

SPECTRO ARCOS

FHx12a

High Resolution ICP-CCD Spectrometer for the Most Demanding Elemental Analysis Requirements in Industry, Environmental Protection and Academia





Surpassing Performance Limits

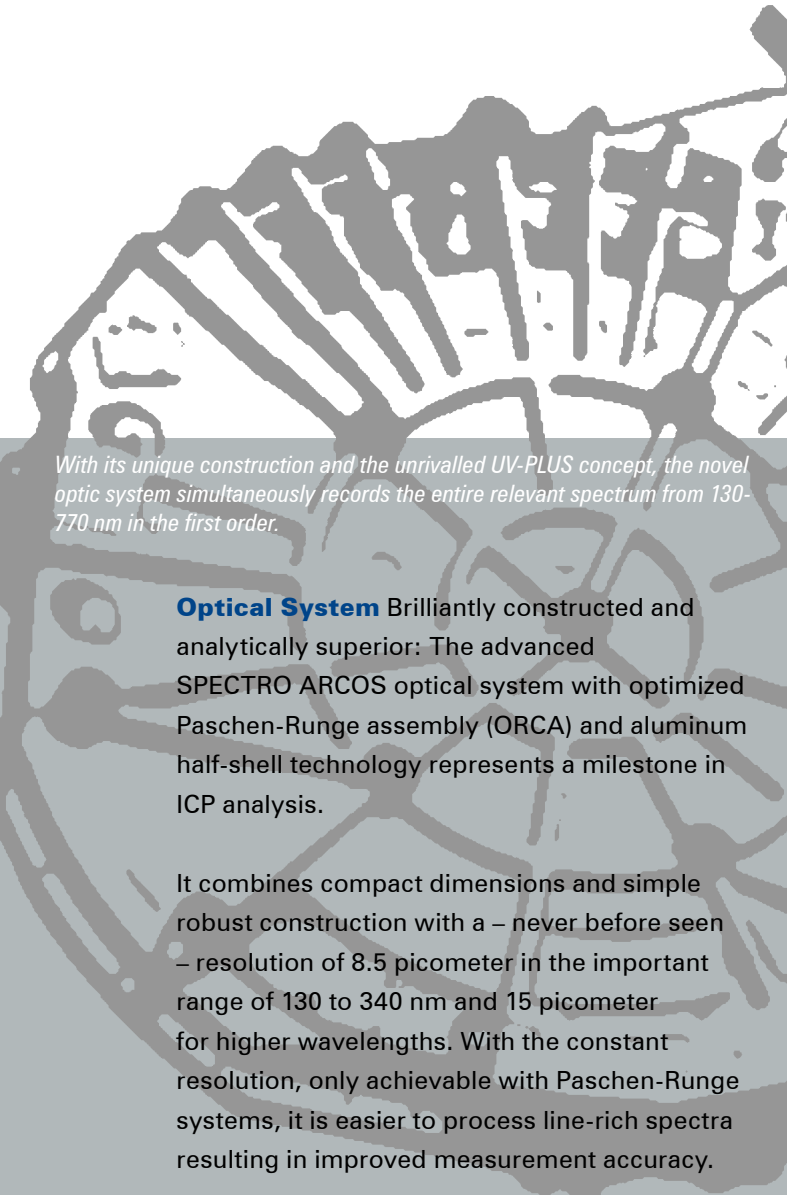
Because ICP-CCD spectrometers represent a relatively fast and uncomplicated solution they are currently utilized for widely varying tasks in elemental analysis. However, conventional ICP analysis can often reach its limits for especially demanding applications. The new SPECTRO ARCOS offers the optimum capability and flexibility for these analytical challenges. Innovative components with spectacular performance characteristics overcome contemporary barriers with plenty of power in reserve for complex tasks in industry, environmental protection and research.

Its appearance alone sends out a definite signal: The SPECTRO ARCOS is different from conventional ICP spectrometers. The prominent left side of the instrument houses the unique optical system – a major development with unbeatable resolution, accuracy and stability.

The compact instrument fits on every ordinary lab bench enabling it to be easily integrated into existing laboratories. Housing and fluid paths are fitted with a chemical resistant coating. The entire sample introduction area is protected against damage from leaking sample fluids. All components and connections are accessible – without moving the instrument – from the front and sides, simplifying maintenance.

