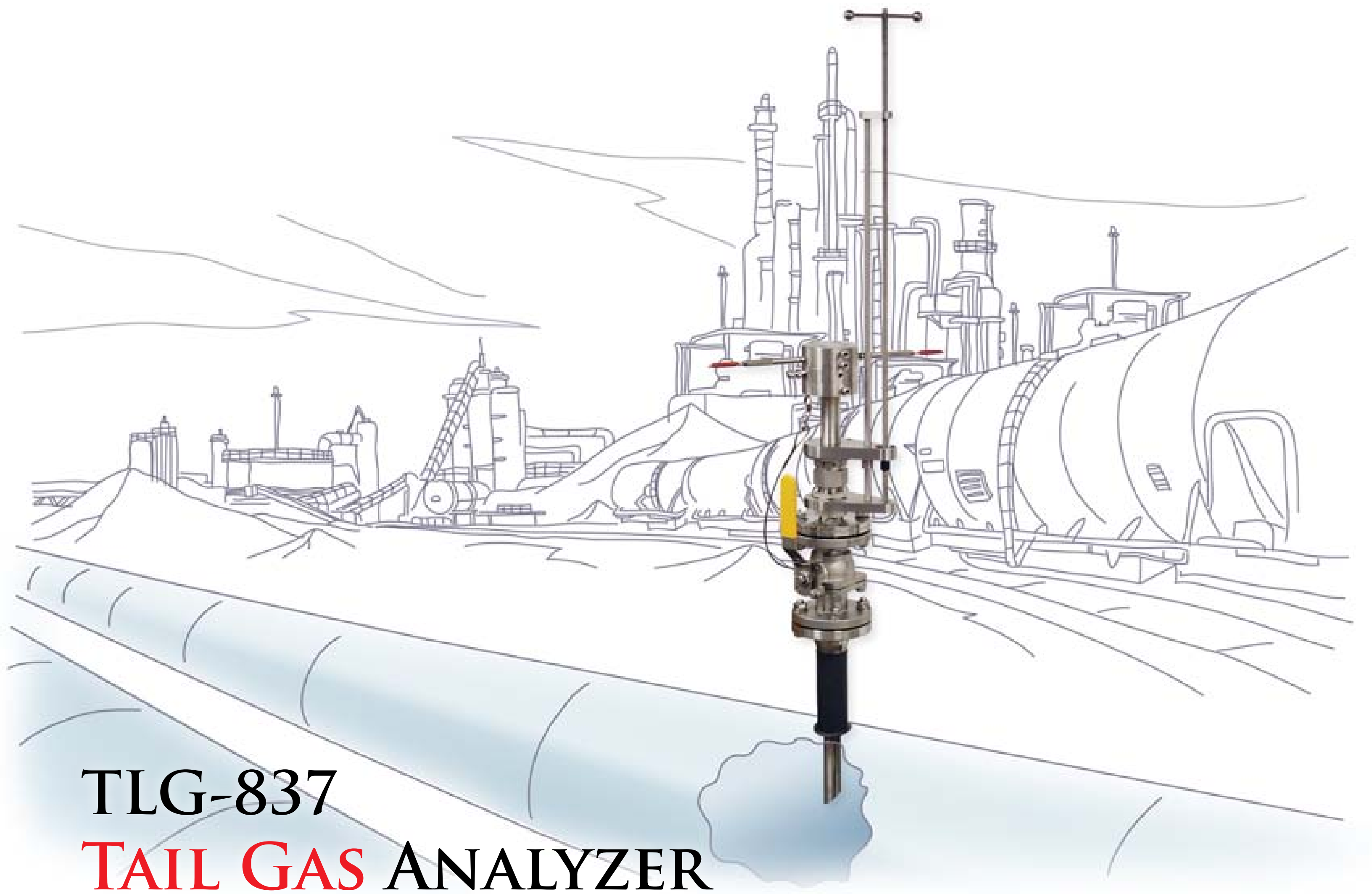


TLG-837
Tail Gas Analyzer

- in situ demister probe
- no sample line, no heat-tracing
- solid state diode array detector
- synchronous monitoring of H_2S, SO_2, COS, CS_2
- continuous air demand signal via 4-20mA output
- long-lifespan xenon light source

Designed for use in:

- Claus
- SuperClaus
- selective oxidation

The TLG-837 is AAI's solid state, in situ solution for online tail gas analysis in sulfur recovery. This system monitors real-time concentrations of H_2S and SO_2 in the Claus process stream, computing the control parameter for a continuously reliable air demand signal.

