

## Analyzer Calibration Certificate

### SYSTEM INFORMATION

SALES ORDER NO.: 10441-01  
ANALYZER S/N: 8603  
MEASUREMENT CELL S/N: 25255-01  
TAG NO: AT-511001A

MODEL: SS2100  
SPECTRASSENSORS P/N: 01044101100  
SOFTWARE: NS 5.13-DA04  
SCRUBBER S/N: NA  
CHANNEL: Single

### SYSTEM SPECIFICATIONS

ANALYTE: CO2  
MEASUREMENT RANGE: 0 - 100 ppmv  
ENCLOSURE TEMP: 50C

BACKGROUND: Process  
REPEATABILITY: + / - 4 ppmv  
OPERATING PRESS RANGE: 900 - 1700 mbar

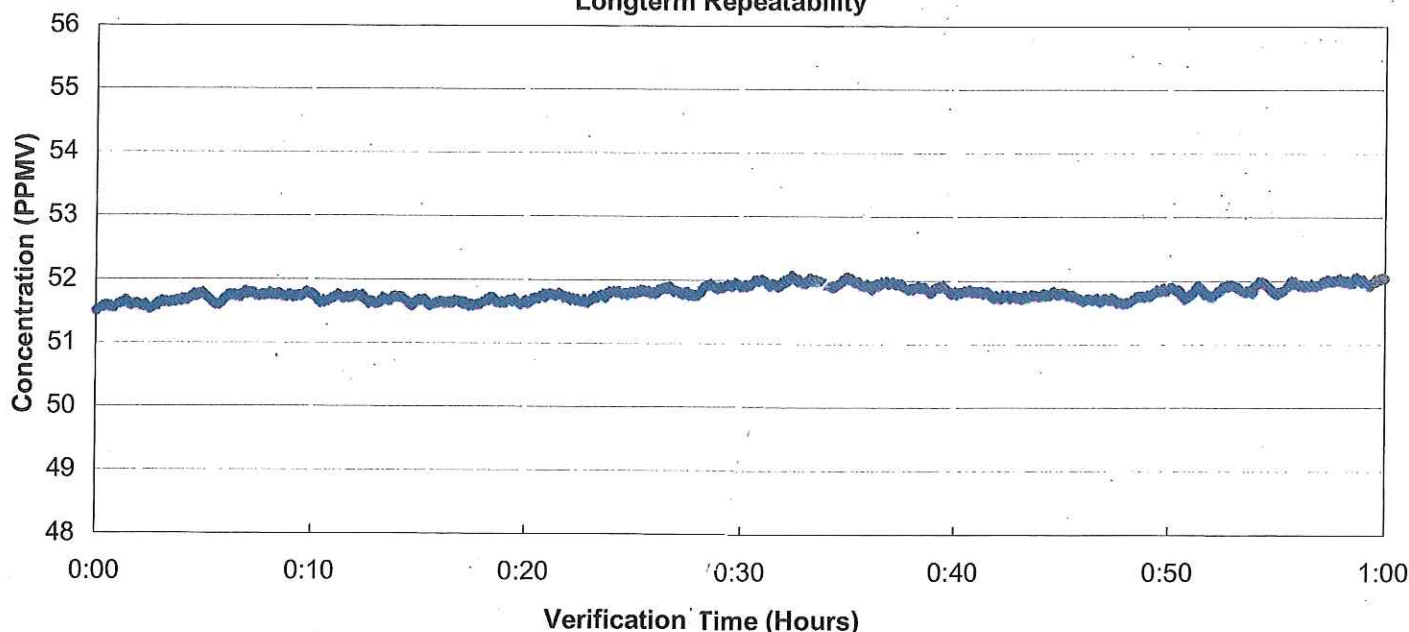
### CALIBRATION GAS COMPOSITION

Methane(C1)	Ethane(C2)	Propane(C3)	i-Butane(C4)			
63.62%	18.41%	9.00%	8.97%			

### VALIDATION GAS COMP.

Nitrogen
100%

Longterm Repeatability



### SYSTEM PERFORMANCE

AVERAGE: 51.81 ppm  
REPEATABILITY: 0.42 ppm  
PRESSURE: 1019 mbar  
# SPECTRUM AVG: 16  
WET CYCLES: NA  
LOGGER RATE: 8  
TEMPERATURE: 50.6 °C

