



S-PRO 3200 GC System for Sulfur Analysis

Superior Selectivity and Sensitivity



The ability to detect and measure sulfur contaminants in gases is critically important for efficient operation of industrial processes and to control product quality. S-PRO 3200 GC systems have proven highly effective in demanding sulfur analysis applications.

- Sulfur content in Liquefied Petroleum Gas (LPG)
- COS in ethylene and propylene feedstock
- Sulfur in natural gas
- Impurities in beverage grade CO₂
- Semiconductor and industrial gas purity
- Quality control in gas production and blending operations

Gas and Liquid Phase Petrochemicals

Carbonyl Sulfide in Propylene
(ASTM D5303)

Sulfur Compounds in Natural Gas
(ASTM D5504 & D6228)

Ultra-Low sulfur Gasoline (ULSG)

Ultra-Low sulfur Diesel (ULSD)

Thiophene in Benzene (ASTM D4735-02 & D7011)

Sulfur Compounds in Light Petroleum Liquids
(ASTM D5623)

Jet Fuel

Naphtha

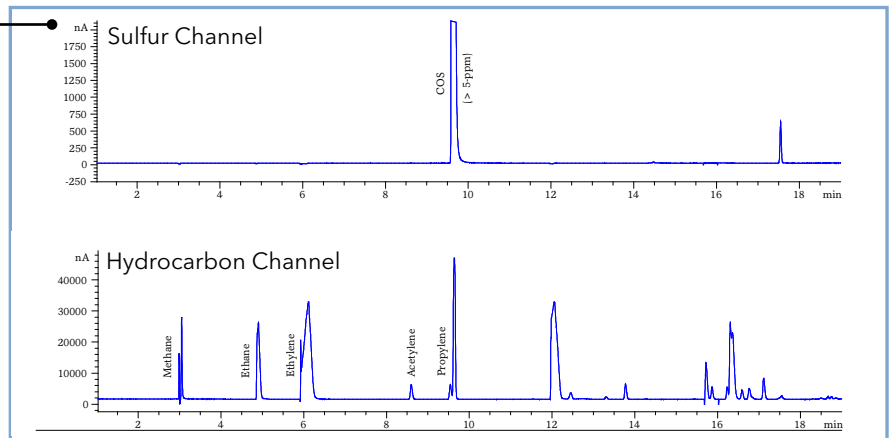
Crude & Synthetic Oils

Furnace Oil

Light Cycle Oil (LCO)

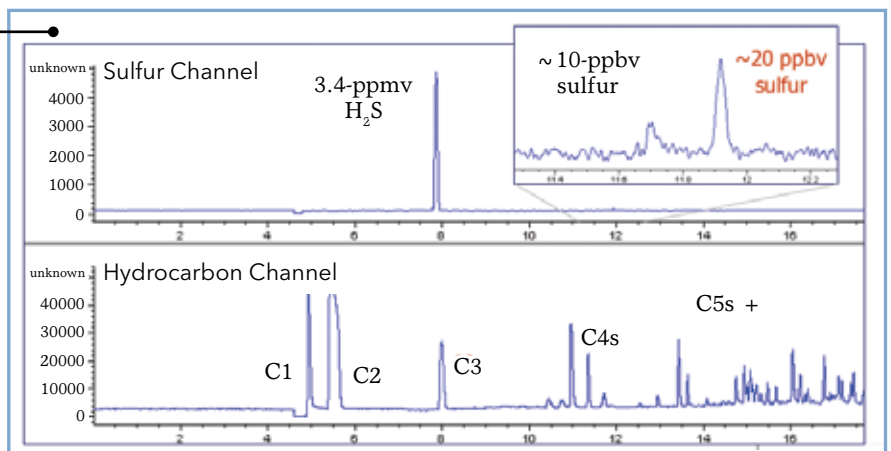
Ethylene and Propylene Feedstock

Propylene is a co-product from steam cracking of ethylene. Carbonyl sulfide (COS) is a major contaminant in propylene feedstock and can destroy expensive catalyst beds used in polymer production and other processes if not removed. The accompanying chromatograms show the hydrocarbons and COS present in a feedstock gas before separation of propylene and ethylene components, and prior to sulfur scrubbing.