The critical point of innovation lies in the sampling design. The patented, in situ demister probe condenses sulfur vapor out of the process gas in a controlled manner, elegantly resolving the major vulnerability of most tail gas analyzers. The lack of sample lines and heat tracing translates to extremely fast response and low-maintenance performance. The demister probe vastly outperforms the clumsier sampling methods used widely in sulfur recovery.

Altogether, the TLG-837 packages relentless accuracy, set-and-forget reliability, and true automation—that is, everything that modern sulfur recovery deserves.

APPLIED™ ANALYTICS

The future of industrial process analysis.

Some Context

A critical step in refining crude oil and natural gas is the removal of naturally-occurring hydrogen sulfide. Notorious for being corrosive, toxic, flammable, and odorous, this colorless H_2S gas has been a hazard to both workers and equipment since the inception of modern refining.

Typically, an amine unit is used to absorb H_2S from fossil fuels. The Claus process is the industry standard for converting the "sour" (rich in H_2S) gas from the amine unit into elemental sulfur, which can be repurposed in producing sulfuric acid, fertilizer, gunpowder, and more.

In the reaction furnace, H_2S is combusted with oxygen:

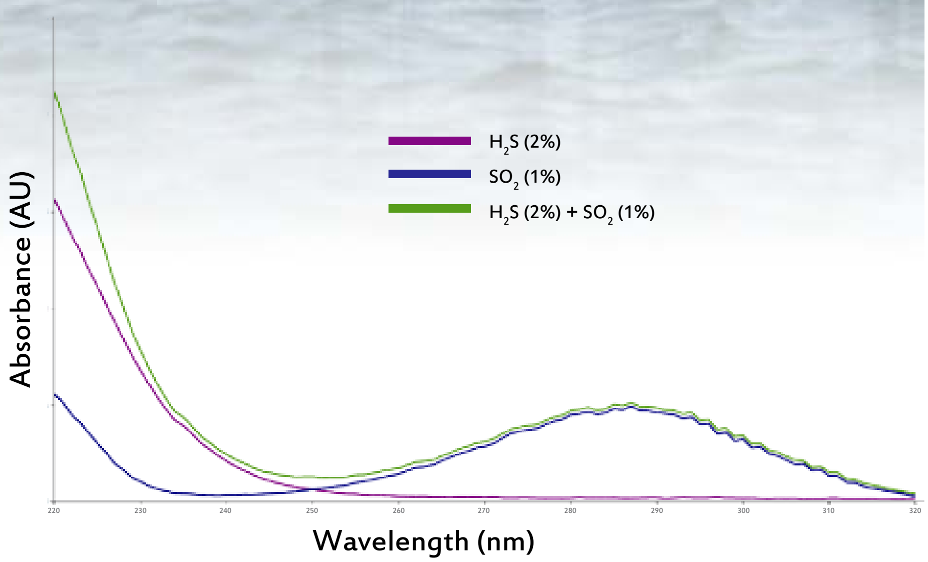
$$3H_2S + {}^{3}/_{2}O_2 \longrightarrow SO_2 + H_2O + 2H_2S$$

A catalytic converter reacts these products to create elemental sulfur in its various crystalline forms:

$$2H_2S + SO_2 \longrightarrow 2H_2O + {}^{3}/_{x}S_x$$

The correct 2:1 stoichiometric ratio of H_2S to SO_2 is necessary for efficient conversion. As shown by the combustion reaction above, this ratio is maintained by adjusting the amount of available oxygen. The efficiency of the Claus process thus hinges on the reliability of the air demand signal, a value calculated from continuous measurement of H_2S and SO_2 concentrations in the tail gas stream. An additional concern is the detection of CS_2 and COS, as the presence of these compounds indicates potential problems with the catalyst bed.

Composite UV Absorbance of H_2S and SO_2



These overlaid spectra (at left) show the interfering ultraviolet absorbance features of H_2S and SO_2. The total sample absorbance is like a composite image built from the contributions of each individual species.

The narrow-band analyzers used commonly for tail gas streams are crippled by interference. Designed to watch predetermined peaks, they lack the fundamental capacity to distinguish between the absorbance of one species, of another, and of the process background. In breaking the measured spectrum down to its structural elements, diode array technology stands alone.