The SPECTRO ARCOS can be outfitted with an interface for either axial or radial plasma observation. The new CCD optic system with a Paschen-Runge mount assembly delivers a matchless resolution of 8.5 picometer in the wavelength range from 130 to 340 nm.

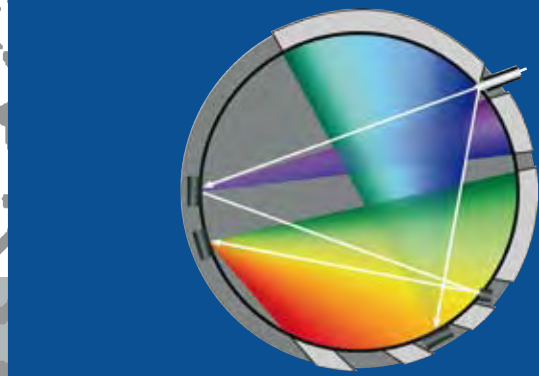




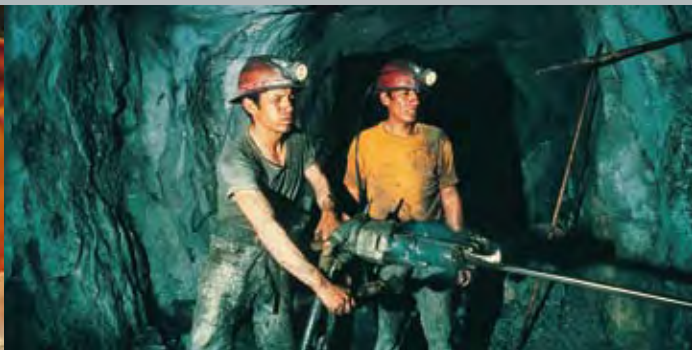
With its unique construction and the unrivalled UV-PLUS concept, the novel optic system simultaneously records the entire relevant spectrum from 130-770 nm in the first order.

Optical System Brilliantly constructed and analytically superior: The advanced SPECTRO ARCOS optical system with optimized Paschen-Runge assembly (ORCA) and aluminum half-shell technology represents a milestone in ICP analysis.

It combines compact dimensions and simple robust construction with a – never before seen – resolution of 8.5 picometer in the important range of 130 to 340 nm and 15 picometer for higher wavelengths. With the constant resolution, only achievable with Paschen-Runge systems, it is easier to process line-rich spectra resulting in improved measurement accuracy.



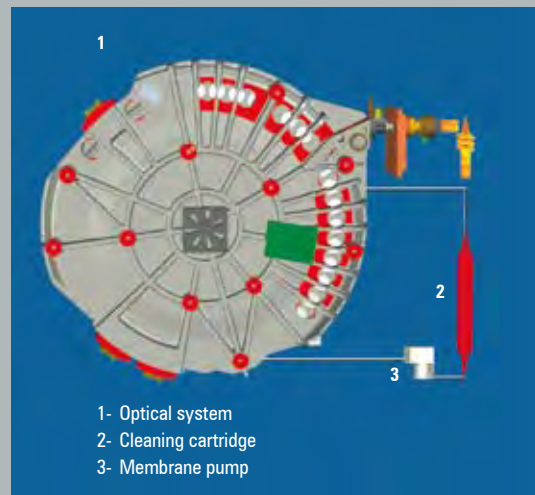
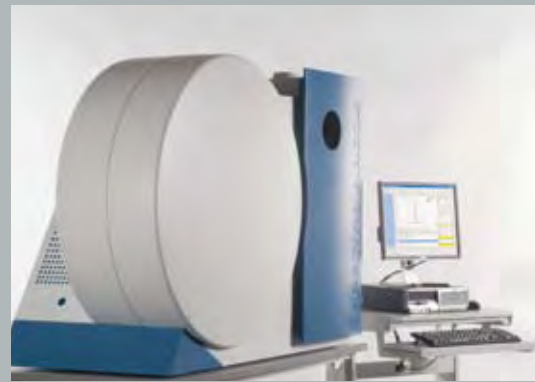
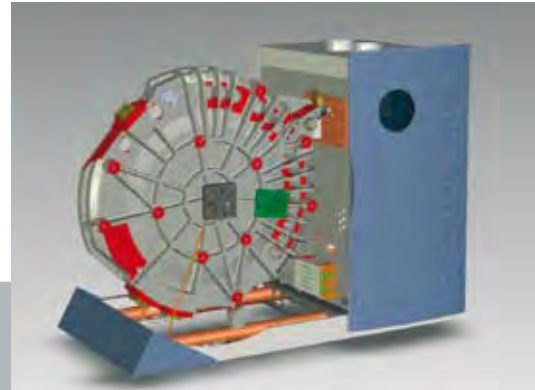
A noteworthy aspect of this concept is the extension of the wavelength range coverage to the complete relevant spectrum from 130 to 770 nm. It is simultaneously and continuously recorded in the first order; even the VUV segment is recorded with highest sensitivity. This enables access to wavelengths for the halogens as well as many highly sensitive lines that were previously out of reach; facilitating superior ultra trace determination of numerous elements. Interference-free emission lines are now available for complex matrices; simplifying method development and decisively improving the accuracy of the analysis.



