



## SS2100 HYDROGEN SULFIDE IN REFINERY FLARE GAS

Product Code 23302

### KEY FEATURES

- No Consumable Gases or Lead Acetate Tapes – Low Cost of Ownership
- No ongoing recalibration - Low maintenance
- Electronics Isolated From the Process Gas – Rugged, Simple design, trouble free operation
- Optical Tunable Diode Laser Technology - Repeatable, fast measurements
- Meets EPA Requirements for 40CFR60 Subpart J
- Automated 2 –Point daily Validation Included



Just like with heaters, boilers, and furnaces, plants must regulate the amount of H<sub>2</sub>S in the flare gas in order to comply with mandates from the Clean Air Act Amendments (CAAA) of 1990. The SpectraSensors SS2100 H<sub>2</sub>S Analyzer is a new, low cost, low maintenance analytical solution that generates extremely reliable measurement of H<sub>2</sub>S in the flare gas stream.

### H<sub>2</sub>S IN REFINERY FLARE GAS

Refinery flares present a special challenge in measuring H<sub>2</sub>S due to the variability of the background stream composition. See Table 1 for a typical composition of refinery fuel gas. Nearly all analytical technologies are sensitive to rapid changes in background composition to some extent. Fortunately, the regulations recognize this fact and have an exception for upsets and leaks through relief valves.

Specifically, 40 CFR Part 60, Subpart J, paragraph 60.104 (a) (1) states:

*“The combustion in a flare of process upset gases or fuel gas that is released to the flare as a result of relief valve leakage or other emergency malfunctions is exempt from this paragraph.”*

So an important part of specifying and designing an analyzer for H<sub>2</sub>S in Flare Gas is to define the “normal” gas. To prevent in the ingress of atmospheric air into the flare header, a purge or sweep gas is used. This may be refinery fuel gas, natural gas or some other light gas that is inert and non-corrosive. The design basis of the analyzer should be this purge gas composition.

### ONLINE H<sub>2</sub>S ANALYZERS

Many refinery sites have installed on-line gas chromatography (GC) systems for this measurement. In addition to their initial cost, GC’s have high consumable costs for carrier gas, columns and other parts. Additionally,

they require frequent maintenance, especially those utilizing a flame photometric detector (FPD). Lead-Acetate tape systems can be used, which are expensive, use consumables, and require constant maintenance. Additionally, the spent tape is considered hazardous waste and is expensive to dispose.

### SPECTRASENSORS’ SOLUTION

Only SpectraSensors employs Differential TDL spectroscopy to get accurate measurements in the changing background gas composition of flare gases. The sample is scrubbed using a proprietary Copper nanoparticle absorbent that removes only H<sub>2</sub>S, and the background spectrum is acquired. Then the spectrum of the raw, un-scrubbed sample is acquired and the background spectrum is subtracted, leaving only the laser light absorbance due to H<sub>2</sub>S. The same background spectrum can be used until the background gas changes which is detected automatically by the smart controller logic looking at the background spectrum. Since the scrubber is only used intermittently, its lifetime is typically a minimum of 18 months. Software calculates the loading of H<sub>2</sub>S on the scrubber and gives a warning when it is time to replace the scrubber, and an indicating scrubber downstream warns if the scrubber fails prematurely. The scrubber is easily replaced in a few minutes; the spent scrubber contains no hazardous materials and can be exchanged at a reduced price for a new scrubber.

The laser and detector are isolated from the sample and protected against corrosive gases. The analyzer is extremely fast (typically 16 sec/measurement) and the results are highly reliable. Requiring no consumable gases or lead acetate tapes, the cost of ownership is extremely low.

<http://www.gpoaccess.gov/cfr/index.html>

# SS2100 Hydrogen Sulfide Analyzer



## SPECIFICATIONS

### Application Data

Target Components	H <sub>2</sub> S in Flare Gas
Typical Measurement Ranges	0-10 through 0-300ppm*
Typical Precision	±0.5ppm or 2% of Full Scale (whichever is greater)*
Measurement Response Time	1 to ~60 seconds*
Principle of Measurement	Differential Diode Laser Absorption Spectroscopy (H <sub>2</sub> S scrubber included)
Environmental Temperature Range	-20° to 50° C (-4° to 122° F) -10° to 60° C (14° to 140° F) <i>optional</i>
Sample Inlet Pressure	70kPag (10 PSIG) typical 210kPag (30 PSIG) maximum
Sample Cell Temperature Range	Maintain at 50° C ±2° C
Maximum Cell Pressure	70kPag (10 PSIG)
Sample Flow Rate	3-4 L/min (6.4 to 8.5 scfh)*
Recommended Validation	Certified blend of H <sub>2</sub> S in Nitrogen balance