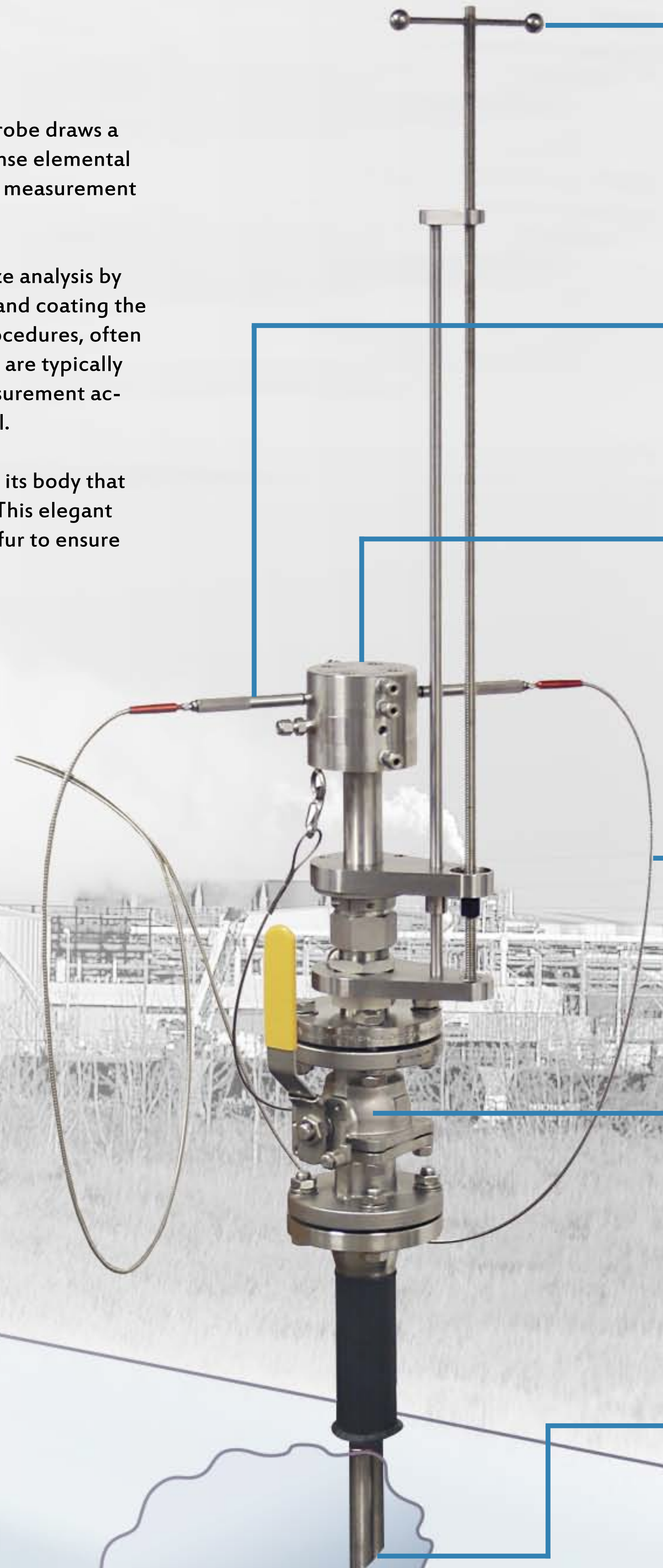
APPLIED ANALYTICS

Mounted directly on the process pipeline, the in situ demister probe draws a continuous sample for analysis. The probe is designed to condense elemental sulfur vapor out of the sample in a controlled manner to protect measurement integrity.

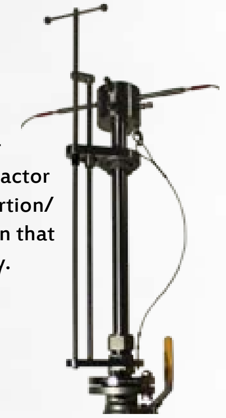
Usually present in the form of S_8 or S_6, sulfur vapor will jeopardize analysis by distorting absorbance readings or by condensing to solid sulfur and coating the optical windows. Other analyzers use convoluted correction procedures, often relying on temperature-based sulfur prediction. These methods are typically crude compensation measures; the only way to secure true measurement accuracy is to physically keep the sulfur from reaching the flow cell.

Using steam, the TLG-837 maintains a stable temperature along its body that forces incident sulfur to liquefy and drip back into the process. This elegant design exploits the relatively high boiling point of elemental sulfur to ensure that the sample reaching the flow cell is nearly sulfur-free.

