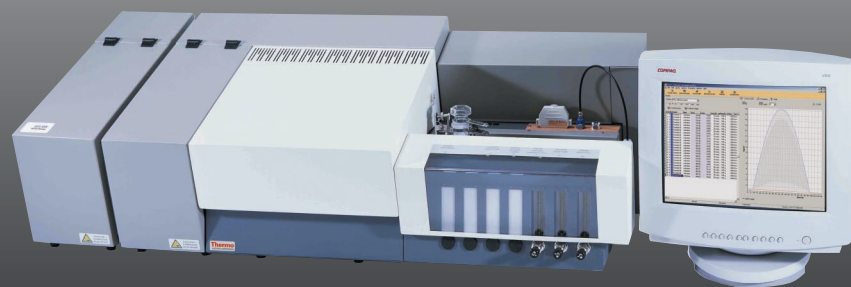


**Total Sulfur Analyzer
TS 3000**



Being prepared for the future

Total Sulfur Analyzer TS 3000

Being prepared for the future

Sulfur analysis: the need to know

Environmental regulatory agencies like U.S. EPA are promulgating dramatic motor fuel sulfur level reductions. Before 2006, the U.S. EPA requires the sulfur content of diesel to be reduced from 500 ppm to 15 ppm. Also other regulatory offices in countries within the European Union and Asia Pacific are setting up proposals to reduce the sulfur content in motor fuels and some of them have already made this mandatory. The challenge to meet the low sulfur fuel specification has a worldwide impact.

In addition refineries have moved to the production of lighter compounds in crude oil fractions, which are sold for higher prices and produce higher margins. Catalysts play a major role in these new processes and sulfur is detrimental to the effectiveness of these catalysts. To ensure efficient production, trace analysis of these elements has to be done on a very regular basis.

TS 3000

Thermo Electron Corporation has developed a trace level Total Sulfur Analyzer; model TS 3000 UV based on Pulsed UV-Fluorescence detection, to meet these challenges. The TS 3000 offers versatile, reliable and repeatable results at ultra-low levels in liquid, solid and gas samples. This Total Sulfur analyzer incorporates a high-end pulsed UV-fluorescence detector, which proves superior repeatability, provides excellent uptime, and presents unequalled linearity and enhanced performance of the analyzer.

The TS 3000 is matrix independent and complies with ASTM D5453 methodology, for the determination of total sulfur in motor fuels and a wide range of light and heavy hydrocarbons.

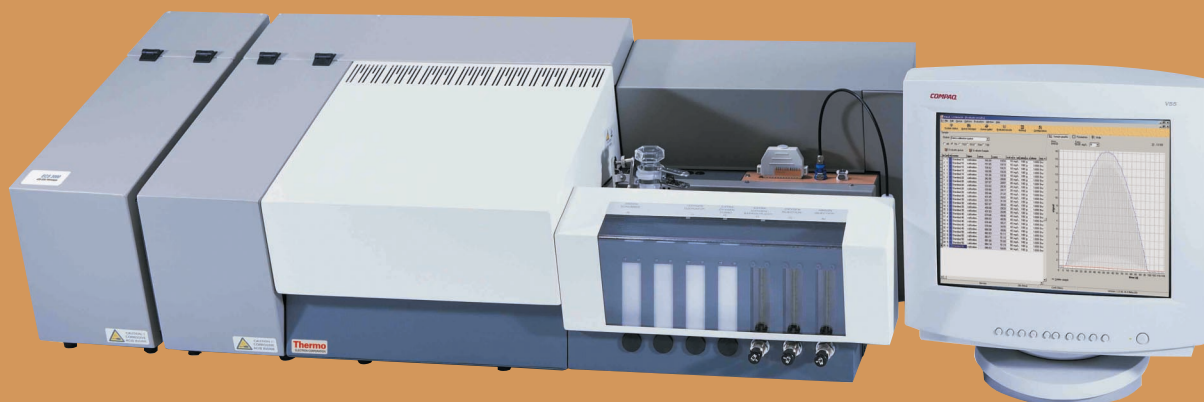
The TS 3000 provides the following benefits:

