



SS2100 HYDROGEN SULFIDE IN HYDROGEN RECYCLE ANALYZER

FOR REFINERY CATALYTIC REFORMER H₂ RECYCLE STREAMS
Product Code 23202

KEY FEATURES

- Fast – Sensitive measurement of H₂S
- Virtually maintenance free – No routine maintenance required
- Low Cost of Ownership – No Lead Acetate paper tape, carrier gases or Flame fuel to buy
- No interference from other compounds – uses high resolution TDL technology



Control H₂ Recycle H₂S concentration to prevent catalyst poisoning.

CATALYTIC REFORMING UNIT

The Catalytic Reformer Unit of a modern refinery is an important process unit for converting lower octane naphtha streams into higher octane aromatic compounds.

These chemical conversions are done in catalytic reactors that transform straight-chain C₆-C₈ compounds found in the naphtha into light aromatics such as Benzene, Toluene and Xylenes (BTX). This high octane reformat can then be used in gasoline blending or sold to chemical plants.

As shown in Figure 1, depentanized naphtha feed is mixed with recycled Hydrogen gas, preheated and passed through a series of reactors where the conversion to aromatics takes place.

After the last reactor, a Hydrogen Separator strips out the hydrogen and other light gases from the stream. After the removal of the Hydrogen, the stream enters a Stabilizer Tower (also called a Debutanizer) which removes the Butanes and lighter gases with the Reformat leaving the Bottoms for gasoline blending or sent to a chemical plant.

CRITICAL CONTROL OF HYDROGEN SULFIDE

The catalyst in the reactors is very expensive and sensitive to poisoning if exposed to certain compounds; most notably H₂S. Traces of sulfur compounds are converted to H₂S in the reformer and accumulate in the H₂ recycle, where the H₂S is readily measured. Recommended H₂S levels to prevent poisoning in the feed are 0.25 – 1.0 ppm.

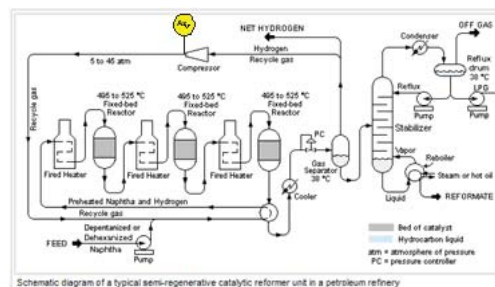


Figure 1

TRADITIONAL MEASUREMENT SOLUTIONS

Lead Acetate paper tape analyzers have been used but they require frequent replacement of the paper tape and many regard the paper tape itself as a handling and disposal problem due to its lead content. Gas Chromatographs have often been used but the desired measurements require Flame Photometric and other trace sulfur detectors that can be maintenance intensive.

SPECTRASENSORS' SOLUTION

SpectraSensors SS2100 is the ideal solution for this challenging application. It is extremely fast (<1 sec. updates if desired) and very sensitive (0.5 ppm repeatability). No cylinder gases are required, and the only consumable part, the H₂S scrubber, is sized to last a minimum of 18 months between changes. The use of Tunable Diode Laser technology means measurement interferences from other infrared absorbing compounds are avoided.

DUAL RANGE / DUAL CHANNEL

Refineries normally operate around 5 – 50 ppm moisture level in the hydrogen recycle stream, and attempt to keep the H₂S at a minimum. The SS2100 Analyzer can be configured with two cells to measure both moisture and H₂S.

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. Validation is done with a certified blend of H₂S in N₂ background available for a number of reputable specialty gas blenders.