Other probe features include:
- internal pressure and temperature compensation
- simple hot-tapping capability
- convenient introduction of verification gases
- automated steam wash cycle for optics



Retractor



Operated by hand or electric drill, the retractor simplifies probe insertion/removal with a design that prioritizes user safety.

Cooling Extensions

By insulating the optical fibers from the hot sample inside the flow cell, the extensions allow the probe to operate at extreme process temperatures without frequent cable replacement or any loss of signal integrity.

Flow Cell Disk

Steam tracing in the flow cell heats the sample gas and prevents condensation of trace sulfur near the optics. The steam path is designed for maximal surface area, protecting against any sulfur buildup and ensuring maintenance-free performance.

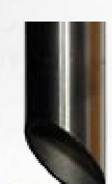
Fiber Optic Cables

Custom-length optical fibers afford much flexibility when it comes to installation (e.g. remote analyzer placement). This medium also keeps both user and elctronics safe from corrosive process gas.

Ball Valve

The probe is easily hot-tapped by means of the ball valve, which maintains the process seal during installation or removal. This capability eradicates downtime and streamlines probe start-up.

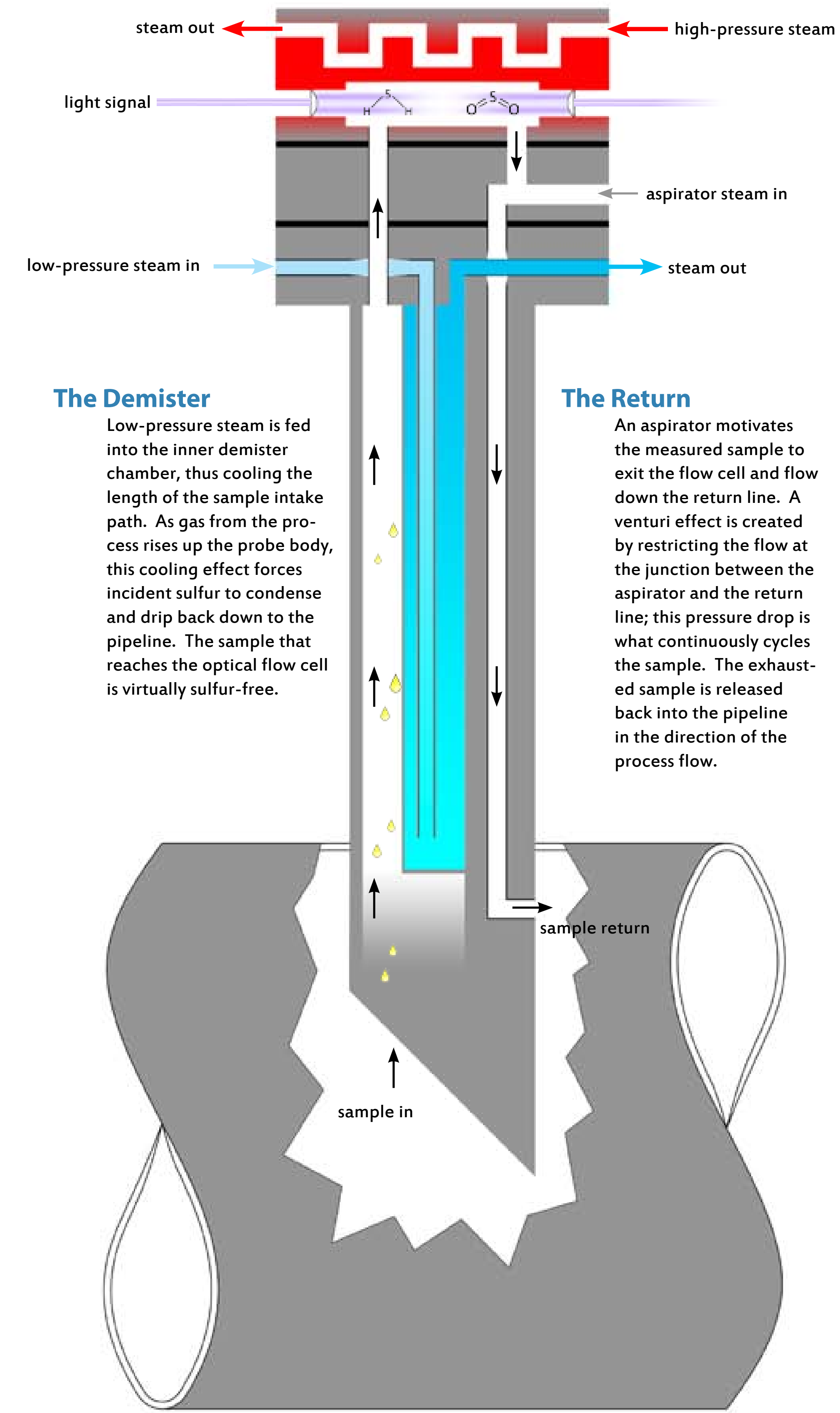
Angled Inlet Tip



The angle improves efficency by using flow direction to motivate sampling.

