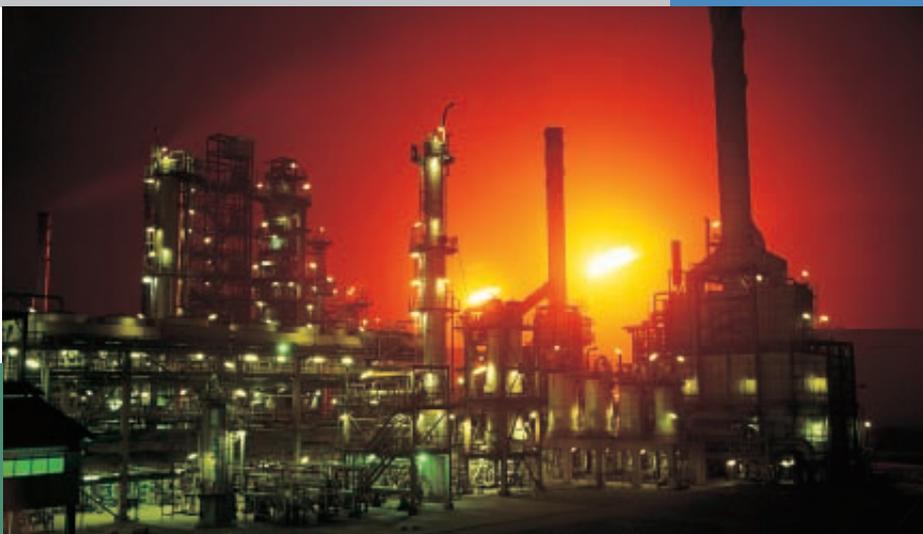


The SOLA II is an on-line analyzer used to rapidly determine the total sulfur content of liquid and gas phase samples. The SOLA II enables cost efficient production of ultra low sulfur fuels and economic operation of desulfurization processes with unparalleled accuracy and precision.

SOLA II

Sulfur On-Line Analyzer



Features and Benefits

- Unparalleled Precision & Accuracy — Superior performance from 0.25 ppm S to 9000 ppm S
- Safe Operation — Pure O₂ is not required, thereby eliminating the risks associated with oxygen use in a process environment
- Comprehensive Diagnostics — Potential for coke or soot formation is eliminated, thereby, maximizing analyzer up time
- Rapid Response — Semi-continuous operation, direction of change in sulfur concentration indicated every 30 seconds
- Superior Data Communications — Remote operation enabled with unique web browser interface, SOLAWeb
- Automatic Density Compensation for ppm S (wt./wt.) Measurements
- Automatic Calibration
- High Reliability — 99+% on-line time
- Automatic Control of UV Light Intensity — Calibrations held stable over a long period of time

The SOLA II from Thermo is an essential tool for the measurement and control of gas or liquid phase sample sulfur content. Producers of low sulfur motor fuels use the SOLA II to ensure diesel and gasoline are produced with the targeted sulfur content. The SOLA II's superior analytical performance enables petroleum refiners to confidently make timely process adjustments to enhance the economic efficiency of desulfurization and fuel blending operations. A refiner or petrochemical producer may also use the SOLA II to measure and control the total sulfur content of kerosene, naphthas, LPGs, natural gas, propylene, and ethylene.

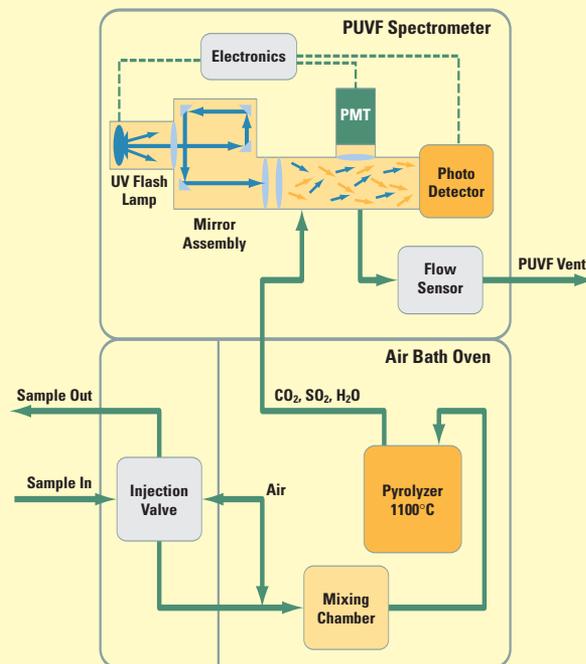
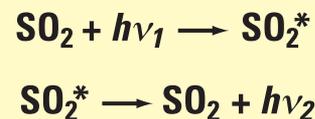
The SOLA II is an on-line adaptation of:

- ASTM Method D5453 "Determination of Total Sulfur in Light Hydrocarbons, Motor Fuels and Oils by Ultraviolet Fluorescence"
- ISO Method 20846 "Petroleum Products – Determination of Sulfur Content of Automotive Fuels – Ultraviolet Fluorescence Method"

The SOLA II's simple, effective design, low utility requirements, proven reliability, unparalleled accuracy and precision, comprehensive diagnostics, and superior data communications set it apart from all other on-line total sulfur analyzers.