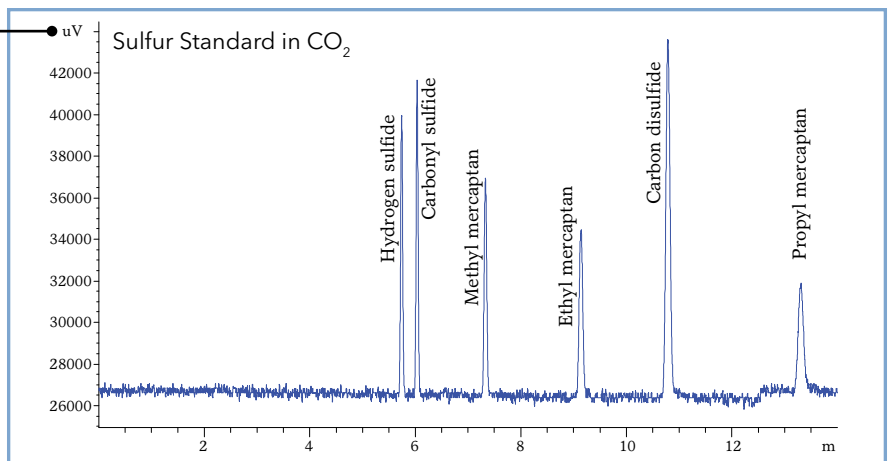
Natural Gas

Natural gas containing hydrogen sulfide or mercaptans is referred to as "sour" gas. The concentration of hydrogen sulfide in natural gas ranges from barely detectable levels to more than 0.30% (3,000 ppm).¹



Sulfur Impurities in CO₂

Early detection and control of H₂S and COS is an important consideration in the production of food-grade CO₂ because the presence of these compounds can impart undesirable odors and flavors to carbonated beverages.



¹ - The Chemistry and Technology of Petroleum, Marcel Dekker, Inc., 1991.

Advanced Detection Technology

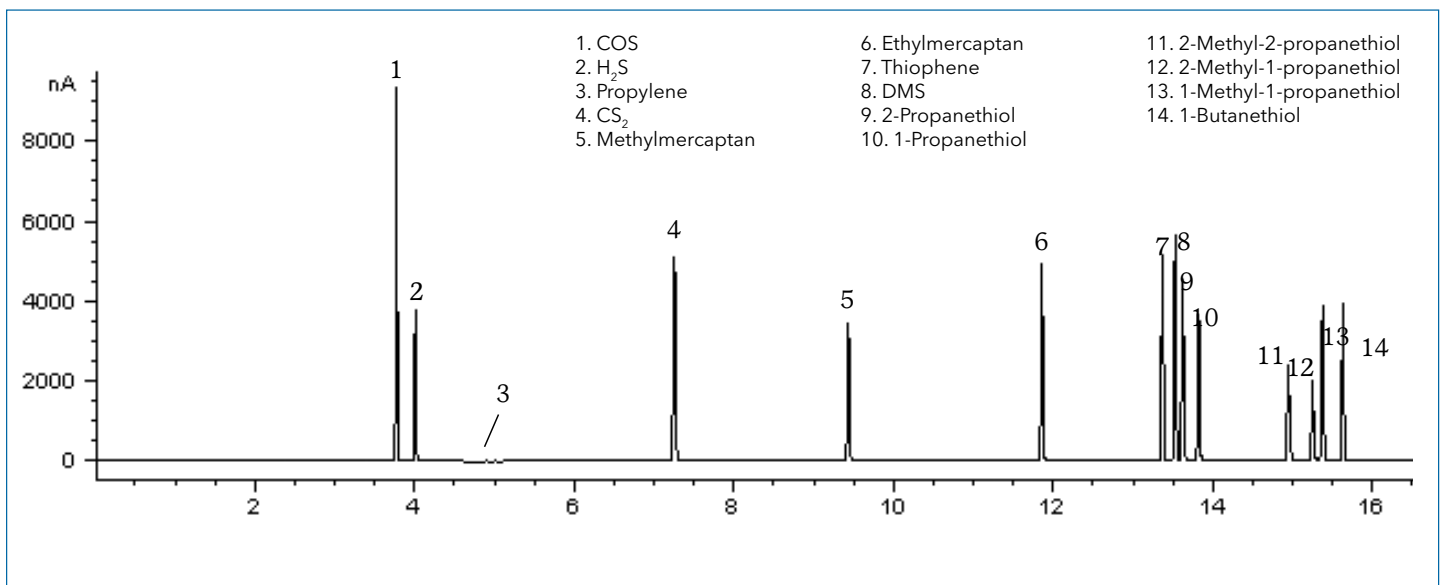


S-PRO 3200 Gas Chromatograph

The S-PRO 3200 is a custom-configured gas chromatograph for selective, high-sensitivity measurement of sulfur compounds in gas-phase samples and Liquefied Petroleum Gas (LPG) streams such as propylene and ethylene.