The Measurement

High-pressure steam is fed into a special channel in the probe head to heat the optical flow cell. This prevents any sulfur that might have survived the demister from condensing inside the flow cell and coating the lenses.

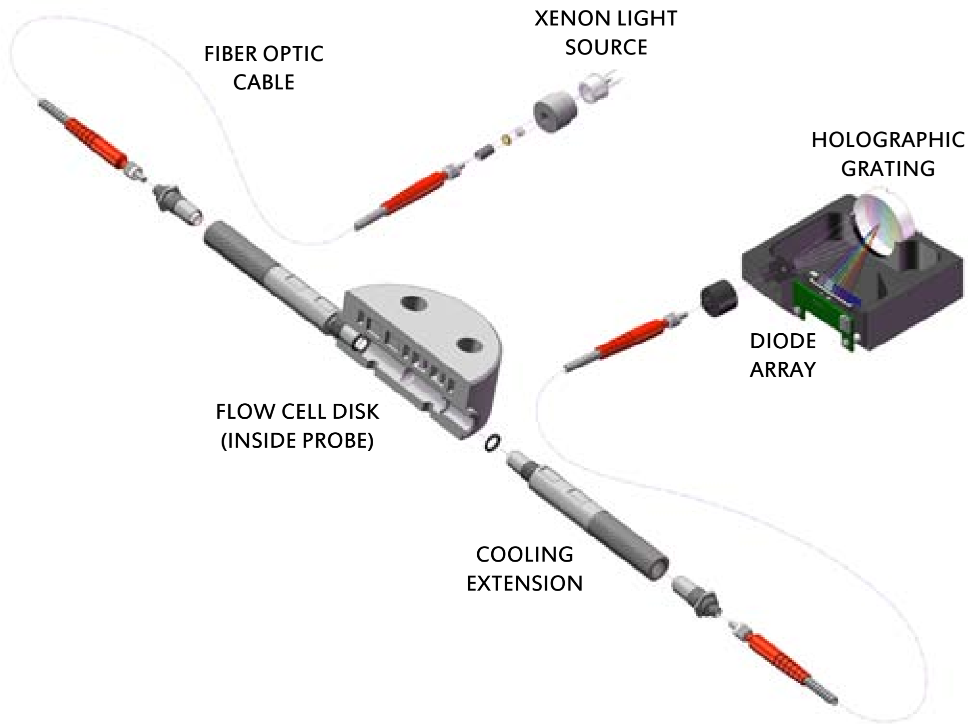


The Demister

Low-pressure steam is fed into the inner demister chamber, thus cooling the length of the sample intake path. As gas from the process rises up the probe body, this cooling effect forces incident sulfur to condense and drip back down to the pipeline. The sample that reaches the optical flow cell is virtually sulfur-free.

The Return

An aspirator motivates the measured sample to exit the flow cell and flow down the return line. A venturi effect is created by restricting the flow at the junction between the aspirator and the return line; this pressure drop is what continuously cycles the sample. The exhausted sample is released back into the pipeline in the direction of the process flow.



Solid State Optical Design

Though virtually instantaneous, the measurement cycle is best understood in stages. First, a pulsed xenon source inside the analyzer emits a white light signal that travels via fiber optic cable to the in situ probe. The flow cell disk inside the probe head is the sample interface, i.e. the path along which molecules from the process stream interact with the light signal.

Emerging on the opposite end of the flow cell disk, the signal returns via fiber optic cable to the analyzer enclosure. In the nova-II spectrometer, a dispersive holographic grating prismatically separates the white light into its constituent wavelengths, focusing each differentiated wavelength onto a designated photodiode on the diode array. The measured transmittance values are used to construct real-time absorbance spectra at ultra-fine resolution.

The factory-calibrated TLG-837 Analyzer recognizes the unique absorbance structures of H_2S and SO_2 in the sample spectrum. Using systemic overdetermined regression, the software isolates the absorbance attributed to each species. Benefitting from the most robust background correction available in online tail gas analysis, these values are correlated to dynamic concentrations with unrivaled accuracy.