The SOLA II employs pulsed ultraviolet fluorescence spectrometry, PUVF, for determination of total sulfur. 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, hv₁, will form an electronically excited form of sulfur dioxide, SO₂*. The SO₂* will relax to its ground state, SO₂, by emission (fluorescence) of light at a slightly different wavelength, hv₂. The intensity of the emitted light, hv₂, is directly proportional to the total sulfur content of the sample.

An automated sample injection valve is used to introduce 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 SOLA II to ensure calibrations are held stable over a long period of time. The SOLA II's unique PUVF spectrometer delivers lower detection limits as low as 0.25 ppm S.



Unparalleled Precision and Accuracy

The SOLA II delivers value through unparalleled accuracy and precision. Excellent precision or repeatability means that SOLA II users can be confident of its data. Changes in total sulfur readings are real, and users can confidently make process adjustments to ensure desulfurization or blending operations are yielding product at the 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.

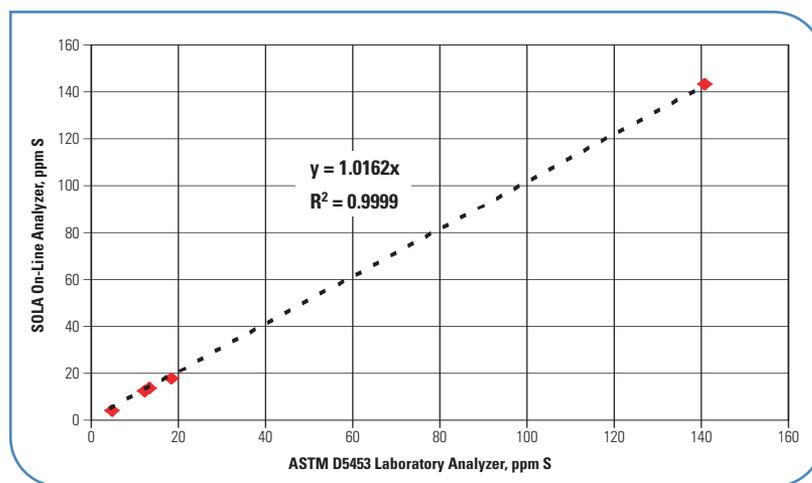
The SOLA II's accuracy was evaluated by comparing its data to lab analyses by ASTM D5453. The SOLA II has regularly demonstrated excellent agreement with all laboratory total sulfur measurement methods, including:

- ASTM D5453
- ISO 20846
- lead acetate colorimetry
- ASTM D2622

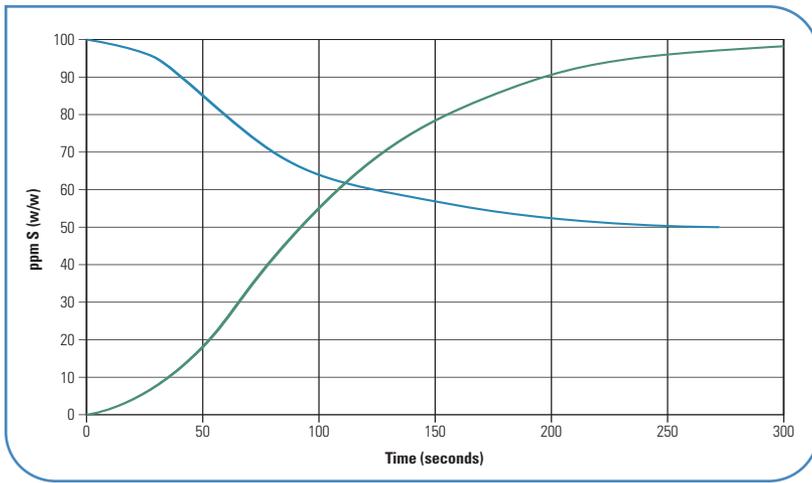
Typical Measurement Precision

| 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 (wt./wt.) | 77.35 ppm S (wt./wt.) | 4.97 ppm S (wt./wt.) |
| Standard Deviation for Run | 0.15 | 0.83 | 0.03 |