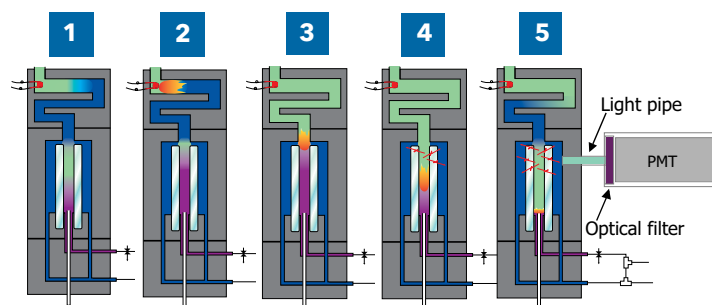
The key technology within the S-PRO 3200 system is OI Analytical's patented* Pulsed Flame Photometric Detector (PFPD). Our Model 5383 PFPD has a linear, equimolar response to sulfur allowing selective measurement of individual sulfur species from low ppb to ppm levels, and total sulfur as the sum of individual peaks. The unique capability to obtain simultaneous sulfur and hydrocarbon chromatograms from a single PFPD detector sets it apart from other sulfur detection technologies. Reliable and cost-effective, the 5383 PFPD uses significantly less gas than SCDs or FPDs and requires less maintenance.

Thirteen Light Sulfur Compounds in a Propylene Standard on the S-PRO 3200



PFPD Principle of Operation

A combustible mixture of H₂ and air is introduced and fills the detector body and cap from the bottom up (1). The combustion mixture is ignited in the cap (2). The resulting flame propagates along the pathway consuming the H₂/air mixture (3). Compounds eluting from the GC column are combusted within a quartz combustor and emit light at element-specific wavelengths (4). The flame is extinguished when it reaches the bottom of the detector, and excited species continue to fluoresce for up to 25 milliseconds. Emissions from the excited species pass along a light pipe, and selected emissions are transmitted through an optical filter to a photomultiplier tube for detection (5). The entire pulsed flame cycle is repeated approximately 3 to 4 times per second.

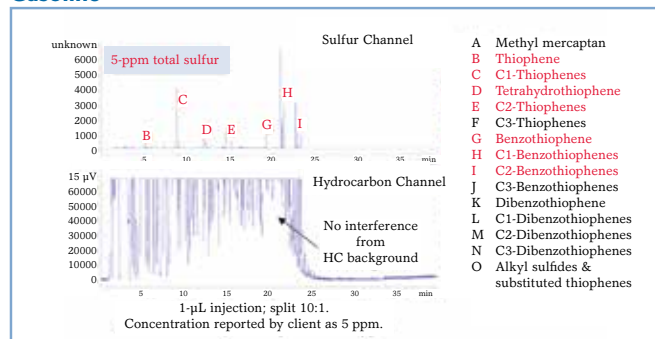


PFPD - Pulsed Flame Photometric Detector

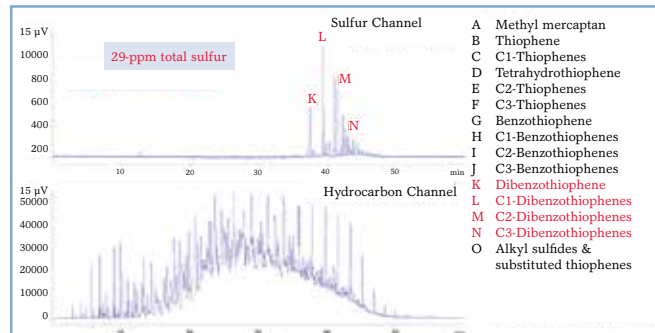
The PFPD is widely used in laboratory and process gas chromatographs to analyze sulfur species and total sulfur levels in liquid-phase petrochemicals.