Watch a Flash demo that explains how the TLG-837 performs multi-component analysis by clicking here.

The AAI Advantage

Complete Tail Gas Monitoring Solution

The system monitors concentrations of H_2S, SO_2, COS, and CS_2 in the process stream and provides a real-time air demand signal to the DCS via 4-20mA output.

Patented In Situ Demister Probe

Internally, the probe condenses elemental sulfur out of the sample and returns it to the process. Sulfur-related complications are entirely circumvented.

No Sample Lines

Leave sample line maintenance in the past: no more heat tracing or cold spot plugging.

UV-VIS Diode Array Detector

Full-spectrum (190-800nm) monitoring allows for interference-free, multi-species analysis and robust background correction. Solid state design and a long-lifetime (~5 yr) xenon light source contribute to the TLG-837's unyielding reliability.

Industry-Leading Response Time

Zero sample lag translates to tighter process control. In the TLG-837, optical measurement occurs directly inside the probe.

Wide Dynamic Range

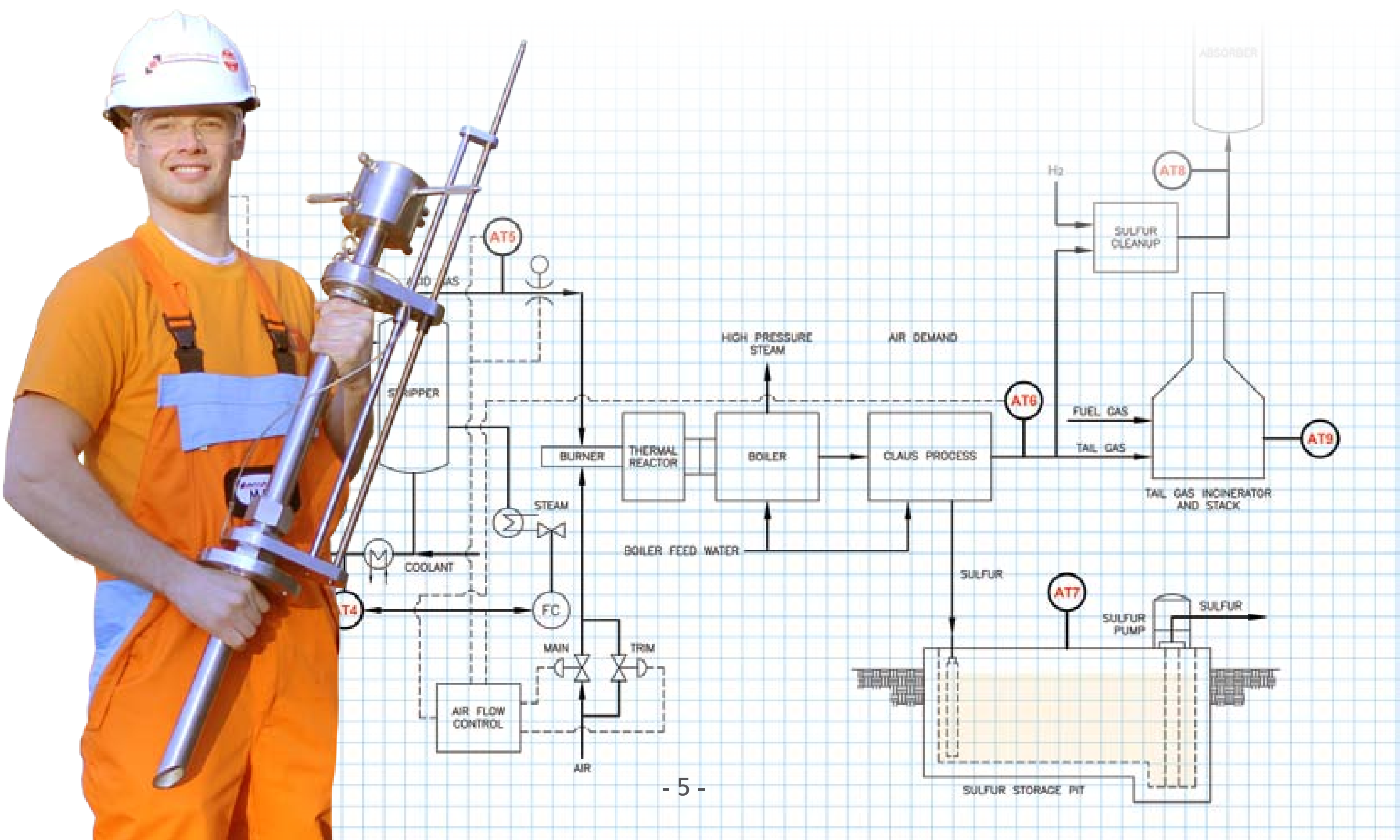
With seamless accuracy from low to high concentrations, the TLG-837 is always in step with the process—from classical Claus conditions to off-ratio extremes, or SuperClaus process configurations.