SOLA II vs. ASTM D5453

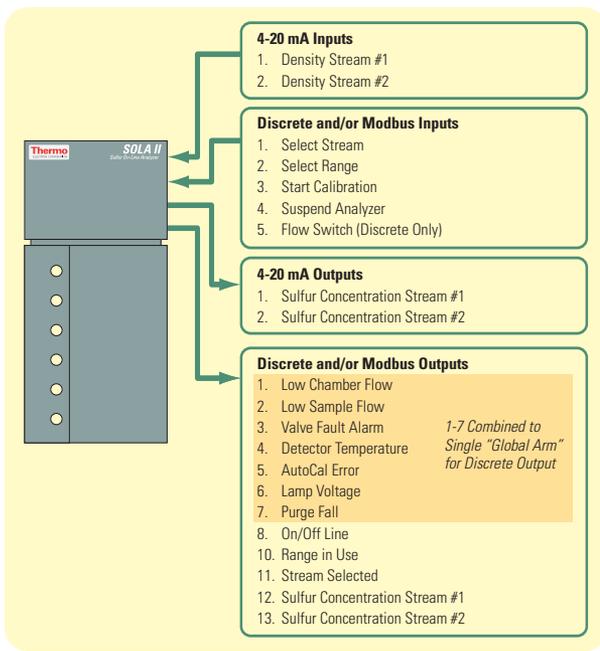


SOLA II Response Time



Rapid Response

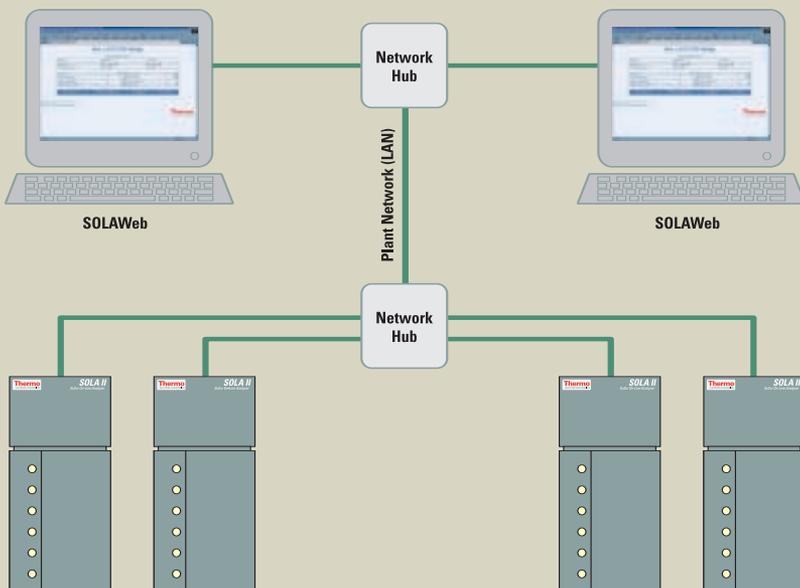
The SOLA II is a semi-continuous on-line total sulfur analyzer. The SOLA II responds to a change in total sulfur concentration immediately following sample injection providing the user a rapid indication of the rate of total sulfur concentration change. While the SOLA II requires 3 to 5 minutes to establish 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 your control system is 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 Sarasota FD910 densitometers from Thermo can be supplied with the SOLA II for purposes of density compensation.

When using modbus communications the user benefits from detailed alarm information. The detailed alarm information 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 will automatically divert sample flow from the injection valve then annunciate the condition through a latching alarm, thus, preventing damage due to coke or soot formation. The SOLA II's comprehensive diagnostics deliver value by significantly reducing the mean time to repair.



The SOLAWeb

SOLAWeb enables the user to communicate with SOLA II via a standard LAN connection. SOLAWeb does not require the installation of vendor specific software. If your PC can access the internet then it can access a SOLA II. 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 such as lamp voltage, PMT voltage, air flow, raw detector signal, lamp intensity, and detector cell temperature. Factory personnel can link to your SOLAWeb workstation via modem to provide invaluable technical support. Equip your SOLA II with the optional interface board, and you have access to SOLAWeb. It is that simple.

SOLA II – Sulfur On-Line Analyzer

| Specifications | |
|--------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Analytical Performance | |
| Detector | Pulsed UV Fluorescence, PUVF, with Pyrolyzer for Total Sulfur Measurement |
| Measuring Ranges | Full Scale Ranges from 0-5 ppm S (w/w) to 0-9000 ppm S (w/w) |
| Repeatability | For full scale ranges ≥ 15 ppm S $\pm 1\%$ of full scale (signal average times may vary with full scale measuring range) For full scale ranges < 15 ppm S $\pm 2\%$ of full scale (signal average times may vary with full scale measuring range) |
| Linearity | $\pm 1\%$ of full scale |
| Response Time | Semi-continuous, outputs updated every 10 seconds, 3-5 minutes to 90% of new value |
| Number of Process Streams | Dual streams with auto stream select (optional) |
| Calibration | 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 via modem |
| 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 via modem |
| 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 1, Division 2, Group B,C,D (Built to) NEC Class 1, Division 1 (optional), Group B,C,D CSA with associated "C/US Mark" Class 1, Division 2, Group B,C,D (pending) CSA with associated "C/US Mark" Class 1, Division 1 (optional), Group B,C,D (pending) ATEX Zone 2, EEx p IIC T2 (T3,T4 Optional) ATEX Zone 1 (optional), EEx p IIC T2 (T3,T4 Optional) CE Mark |

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