### CALIBRATION GA CYL#

CYL#	STATION	ID#
4757	MFC	574
4713	MFC	573
4558	MFC	071
3258	MFC	242
2310	MFC	476
4592	MFC	288
4270	Pcontroller	514
	O-Scope	100
	DMM	091

CALIBRATED BY: FT20

DATE: August 1, 2014

### SYSTEM INFORMATION

Sales Order:	10441	Model:	SS2100
Analyzer S/N:	8603	Spectrasensors P/N:	01044101100
Measurement Cell S/N:	31194-01	Software:	FS 5.14-D930

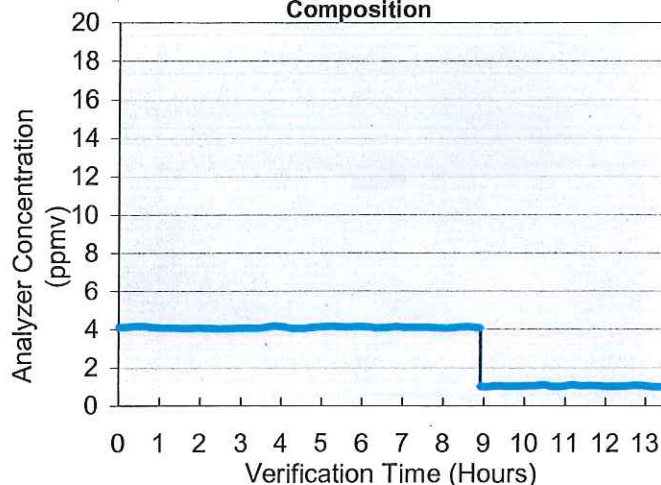
### SYSTEM SPECIFICATIONS

Analyte:	H2S	Accuracy (Quoted):	± 0.5 @ 4	ppmv
Measurement Range:	0 - 25 ppmv	Repeatability (Quoted):	± 0.25 or ± 2%	ppmv
Ambient Temp Rating:	-20° to 50°C	Cell Pressure Range:	700 - 1700	mBar

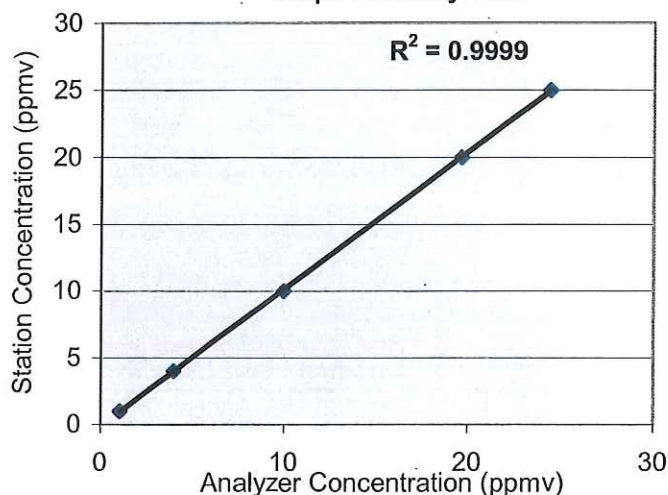
### CALIBRATION GAS COMPOSITION

Methane	Ethane	Propane	Butane	Pent+	Nitrogen	CO <sub>2</sub>	Hydrogen
63.80%	18.40%	9.00%	6.10%		2.70%		

**Stability Test H2S in Calibration Gas Composition**



**Step / Linearity Test**



### RECOMMENDED VALIDATION GAS

20% to 80% of Full Range: **H2S in Nitrogen**

### MEASURED SYSTEM PERFORMANCE

Average at 4 ppm:	4.10	ppmv	[Pass]
Repeatability 2σ at 4 ppm	± 0.07	ppmv	[Pass]

### TEST CONDITIONS

Cell Pressure:	1082	mbar
Cell Temperature:	49.8	°C

### SYSTEM ACCURACY

SpectraSensors Reference:	4ppmv H2S in CH4
Cylinder Mfg and S/N:	Air Liquide S/N 3913
Traceability:	±1% NIST Traceable Class 1 Weights
	±1% Lab Analysis Traceable to NIST SRM
Reference Cyl Concentration:	4.00 ppmv
Measured Concentration:	4.41 ppmv [Pass]

*The analyzer is calibrated against a background of blended reference gases. This blend is designed to be spectroscopically representative of the process stream that was submitted with the purchase order, and its composition will not necessarily match the component concentrations of the stream. Any differences that are present are not indicative of an incorrect calibration.*