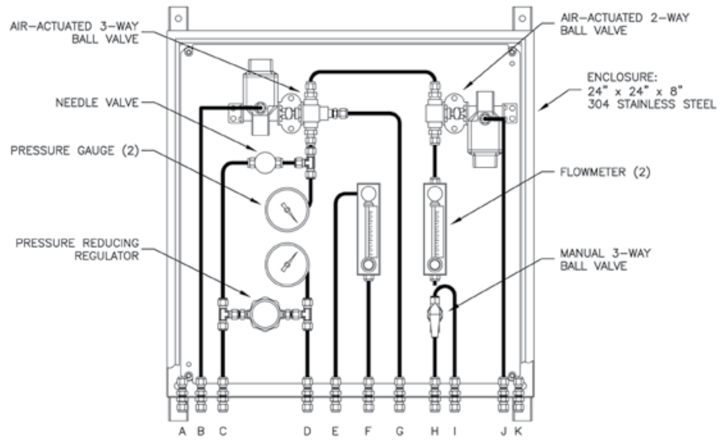
True Measurement Verification

System stability is ensured by a user-scheduled automatic zero. The probe offers convenient introduction of verification gas to the flow cell itself.

Self-Maintaining Functions

An automated steam wash cycle cleans the probe optics (with auto-determined duration based on lens transmittance checks). The system also watches probe temperatures; in case of utility fault, the steam failure blowback feature automatically seals off the flow cell and fills it with nitrogen, thus protecting the probe from inconsistent plant utilities.





A. PURGE AIR IN/OUT, 1/4" OD
B. AIR TO VALVE 1, 1/4" OD
C. STEAM IN, 1/4" OD
D. STEAM TO COLD FINGER, 1/4" OD
E. AIR TO ASPIRATOR, 1/4" OD
F. ASPIRATOR AIR IN, 1/4" OD
G. TO FLOW CELL, 1/4" OD
H. SPAN, 1/4" OD
I. ZERO (N_2), 1/4" OD
J. AIR TO VALVE 2, 1/4" OD
K. PURGE AIR IN/OUT, 1/4" OD