SS2100 Hydrogen Sulfide Analyzer



SPECIFICATIONS

Application Data

Target Components	H ₂ S in Hydrogen Recycle Gas
Typical Measurement Ranges	0-50 through 0-300ppm*
Typical Precision	±2% of Full Scale*
Measurement Response Time	1 to ~60 seconds*
Principle of Measurement	Differential Diode Laser Absorption Spectroscopy (H ₂ 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 ₂ 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 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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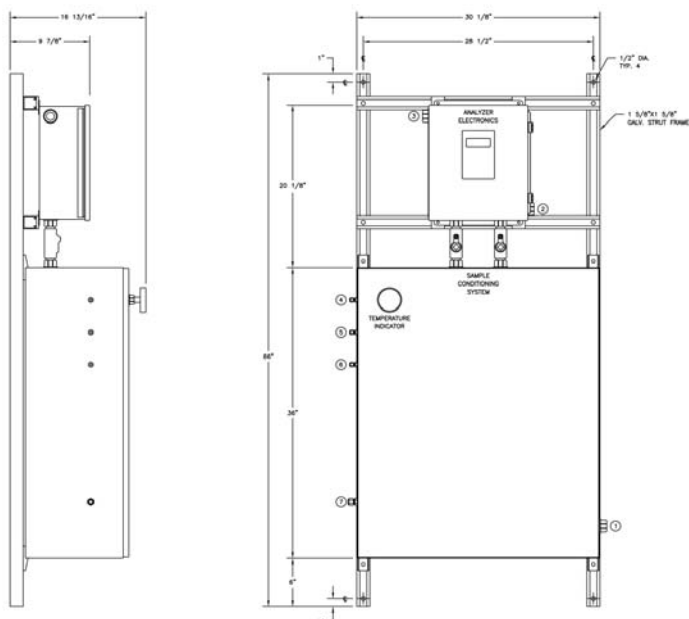
* Application specific; consult factory.

SPECTRASENSORS SS2100 WATER IN HYDROGEN RECYCLE 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) which 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.



TYPICAL BACKGROUND STREAM COMPOSITION

Component	Minimum (Mole %)	Normal (Mole %)	Maximum (Mole %)
Hydrogen	70	80	90
Methane	8	12	20
Ethane	3	5	10
Propane	0	2	5
i-Butane	0	1	2
n-Butane	0	<1	2
C5	0	0	1

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 hydrogen sulfide, 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.

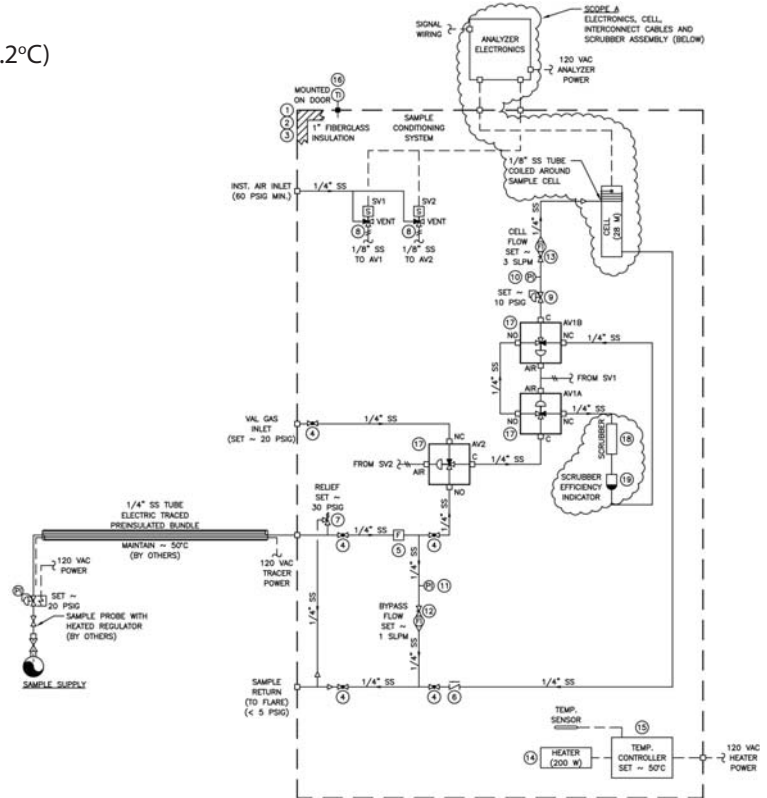
MEASUREMENT SOLUTION - H₂S IN REFINERY CATALYTIC REFORMER HYDROGEN RECYCLE STREAMS

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.

TYPICAL SAMPLE CONDITIONING SYSTEM FOR H₂O IN H₂ RECYCLE STREAMS

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 H₂S in a background of Nitrogen, available from a number of reliable specialty gas blenders.