CALIBRATED BY: **FT15**

DATE: **July 29, 2014**



## Analyzer Calibration Certificate

### SYSTEM INFORMATION

ANALYZER S/N: 6477  
MEASUREMENT CELL S/N: 22855-01

MODEL: SS2100  
SPECTRASSENSORS P/N: 00934001100  
SOFTWARE: NS 5.11-C711  
SCRUBBER S/N: N/A  
CHANNEL: Dual

### SYSTEM SPECIFICATIONS

ANALYTE: CO2  
MEASUREMENT RANGE: 0-2000ppm  
OPERATING TEMP RANGE: 45-55C

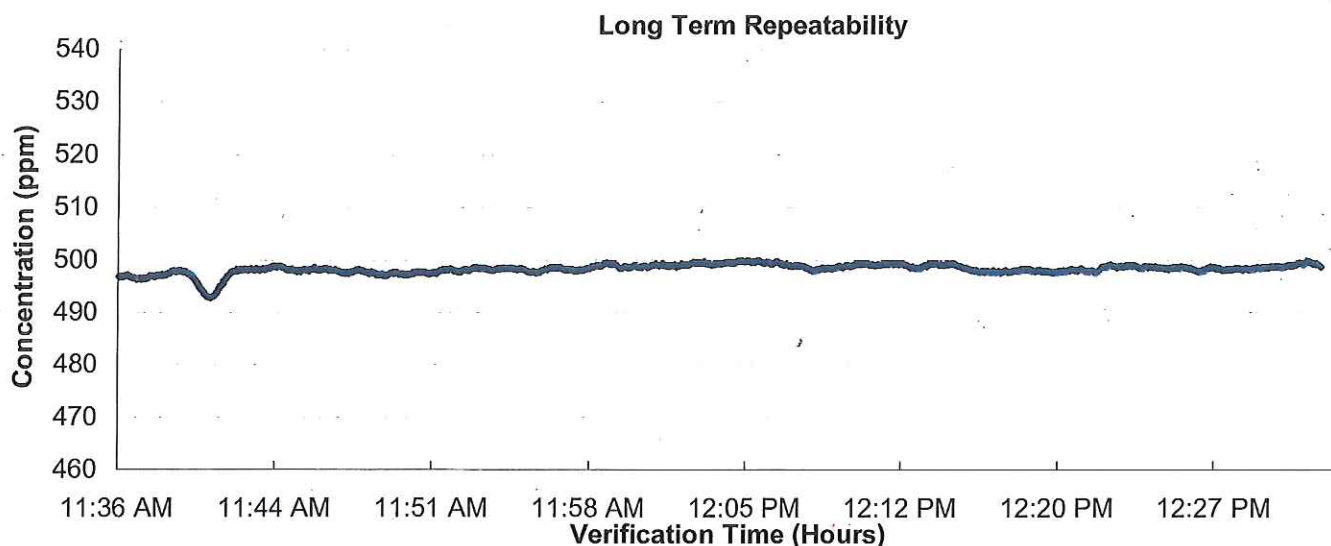
BACKGROUND: Process  
REPEATABILITY: +/-40 ppm  
OPERATING PRESS RANGE: 950-1700mb

### CALIBRATION GAS COMPOSITION

Methane	Ethane	Propane	Isobutane	N2	H2S	Ethylene	Propylene
61.8%	20.7%	9.6%	5.2%	2.7%	0.0%	0.0%	0.0%

### VALIDATION GAS COMP.

CO2 in N2



### 500ppm SYSTEM PERFORMANCE

AVERAGE: 497.8 ppm  
REPEATABILITY: 4.5 ppm  
PRESSURE: 1053 mbar  
# SPECTRUM AVG: 16  
WET CYCLES: N/A  
LOGGER RATE: 8  
TEMPERATURE: 50.7 °C

### CALIBRATION GAS

Methane  
Ethane  
Propane  
Isobutane  
2% CO2 in Methane  
1.01% CO2 in N2  
N2

CYL#	DEVICE	S/N
3403	piMFC	426
3250	piMFC	398
3257	piMFC	135
3260	piMFC	118
3320	piMFC	128
2292	piMFC	128
3310	piMFC	141
	DMM	307

