

Application Note

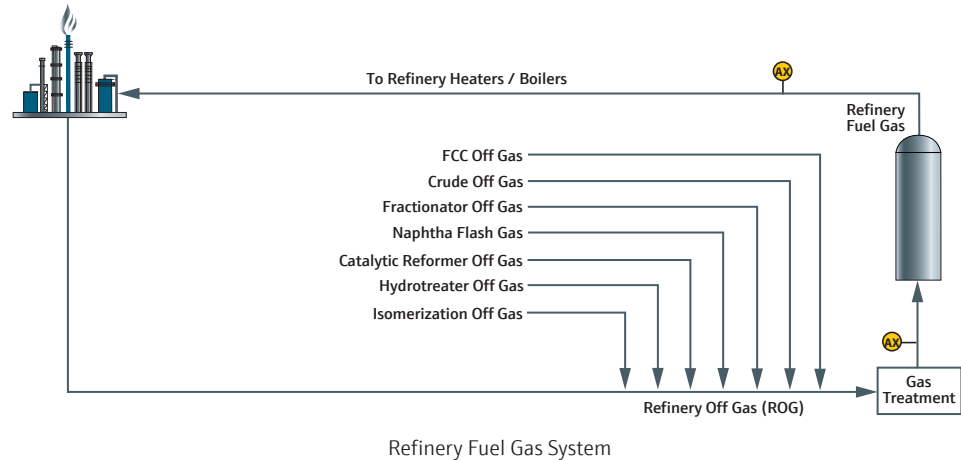
Hydrogen sulfide in refinery fuel gas

Industry: Refining Application Note 23402

Key Points

- Meets U.S. EPA requirements for 40 CFR 60 Subpart J
- Automated 2-point daily validation check for USEPA compliance
- Patented* Differential Spectroscopy technique measures H₂S in refinery fuel
- Low maintenance and OPEX costs – no cylinders of carrier and combustion gases or lead acetate tape

Refinery fuel gas Refinery fuel gas (RFG) is composed of a mixture of hydrogen and C₁ to C₅ hydrocarbons recovered from different unit operations within a refinery for use as a fuel source in fired heaters and boilers. In the U.S. sulfur emissions from refineries are regulated under the Clean Air Act & Amendments (CAAA). The U.S. EPA is responsible for issuing specific regulations and applicable test methods for compliance enforcement. Regulations covering sulfur (SO₂) emissions from combustion of fuel gas are defined in 40 CFR 60 Subpart Ja. Similar regulations aimed at reducing SO₂ emissions have been promulgated in Europe, the Middle East, and Asia.



H₂S measurement for regulatory compliance The U.S. EPA recognizes that measurement of H₂S gives a good approximation of the total SO₂ that is generated from combustion of refinery fuel gas. The required measurement range for H₂S in fuel gas is 0 - 320 ppm_v. The regulatory limit for H₂S in refinery fuel gas is 162 ppm_v. One measurement every 15 minutes (96 times/day) is required to meet U.S. EPA requirements for continuous emission monitoring. A daily two-point validation check is also required to confirm the analyzer is operating properly within its calibration range.

SpectraSensors' solution SpectraSensors tunable diode laser absorption spectroscopy (TDLAS) analyzers have proven highly effective for monitoring H₂S in refinery fuel gas. TDLAS analyzers have an exceptionally fast response to changes in H₂S concentration, an important performance characteristic for continuous emission monitoring of refinery fuel gas. SpectraSensors' patented* differential spectroscopy technique enables detection and quantitation of H₂S in complex refinery fuel gas streams. Laser and detector components are isolated and protected from the gas stream and entrained contaminants avoiding fouling and corrosion and ensuring stable long-term operation and accurate measurements.

*www.spectrasensors.com/patents

Application Data

Target Component (Analyte)	H ₂ S in Refinery Fuel Gas
Measurement Range	0-320 ppm*
Typical Repeatability	±0.5 ppm or 2% of Full Scale* (whichever is greater)
Measurement Response Time	1 to ~60 seconds*
Principle of Measurement	Differential Tunable Diode Laser Absorption Spectroscopy (H ₂ S scrubber included)
Validation Gas	Certified blend of H ₂ S in Nitrogen
Validation – U.S. EPA Compliant	Automated daily two-point validation using certified standards at 20% and 80% of full scale**

* Consult factory for alternate ranges.

** Single-point validation is available for cases where U.S. EPA regulations don't apply.

Typical Background Stream Composition

Component	Minimum (Mol%)	Typical (Mol%)	Maximum (Mol%)
Hydrogen Sulfide (H ₂ S)	0.5 ppm	150 ppm	300 ppm
Hydrogen (H ₂)	25	40	65
Nitrogen (N ₂)	0	4	20
Oxygen (O ₂)	0.1	1	5
Carbon Monoxide (CO)	0	0.5	5
Carbon Dioxide (CO ₂)	0	1	5
Methane (C ₁)	15	30	55
Ethane (C ₂)	5	8	15
Ethylene (C ₂ H ₄)	1	6	15
Propane (C ₃)	1	5	15
Propylene (C ₃ H ₆)	1	2	5
i-Butane (C ₄ H ₁₀)	0	1	5
n-Butane (C ₄ H ₁₀)	0	1	3
C ₅ +	0	1	5

The background stream composition must be specified for proper calibration and measurement performance. Specify the normal composition, along with the minimum and maximum expected values for each component, especially H₂S, the measured component. Other stream compositions may be allowable with approval from SpectraSensors.

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