

The Thermo Scientific SOLA II determines the total sulfur content of liquid or gas phase samples with unparalleled accuracy and precision. This industry-leading online analyzer features proven reliability, low utility requirements, comprehensive diagnostics and superior data communications to ensure process optimization and maximum uptime.

Thermo Scientific SOLA II

Sulfur On-Line Analyzer



Features and Benefits

- Unparalleled Precision & Accuracy — Superior performance from 0.25 ppm S to 5000 ppm S
- Safe Operation — Pure O₂ is not required, eliminating the risks associated with oxygen use in a process environment
- Comprehensive Diagnostics — Potential for coke or soot formation is eliminated, maximizing analyzer uptime
- Rapid Response — Semi-continuous operation; direction of change in sulfur concentration indicated at every injection
- Superior Data Communications — Remote operation enabled by unique web browser interface, Thermo Scientific SOLAWeb
- Automatic Density Compensation for ppm S wt/wt Measurements
- Automatic Calibration/Validation
- High Reliability — 99%+ online time
- Automatic Control of UV Light Intensity — Calibrations held stable over a long period of time

The Thermo Scientific SOLA II sulfur online analyzer replaces labor-intensive laboratory grab samples with online analysis for rapid determination of sulfur contamination sources and timely corrective action. With a worldwide installation base and a number of applications, this industry-leading instrument ensures maximum product yield, optimum product quality and improved operational efficiencies.

Clean Fuels

Producers of low-sulfur motor fuels use the SOLA II to ensure diesel and gasoline are produced within the targeted sulfur content. The superior analytical capability, including detection in parts per million (ppm), enables petroleum refiners to make timely process adjustments to enhance the economic efficiency of desulfurization and fuel blending operations.

Catalyst Protection

With detection in parts per billion (ppb), the SOLA II Trace controls the sulfur level of the hydrocarbon feed into the reactor catalyst, minimizing costly catalyst replacements and shutdowns.

Flare Feed Gas & Condensable Vapor

The highly accurate SOLA II Flare features a dynamic measuring range from 10 ppm to 95% S by volume with fast high-to-low response time, enabling reliable flare stack sulfur emission monitoring.

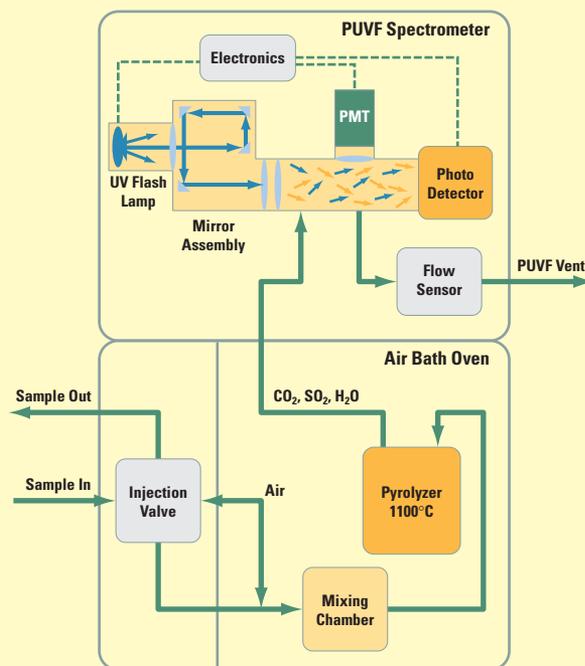
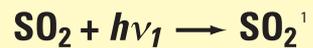
Dual Calibration/Dual Stream

The SOLA II Dual Calibration/Dual Stream enables two streams of radically different sulfur concentrations (i.e. batch processing, inlet/outlet of reactors, etc.) to be measured by a single analyzer, simplifying the process and reducing capital expenditures.

Detection Limits as Low as 0.25 ppm S

The SOLA II determines total sulfur by using pulsed ultraviolet fluorescence (PUVF) spectrometry. To determine the total sulfur content of hydrocarbon samples by PUVF, all organically bound sulfur must be converted to sulfur dioxide, SO₂. Irradiation of SO₂ with a specific wavelength of ultraviolet light, hν₁, will form an electronically excited form of sulfur dioxide, SO₂¹. The SO₂¹ will relax to its ground state, SO₂, by emission (fluorescence) of light at a slightly different wavelength, hν₂. The intensity of the emitted light, hν₂, is directly proportional to the total sulfur content of the sample.

