbs. (11 kg)</td>
</tr>
<tr>
<td>Wetted Materials</td>
<td>Standard: K7 glass, Viton, stainless steel 316L</td>
<td></td>
</tr>
</tbody>
</table>
See data sheets for drawings of OMA-206P and OMA-406R.