UV-PLUS The proven SPECTRO-UV-PLUS system is utilized in the SPECTRO ARCOS for measurements in the UV range. In this method, the optical system chamber is filled once with argon. The argon is circulated with a small membrane pump through a cleaning device; ensuring excellent long-term stability and eliminating disadvantages typical for systems with a vacuum or purge gas, such as contamination of the optical components.

Neither purge gas nor operation of a vacuum pump is required for the UV-PLUS. The cleaning or replacement of optical components becomes unnecessary. Except for replacement of the cleaning cartridge every twelve to fifteen months, the UV-PLUS system is completely maintenance-free.

In addition to providing exceptional transparency in the wavelength range between 130 and 180 nm, the system dramatically reduces operating costs. Over the lifetime of the spectrometer this can mean a savings of up to one third of the initial instrument purchase price when compared to a purged system.





Additional SPECTRO ARCOS strengths include the new, extremely robust, free-running generator with a ceramic tube and solid-state power supply, the low maintenance and economical UV-PLUS system for high VUV transparency down to 130 nm, as well as the fast readout system with a dynamic range of eight decades and a transient measuring frequency of up to 10 Hz.

The ICAL system logic automatically monitors operation of the SPECTRO ARCOS guaranteeing continuous optimum operating conditions.

A high degree of flexibility, clear structure and simple operation characterize the "SMART ANALYZER VISION" graphical user interface. Whether defining norm-conforming measurement procedures, quantitatively reprocessing stored spectra or creating measurement methods, operators appreciate the straightforward and easily accessible functions. They enable the SPECTRO ICP to be perfectly tuned to local and/or industrial analytical regulations and requirements.

An extended SMART ANALYZER VISION platform is available for the SPECTRO ARCOS. A document server for simple, automatic storage of methods and results is an integral component of the software, in addition to functions for transient measurements and automatic optimization.

- **New ICP performance class for complex analytical tasks**
- **Axial or radial plasma observation**
- **Sample introduction system with automatic positioning**
- **Stable plasma conditions due to the robust free-running generator**
- **Unique optical system with excellent resolution**
- **Extended spectral range from 130-770 nm for perfect line selection**
- **Low maintenance UV system with minimal operating cost**