An automated sample injection valve is used to introduce the sample. An air carrier gas is used to deliver the sample from the injection valve to the air bath oven. The air bath oven provides the necessary heat to fully vaporize all components of liquid samples. The hydrocarbon / air mixture next enters the mixing chamber where additional air is added. Upon exiting the mixing chamber, the sample is fully combusted to CO₂, H₂O and SO₂ in the 1100°C Pyrolyzer. At the measurement cell, the sample is irradiated with ultraviolet light. The photomultiplier tube (PMT) measures the intensity of the resulting fluorescence. Finally, the PMT signal is processed by the electronics to provide data communications to the process control system. The photodiode serves as the heart of a feedback circuit to ensure that the intensity of the ultraviolet, UV, flashlamp remains constant. Maintenance of a constant UV light intensity is a feature unique to the SOLA II to ensure calibrations are held stable over a long period of time. The SOLA II's unique PUVF spectrometer delivers detection limits as low as 0.25 ppm S.



Unparalleled Precision and Accuracy

With unparalleled accuracy and precision, the SOLA II rapidly indicates changes in total sulfur, enabling users to make process adjustments that ensure product yields are at targeted sulfur specification. Precision is measured in terms of standard deviation. Long-term repeatability runs of diesel, gasoline, and natural gas samples indicate excellent measurement precision.

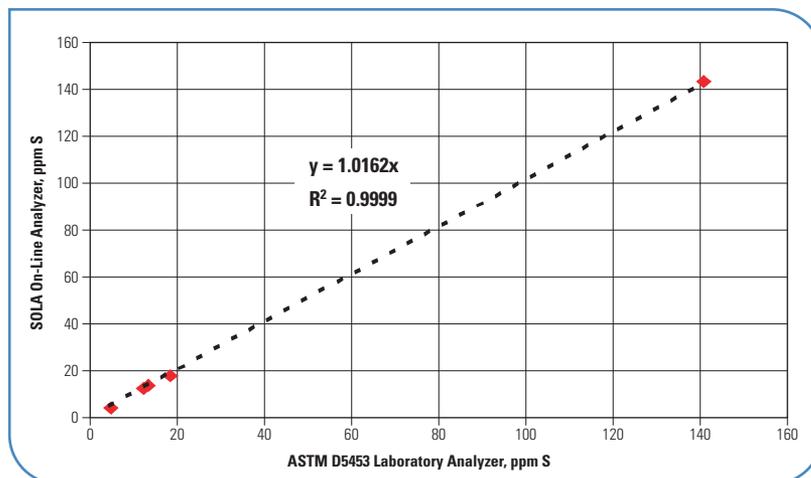
The SOLA II's accuracy was evaluated by comparing its data to lab analyses by ASTM D5453. The SOLA II has regularly demonstrated excellent agreement with all laboratory total sulfur measurement methods, including:

- ASTM Method D5453 for liquid phase samples; an adaptation of "Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence"
- ISO Method 20846; an adaptation of "Petroleum Products – Determination of Sulfur Content of Automotive Fuels – Ultraviolet Fluorescence Method"
- ASTM Method D6313 for lead acetate colorimetry
- ASTM Method D2622 for XRF wavelength dispersion.

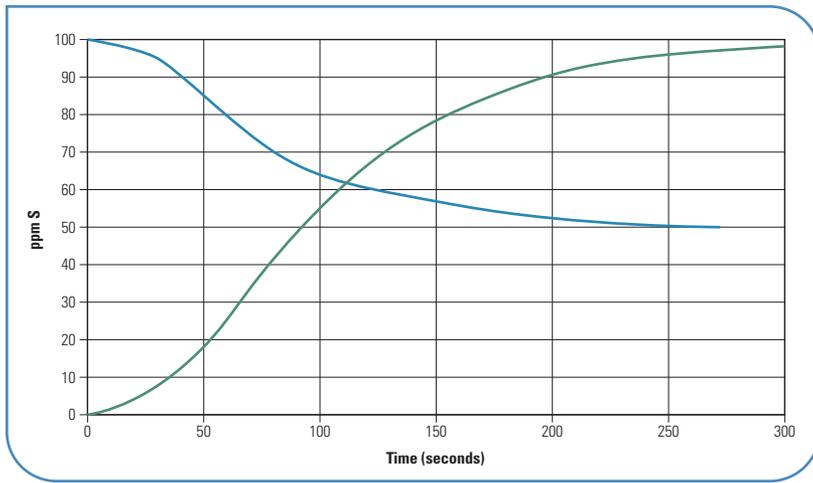
SOLA II Typical Measurement Precision

Sample	Diesel, EBP ≤400°C	Gasoline	Natural Gas
Length of Continuous Run	30 days	7 days	8 hours
Average Value for Run	18.76 ppm S	77.35 ppm S	4.97 ppm S
Standard Deviation for Run	0.15	0.83	0.03