- 1. Versatility.** The TS 3000 analyses liquid, solid and gas/LPG samples from very low levels (20 ppb) to very high concentrations (500 ppm).
- 2. Flexibility.** The TS 3000 is easily adaptable to total chlorine analyses.
- 3. Productivity.** The TS 3000 works around the clock, equipped with a liquids or solids auto sampler.
- 4. Reliability.** The TS 3000 ensures complete combustion, even with large samples.
- 5. Superiority.** The TS 3000 is superior to wet chemistry and competitive instrumental methods. It has the lowest detection limit on the market.
- 6. Stability.** The TS 3000 continuously checks of the lamp and detector sensitivity to ensure long calibration line stability.

Principle of operation

The samples are pyrolysed at 1000 °C under controlled conditions. The patented turbo combustion tube principle ensures complete combustion of sulfur into sulfur dioxide (SO₂).

The formed SO₂ is led through a polymer-based scrubber to remove water out of the combustion gas. Pulsating UV light excites the SO₂ molecules in the reaction chamber. As the excited SO₂ molecules decays to a lower energy level, light is emitted and detected by a photomultiplier tube. Detection of light emitted during the relaxation of excited sulfur dioxide (SO₂^{*}) takes place according to the following reaction scheme:



Applications:

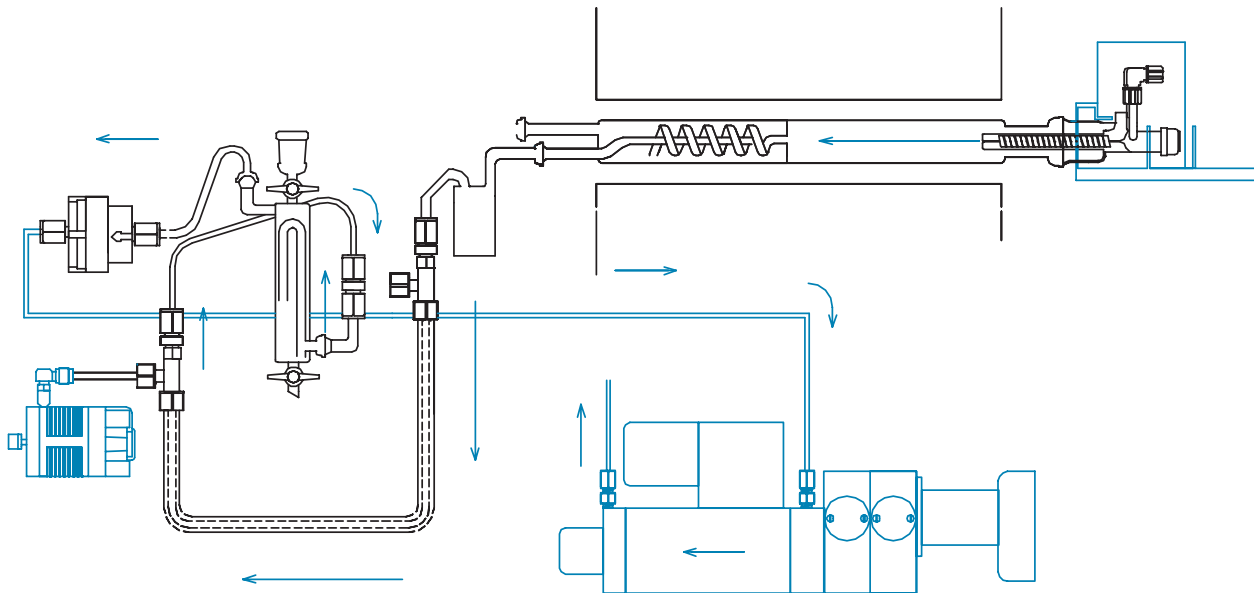
REFINERY PRODUCTS	CHEMICALS	LPG AND GASES
Crude Oil	Acetic Acid	Butane
Kerosene	Polypropylene	Propane
Fuel Oil	Polyethylene	Butadiene
Gasoline	Aromatics	LPG
Diesel Fuel	Polycarbonate	LNG
Catalyst	Resins	Ethylene
Naphtha	Olefins	Propylene
Lubricants	Parrafins	CO ₂