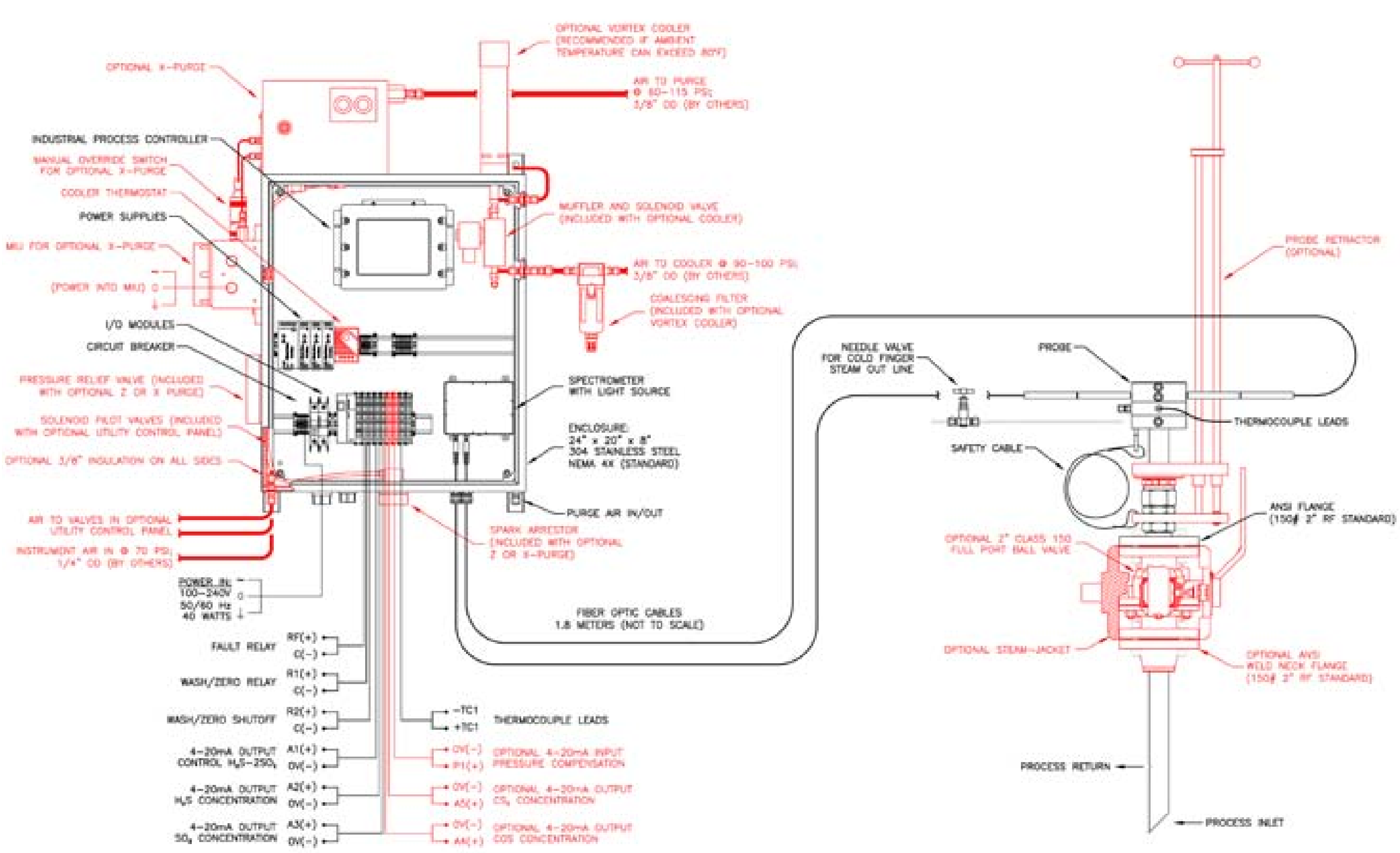
Optional Utility Control Panel

The Utility Control Panel regulates the pressure of the steam used in the probe's demister chamber. It also provides zero gas for automatic zero as well as the nitrogen gas for the steam failure blowback feature (whereby the flow cell disk is sealed and filled with nitrogen in case of faulty steam utilities). Lastly, the Utility Control Panel controls the flow rate for the aspirator and allows for manual span check if desired.

Note: this optional instrument is not involved with sample conditioning.

Analyzer and Probe

Analyzer door shown with NEMA 4X window removed. Common options are labeled in red.



Specifications

Measurement Technology	UV-VIS diode array spectrometer (nova-II)
Light Source	Pulsed xenon lamp (~5 year lifespan)
Sample Introduction	In situ demister probe (patented design)
Components H_2S SO_2 CO_S CS_2 Air Demand	**Measurement Range** / **Acccuracy** / **Repeatability** 0-2% / ±1% of measurement / ±0.4% 0-2% / ±1% of measurement / ±0.4% 0-2,000 ppm / ±1% of measurement* / ±0.4% 0-2,000 ppm / ±1% of measurement* / ±0.4% - / ±1% of measurement / ±0.1% (*±5% when under 500 ppm)
Response Time (T_{10} - T_{90})	10s
Zero Drift	Air demand: 0.1% after 1hr warmup, measured over 24 hrs (constant ambient temperature)
Sensitivity	0.1% full scale
Calibration	Factory calibrated with certified calibration gases
Verification	Simple verification using standard certified gas samples and neutral density filters
Noise	0.004AU at 220 nm
Ambient Temperature	-20 to 50 °C (0 to 120 °F)
Instrument Air	70 psi (-40 °C dew point)
Environment	indoor/outdoor (no shelter required)
Size	analyzer (maximum): 36" H x 38" W x 10" D (914mm H x 965mm W x 254mm D) utility control panel: 24" H x 24" W x 8" D (610mm H x 610mm W x 203mm D)
Weight (w/o Probe)	150 lbs. (68 kg)
Wetted Materials	stainless steel 316/316L
Outputs	one 4-20mA output per component (i.e. H_2S, SO_2, COS, CS_2, and air demand); modbus TCP/IP (optional); RS232 (optional); four digital outputs for fault and sampling system control (user programmable)
Electrical Requirements	80 to 240 VAC 47 to 63 Hz
Power Consumption	40 watts
Area Classification	Class I, Div. 2 (standard) / Class I, Div. 1 (optional) / ATEX Exp II 2(2) GD (optional)

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