SOLA II vs. ASTM D5453

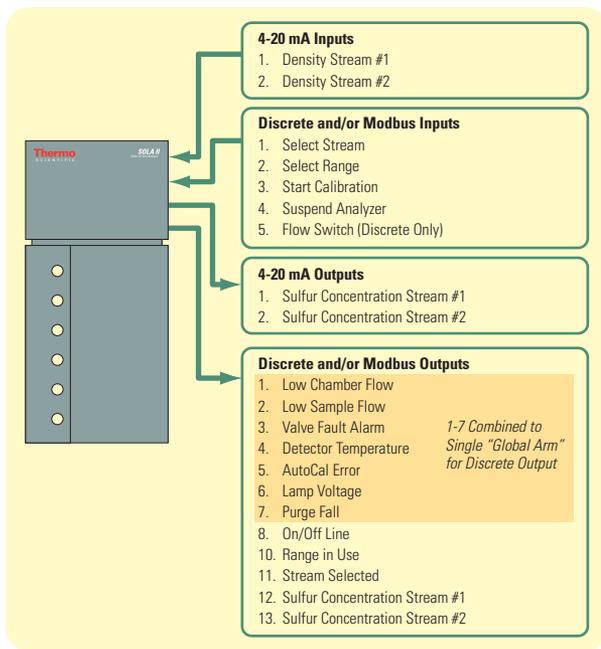


SOLA II Response Time



Rapid Response

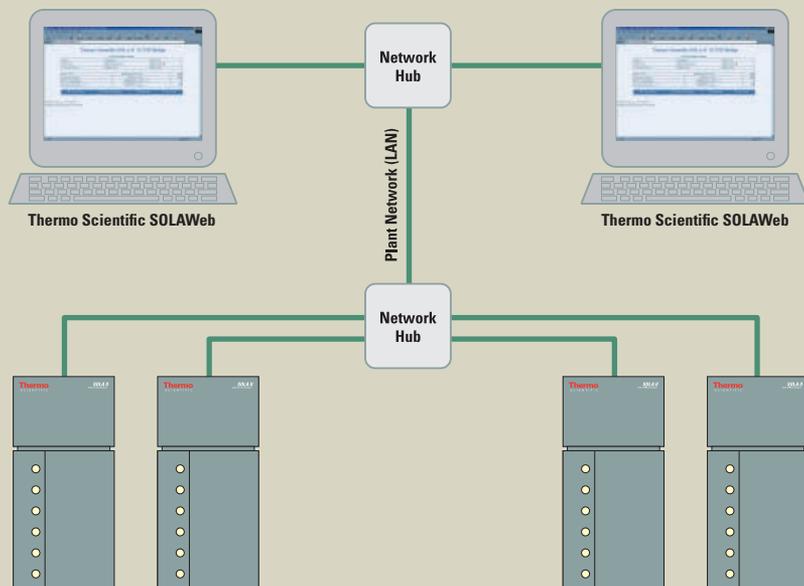
The SOLA II is a semi-continuous online total sulfur analyzer. It responds to a change in total sulfur concentration immediately following sample injection, providing the user with a rapid indication of the rate of total sulfur concentration change. While the SOLA II requires three-to-five minutes to establish itself at 90% of a new value, the user has the benefit of knowing the direction of change in total sulfur concentration at every injection, typically every 30 seconds.



Communications and Diagnostics

The SOLA II is a two-stream analyzer with auto-calibration capability. Data communications from the SOLA II to the control system are enabled by 4-20 mA and discrete I/O or Modbus. A unique feature of the SOLA II is its ability to accept 4-20 mA inputs from densitometers to provide automatic density compensation when the ppm S (wt/wt) unit of measure is used. The well known Thermo Scientific Sarasota FD910 densitometer can be supplied with the SOLA II for purposes of density compensation.

When using Modbus communications, the user benefits from detailed alarm information, which not only informs the user of a fault condition but tells the user exactly what condition caused the fault. Additionally, the detailed fault information is available at the SOLA II's local display. The SOLA II has the unique ability to automatically detect sample injection valve leaks. Should a leaking injection valve be detected, the SOLA II automatically diverts sample flow from the injection valve and annunciates the condition through a latching alarm, preventing damage due to coke or soot formation. The SOLA II's comprehensive diagnostics deliver value by significantly reducing the meantime to repair.



Thermo Scientific SOLAWeb

Thermo Scientific SOLAWeb enables users to communicate with the SOLA II via a standard LAN connection. No vendor-specific software is needed. If the PC is connected to the Internet, it can access a SOLA II using SOLAWeb.