Markets:

- Petrochemical plants
- Refineries
- Commercial Petro-testing labs
- Research & Development Centers
- Chemical plants
- Government

International Methods:

The TS 3000 model complies with the following international standards for Total Sulfur analysis:
ASTM D5453, ASTM D6667



Sample introduction modules

Liquids module

The Thermo Electron Corporation universal liquids module is suitable for fast injection of a wide range of light hydrocarbons. The unique design of catalyst free syringe type introduction module can achieve an operating temperature of 600 °C. This module is provided with quick gas connectors and can handle large volume of samples (max. 250 µl). Injection rate, sample volume and temperatures can be set by the ThEuS software, which ensures an optimum total sulfur analysis.

Solids module

For analysis of heavy hydrocarbons and solid samples, the Thermo Electron boat introduction module is the key. The automatic boat driven concept controlled by ThEuS software, provides the optimum solution for many applications. The high sample load capacity and integrated septum stopper minimizes weighing errors and eliminates problems caused by non-homogeneous samples. The module is supported with quick gas connectors for carrier gas and oxygen as well.

Gas & LPG module

The EGM 1700 is the module for introduction of gas and LPG samples into the Thermo Electron Elemental analyzers. The auto-sampler is provided with a vaporizer and exchangeable sample loop and easy connection to the liquids module.

Key advantages of the EGM 1700 are:

- Adjustable multiple injection
- Easy switching between loops
- Optimal conversion from liquid to gaseous phase by controlling vaporizer temperature
- High reproducibility and low detection limit.



Gas and LPG Module

Liquids Module



Autosamplers

ELS 3000 model

The Thermo Electron ELS 3000 auto-sampler is designed for fully automated introduction of light hydrocarbon samples. The sampler has 74 positions for 2 ml screw capped sample vials and can inject a maximum of 250 µl.

Key advantages of the ELS 3000 auto-sampler are:

- Designed for a 24 hours operational environment
- All operations fully controlled by Windows® (ThEuS) software
- Easy connection to universal syringe type liquids or boat introduction modules
- Wash solvent and waste containers included.

ESA 2000 model

For the automatic introduction of solids and highly viscous liquid samples into the TS 3000, the ESA 2000 autosampler is the best choice. The sampler is provided with a 47 position sample tray suitable for quartz sample cups, which will be picked up from the sample tray and transferred automatically to the quartz boat of the solids module.

The main advantages of the ESA 2000 are:

- Optimal conditioning of samples by using purge flow and a protective lid on the sample carousel
- Works around the clock
- Fully supported by (ThEuS) software



ELS 3000 Model



Extra power: the Chlorine option

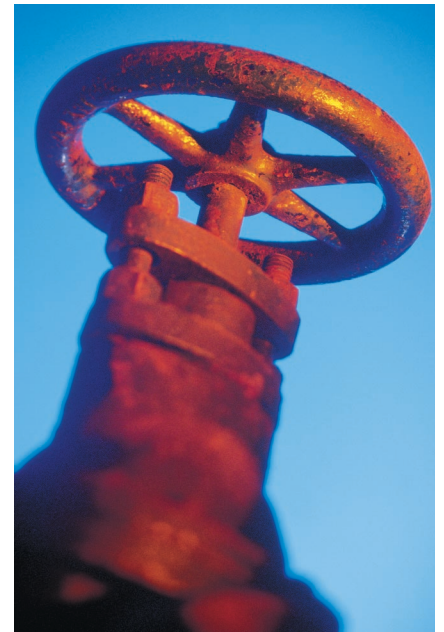
The Total Sulfur analyzer, model TS 3000 can be extended in a couple of minutes into a fully-fledged TS-UV/TX analyzer. The chlorine module has a short start-up time and is able to perform a large number of simultaneous sulfur & chlorine analyses supported by the Thermo Electron Software (ThEuS).