CALIBRATED BY: FT19

DATE: July 12 2012

11027 Arrow Route, Rancho Cucamonga, CA 91730

www.spectrasensors.com

Template version: 8/14/09

## Analyzer Calibration Certificate

### SYSTEM INFORMATION

ANALYZER S/N: 6477  
MEASUREMENT CELL S/N: 21728-01

MODEL: SS2100  
SPECTRASENSORS P/N: 00921401100  
SOFTWARE: NS 5.11-C711  
SCRUBBER S/N: No Scrubber  
CHANNEL: Dual

### SYSTEM SPECIFICATIONS

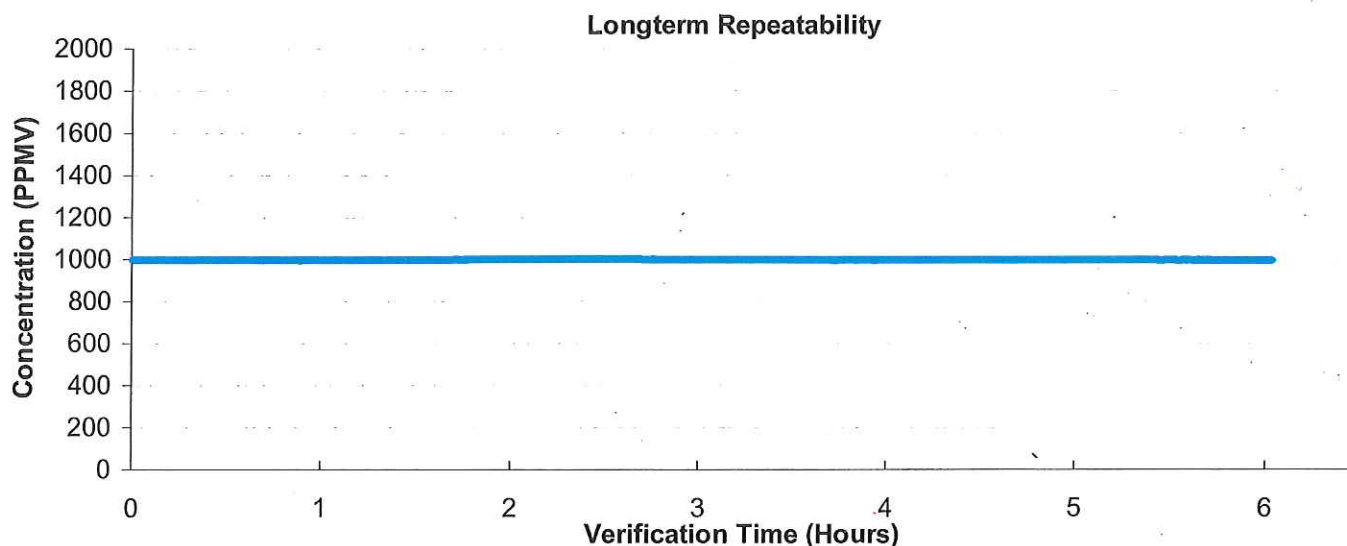
ANALYTE: H<sub>2</sub>S BACKGROUND: Fuel Gas  
MEASUREMENT RANGE: 0-2000 PPMV REPEATABILITY: ±40 PPMV  
OPERATING TEMP RANGE: -20° to 50°C OPERATING PRESS RANGE: 900 - 1800 mBar

### CALIBRATION GAS COMPOSITION

Methane	Ethane	Propane	Isobutane	Pent+	Nitrogen	CO <sub>2</sub>	Hydrogen
63.50%	21.00%	10.00%	5.20%			0.30%	

### VALIDATION GAS COMP

Nitrogen
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### 1000ppm SYSTEM PERFORMANCE

AVERAGE: 999.956 ppm  
REPEATABILITY: 2.78445 ppm  
PRESSURE: 999.952 mbar  
# SPECTRUM AVG: 16  
WET CYCLES: n/a  
LOGGER RATE: 8  
TEMPERATURE: 50.4 °C

### CALIBRATION GAS

Nitrogen  
Methane  
Ethane  
Isobutane  
Propane  
Carbon Dioxide  
2.02% H<sub>2</sub>S in Methane  
2% H<sub>2</sub>S in Nitrogen

CYL#	DEVICE	S/N
3310	piMFC	458
3455	piMFC	140
3249	piMFC	145
2216	piMFC	126
3259	piMFC	271
2856	piPC	330
3322	DMM	307
3224		

CALIBRATED BY: John Lewison

DATE: June 21, 2012