### Electrical Data

Power	100-240 VAC, 50-60 Hz standard
Max Current	Controller: 1 A @ 120 VAC
Controller to Cell Cable Length	1m standard (3m, 5m & 10m available optionally)
Communication	Current Loop Output 4-20 mA Isolated, 1200 ohms @ 24 VDC max load. Serial: ASCII Text RS232C standard, Modbus RS232C
Digital Outputs	Four (4) 12 VDC for valve operations: Scrubber (if required), Process/Val, Val 1, Val 2 5 SPDT (Form C) Dry Contacts: Common Fault, Val 1 Active, Val 2 Active, Val Fail, One user assignable DO to standard alarms
LCD Display	Concentration, Cell Pressure and Temperature, Diagnostic Data

### Physical

Controller Enclosure	NEMA 4X – 304 stainless steel <i>standard</i>
Controller Dimensions	343 mm H x 305 mm W x 165 mm D (13.5" H x 12" W x 6 7/16" D)*
Weight Approximately	13.1 Kg (28.6 lbs)*
Sample Cell Dimensions	28m Herriott cell, 559 mm H x 127 mm W (22" H x 5" W)
Sample Cell Construction	316L Series Polished Stainless Steel Standard
Number of Sample Cells	1 (Single Channel SS2100) or 2 (Dual Channel SS2100)
Dimensions with Sample System	1678 mm H x 613 mm W x 427 mm D (66" H x 24-1/8" W x 16-13/16" D)
Weight with Sample System	68 Kg (150lbs)

### Area Classification

Certification	CSA Certified for Class I, Div. 2, Groups ABCD T3C  II 2G Ex d IIB+H2 T5; Tamb : -20 ÷ +60 °C
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\* Application specific; consult factory.

**ANALYZER**

The Analyzer consists of the Electronic controller, cell, and 1m long interconnecting cable. The customer or analytical systems integrator is responsible for providing a sample conditioning system and/or cell enclosure that maintains the sample and cell at a constant temperature (generally 50°C +/- 0.2°C) that is above the hydrocarbon and moisture dew points of the process stream. The sample flow, sample pressure, and temperature specifications listed above must be maintained at all times. Any departure from these specifications must be approved by SpectraSensors.

The controller and cell can be mounted remotely, with the controller inside an analyzer shelter and the cell mounted with the sample conditioning system on the outside of the shelter. Cable lengths of 3m, 5m and 10m may be added by specifying the corresponding part number. See spare parts and accessories list.

Select the measured range desired. Other ranges are available by special order.

**TABLE 1 TYPICAL BACKGROUND STREAM COMPOSITION**

Component	Minimum (Mole%)	Normal (Mole%)	Maximum (Mole%)
Hydrogen Sulfide	0	150ppm	300ppm
Hydrogen	25	40	65
Nitrogen	0	4	20
Oxygen	0.1	1	5
CO	0	0.5	5
CO2	0	1	5
Methane	15	30	55
Ethane	5	8	15
Ethylene	1	6	15
Propane	1	5	15
Propylene	1	2	5
i-Butane	0	1	5
n-Butane	0	1	3
C5+	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 H<sub>2</sub>S, the measured component. Other stream compositions may be allowable with approval from SpectraSensors.

**RELAY CONTROL AND COMMUNICATIONS**

All SS2100 Process Analyzers are supplied with 9 relays:

- o Four (4) are 12 VDC powered and provided for driving switching valves associated with Process, Validation 1 and Validation 2 and a scrubber (for differential systems only).
- o Five (5) SPDT (Form C) dry contact digital outputs are provided for common fault, Val 1 active, Val 2 Active, Validation Fail, and one (1) user-assignable DO to any standard alarm, such as high concentration, high cell pressure, low cell temperature, high cell temperature, low sample flow, etc. depending on the application.

Data Output is via 4-20 mA Isolated Analog Output.

Serial Communication via Modbus protocol is provided. See Modbus specifications for details.

## MEASUREMENT SOLUTION - H<sub>2</sub>S IN REFINERY FLARE GAS

For a complete analytical solution and to ensure the integrity of the sample stream and its analysis, SpectraSensors Gas Analyzers may be ordered with a Sample Conditioning System (SCS). Each SCS has been specifically designed to deliver a sample stream to the analyzer that is representative of the process stream at the time of sampling.

## SAMPLE SYSTEM FEATURES

The Sample Conditioning System provides the necessary features to complete the total analytical solution:

- o Stable heated environment for the cell (50°C +/- 0.2°C)
- o Sample supply and return shut-off valves
- o Sample overpressure relief valve
- o Analyzer guard particulate filter
- o Validation gas inlet and automatic selection valve
- o Cell pressure regulator
- o Sample bypass pressure gauge
- o Sample bypass flow valve and rotameter
- o Cell flow valve and rotameter
- o Outlet pressure gauge
- o Outlet non-return valve
- o Temperature gauge on cabinet

## VALIDATION

SpectraSensors analyzers require no calibration in the field and the calibration is stable for the life of the analyzer, however, validation of the measurement is very desirable. At the SSI factory, the calibration is done by mixing the output of moisture generators or certified blends with dry gas through NIST-traceable mass flow controllers. The calibration is then validated using NIST-traceable chilled-mirror devices.

In the Field, the analyzer can be validated by using a certified blend of H<sub>2</sub>S in a background of Nitrogen, available from a number of reliable specialty gas blenders.