The robust chlorine titration cell fitted within a cooled compartment has a short start-up time and is able to perform at least 60 analyses without any maintenance. The module can be connected to the coulometer quickly and easily. The chlorine option fully complies with several ASTM standards like D4929, D5194 and D5808 also. Key features of this option are:

- Sensitivity
- Short analysis time
- Excellent analytical performance down to 50 ppb

Key advantages of the TS 3000 with Total Chlorine module are:

- Increases quality control performance and reduction of investment costs
- Fully meets ASTM D4929, D5808 and D 5194 approved chlorine methodology
- Performance down to 100 ppb for typical applications
- User friendly calibration procedures



Benefits:

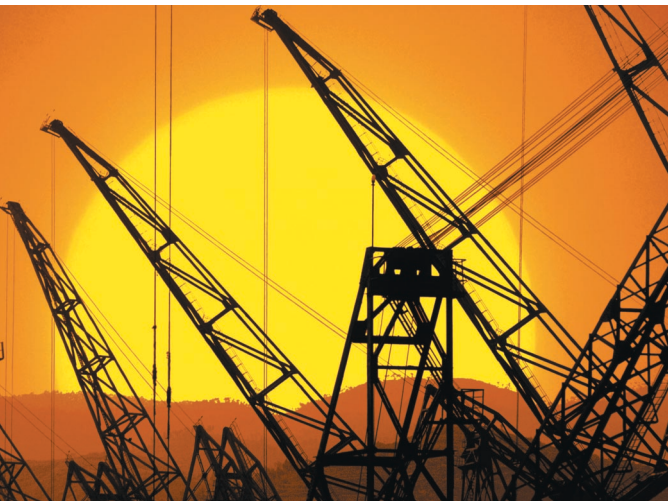
FEATURES	ADVANTAGES	BENEFITS
Pulsed UV-Fluorescence detector with AGC technology	Low recalibration frequency	Less down time of the analyzer and reduced operational costs
Turbo quartz tube	Optimal combustion, No soot formation	Easy maintenance, Less down time
No chemicals required	Easy and maintenance free operation	Reduce operational costs
Auto samplers for liquids and solids	Higher throughput, 24 hour operation	Lower cost per analysis
Windows™-based ThEuS software	Intuitive user interface and fully multi-tasking operation	No need for extensive training, less error-prone
Modular design	Switches easily and rapidly between gas and liquid operations	Reducing both bench space and investment costs
Meets ASTM, D5453 and D6667 methodology	Broad acceptance of results	Works with all customers, Applicable in interlaboratory studies

ThEuS Analytical Software

The advanced user interface of the Thermo Electron Corporation Software (ThEuS) design makes operation of the TS 3000 both intuitive and straight forward. ThEuS assists the user in achieving routine TS analysis in an efficient, fast and reliable way. Clear and user friendly icons, allow simple instrument operation at a glance. The fully multi-tasking operation, makes it possible to modify sample queues, evaluate data and calibration lines independently, while operating the analyzer. Results are presented in customized print reports or exported in a variety of data formats.

Key features of ThEuS are:

FEATURES	BENEFITS
One software solution for all trace Elemental analyzers	Reduces complexity and improves productivity
Real time measurement curves	Maximal analysis control, easy to compare samples at a glimpse
Multi-Elemental analysis	Optimal analysis control and time saving procedure
Selectable user and service levels	Security and data integrity
Customized application and analysis methods	Full control of the analysis/system, flexible method structure
Fully multi-tasking	Efficiency, user friendly and time saving



**The technologies you need.
The brand you trust.
The service you deserve.**

Thermo Electron Corporation

Your solid partner for:

- Elemental analysis
- Customer specific applications
- Advanced service support

For analyzing elements at trace levels Thermo has built a solid reputation with a wide range of elemental analyzers. Various applications for total sulfur, total nitrogen, total chlorine, organic halogens and total organic carbon in liquids, solids and gasses can be performed. Our instruments help you to achieve environmental regulatory, process control, quality control, quality improvement and increasing profitability.

In addition to these offices, Thermo Electron Corporation maintains a network of representative organizations throughout the world.

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