Gasoline



Diesel Fuel



The Complete Solution for Sulfur Analysis

Chemically-Inert Components

Volatile sulfur compounds such as H₂S, methyl, and ethyl mercaptan adsorb strongly to the surfaces of untreated metals. The entire sample pathway of the S-PRO 3200 is constructed with Sulfinert® or SilcoNert® 2000 treated components to prevent adsorption of sulfur compounds that could cause inaccurate results.

Permeation Oven

Generates gas-phase calibration and QA/QC check standards at point of use

Volatiles Interface

Allows wide dynamic range

Automated Injection System

Automates sample introduction, system calibration, and QC checks

Pulsed Flame Photometric Detector

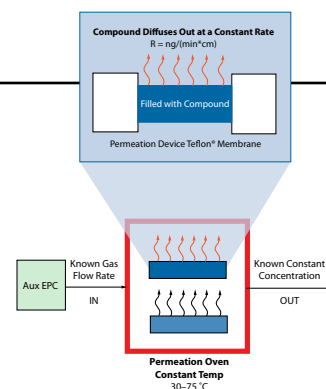
Produces simultaneous, mutually selective sulfur and hydrocarbon chromatograms



OI Analytical has integrated a number of special design features into the Agilent 7890 GC platform to provide unique analytical and performance capabilities.

Permeation Oven

- Accommodates up to 5 permeation devices
- Pure sulfur compound diffuses across a permeable Teflon® barrier at a temperature-dependent rate
- Precise oven temperature control produces a constant diffusion rate
- Controlled, measured flow of dilution gas creates an accurate gas standard for calibration
- Agilent 7890B keypad- or ChemStation-controlled temperature and dilution gas flow



Automated Injection System

- 4-port sample selection valve enables sample selection from a gas stream, or to deliver calibration and check standards from the permeation oven
- 6-port gas-phase switching valve with sample loop injects samples through the Volatiles Interface into the GC column

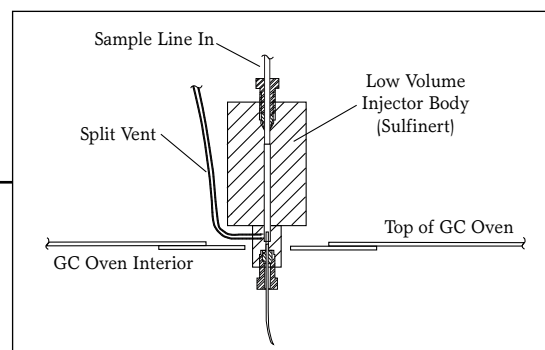
Sulfur Detection - PFPD

- Superior sensitivity and increased selectivity compared to conventional FPDs
- Better long-term stability and less maintenance than SCD or XRF
- Quick, easy calibrations
- Self-cleaning design



Volatiles Interface

- Optimized for ultralow dead volume flow rates, inertness, and ease of column installation



S-PRO 3200 Specifications

Detectivity	Sulfur < 1 pg S/second
Selectivity	At optimum detectivity levels: Sulfur > 10 ⁶ S/C
Permeation Oven	Temperature range: 30 - 75 °C ±0.05 °C
OI Volatiles Interface	Effective split range: Splitless to 150-to-1 Maximum temperature: 325 °C
GC Column	Agilent J&W Select Low Sulfur Column, 80 m x 32 mm ID Maximum temperature: 260 °C

5383 PFPD Specifications

Detectivity

Sulfur	<1 pg S/sec
Phosphorus	<100 fg P/sec

Sensitivity

Sulfur Signal-to-Noise	>300 (at 10 pg S/sec elution rate peak-to-peak noise)
Drift (S or P)	<10x peak-to-peak noise in 20 min

Selectivity (at Optimum Detectivity Levels)

Sulfur	>10 ⁶ S/C
Phosphorus	>10 ⁵ P/C (selectivity is adjustable with a trade-off in detectivity)

Detector Linearity

Sulfur	Quadratic in response; linear to approximately 2.4 orders of magnitude Detector (nonlinear) dynamic range ~3 orders of magnitude
Phosphorus	First order linear over approximately 5 orders of magnitude
Response Uniformity	Equimolar ±8% (S,P)
Chromatographic Peak Tailing	<0.2 sec in S and P



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* U.S. Patent 5,153,673