SOLAWeb provides access to all functions available at the local MMI plus the user can download 24-hour historical data, including analysis results and analyzer operating parameters (i.e. lamp voltage, PMT voltage, air flow, the raw detector signal, lamp intensity and detector cell temperature).

A link to the SOLAWeb workstation via modem can be installed to provide invaluable technical support. An optional interface board is all that is required to provide a complete end-to-end solution.

Thermo Scientific SOLA II

Analytical Performance	
Detector	Pulsed UV Fluorescence (PUVF) with Pyrolyzer for Total Sulfur Measurement ¹
Measuring Ranges	SOLA II: Full scale ranges from 0-5 ppm S to 0-5000 ppm S (greater than 5000 ppm, consult Thermo Fisher Scientific) SOLA Trace: Full scale ranges from 0-2 ppm S to 0-5 ppm S SOLA Flare DI (low and high range analyzer system): 10 ppm to 95% S by volume SOLA Dual Calibration/Dual Stream: Same ranges available as on the SOLA II
Repeatability	SOLA II: $\pm 2\%$ of full scale, one sample injection per minute ² ; $\pm 1\%$ of full scale, two sample injections per minute ² SOLA Trace: Consult Thermo Fisher SOLA Flare DI (low and high range analyzer system): $\pm 1\%$ of full scale SOLA Dual Calibration/Dual Stream: Refer to SOLA II
Linearity	$\pm 2\%$ of full scale, one sample injection per minute ² ; $\pm 1\%$ of full scale, two sample injections per minute ²
Response Time	Semi-continuous, outputs updated every 1 second, 3-5 minutes to 90% of new value
Number of Process Streams	Dual streams with auto stream select (optional)
Calibration/Validation	Automatic or manual
Analog/Discrete Data Communications	
Analog Outputs	4-20 mA DC for each stream (optional)
Alarm Outputs	One global dry contact triggered by one or more of the following: Low sample flow alarm (optional); Low detector flow alarm; Oven/Pyrolyzer temperature fault; Injection valve fault; Purge failure; Calibration fault; Detector temperature fault; Detector lamp voltage fault One out of service dry contact triggered by: Analyzer in calibration; Suspension of analyzer
Analog Inputs	Optional 4-20 mA DC inputs from density meter for automatic density compensation of ppm S (w/w) Optional 4-20 mA DC input from sample flowmeter
Digital Data Communications	Dual channel with the following optional configurations: RS-232 Modbus & RS-485 Modbus Dual channel RS-485 Modbus TCP/IP encapsulated Modbus & RS-485 Modbus
Local MMI	Status of all analyzer parameters (e.g., furnace & oven temperatures, PMT and lamp voltage, detector flow rate, etc.) and analytical results available on front mounted displays, push button menu access, hazardous area classification remains intact while operating local display
SOLA II Modbus Remote Interface	Complete remote control of SOLA; Automatic logging of analysis results and analyzer parameters; Communication to SOLA II via serial or TCP/IP encapsulated Modbus enables remote diagnostics
SOLAWeb Remote Interface	Complete remote control of SOLA; Ability to download 24 hours of analysis results and analyzer parameters; Communication to SOLA II via local area network (TCP/IP) enables remote diagnostics
Utility Requirements	
Ambient Temperature	+12°C to +40°C (+54°F to +104°F)
Power	110 VAC, 50/60 Hz at 2000 watts; 220 VAC, 50/60 Hz at 2000 watts
Instrument Air	80 psig (5.5 barg), 8 SCFM, Oil Free, -40°C (-40°F) dew point
Zero Grade Air	80 psig (5.5 barg), 200-300 SCCM
Dimensions	
Zone 1; Div. 1 Configurations	1581.15 mm (62.25 in) high x 647.70 mm (25.50 in) wide x 476.25 mm (18.75 in) deep
Zone 2; Div. 2 Configurations	1104.39 mm (43.48 in) high x 647.70 mm (25.50 in) wide x 476.25 mm (18.75 in) deep
Certifications	(Built to) NEC Class I, Division 2, Groups B, C & D (Built to) NEC Class I, Division 1 (optional), Groups B, C & D CSA with associated "C/US Mark" Class I, Division 2, Groups B, C & D CSA with associated "C/US Mark" Class I, Division 1, Groups B, C & D ATEX Zone 2, EEx p IIC T2 (T3, T4 Optional) ATEX Zone 1 (optional), EEx p IIC T2 (T3, T4 Optional) CE Mark

¹Online adaptation of ASTM Method D5453 for liquid phase applications and ASTM Method D6667 for LPG and gas phase applications.

²The number of sample injections per minute is user definable.

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