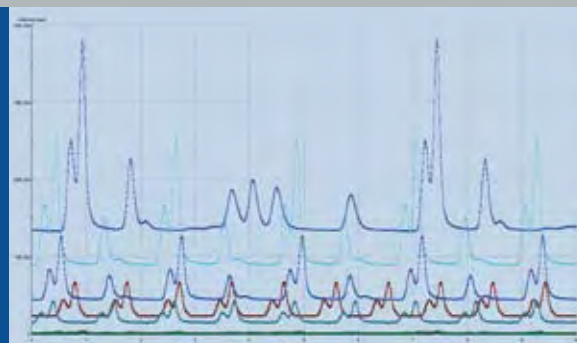


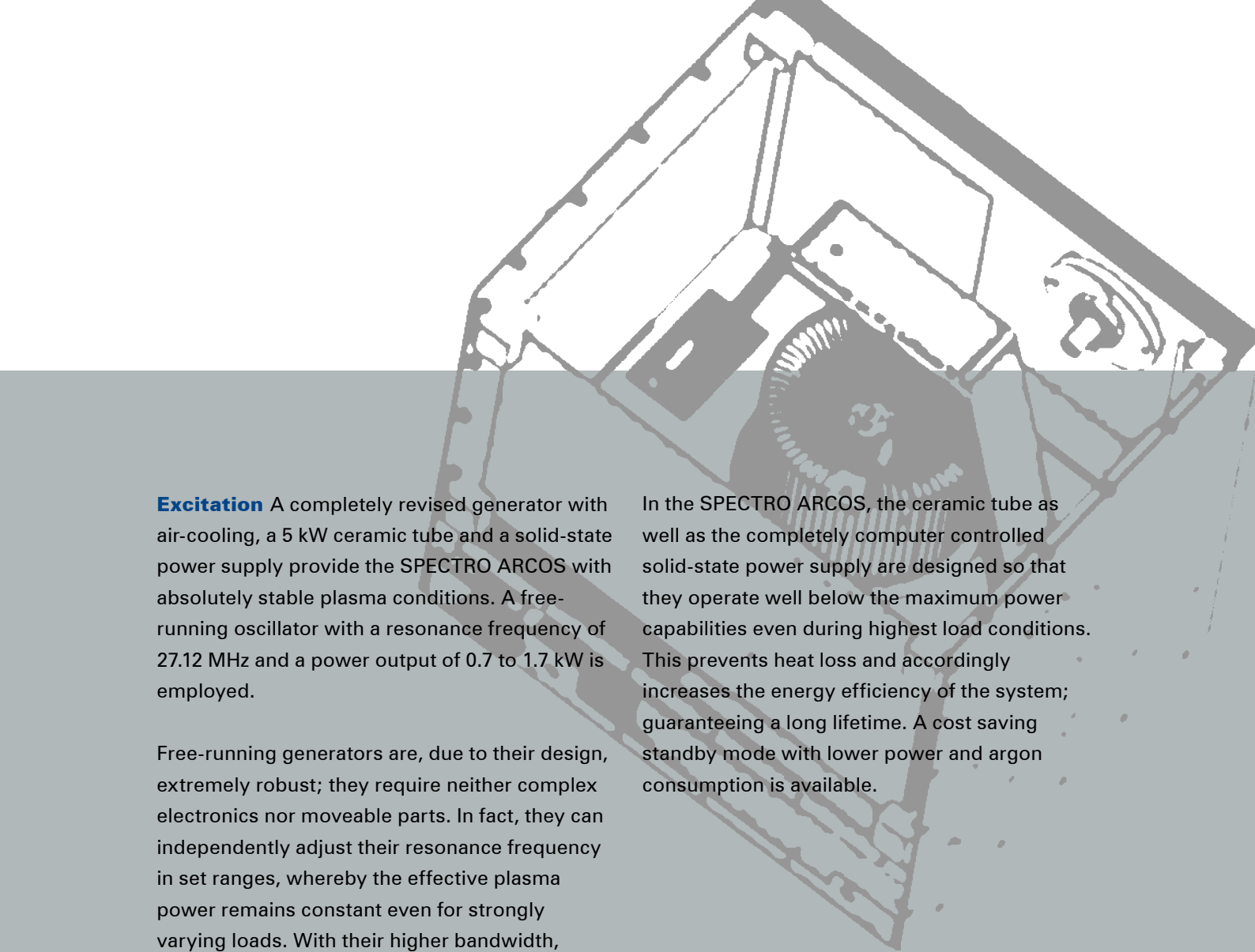
Detector and Readout System The SPECTRO ARCOS records the spectrum with 32 linear CCD detectors aligned to cover the entire wavelength range relevant to ICP-OES from 130 to 770 nm.

An important difference from other detectors used in ICP analysis is that the CCD arrays in the SPECTRO ARCOS require no special minus temperature cooling. Instead, they are thermally stabilized to +15°C together with the complete optical system; a technically simple and robust solution, making them independent from environmental temperature influences.

Every CCD array possesses its own digital signal processor. A high-speed readout system with two parallel units, with 16 channels each, are responsible for further processing. All 32 CCD detectors are readout and the complete spectrum is calculated in less than two seconds. For each pixel, the integration time is automatically adjusted to the signal height. In addition, the readout system can process transient signals with a frequency of up to 10 Hz.

The very high readout speed and the large dynamic range of up to eight decades prevent blooming effects. The determination of trace contents in the presence of major components – typical for many applications – can be handled without the need for additional dilution.



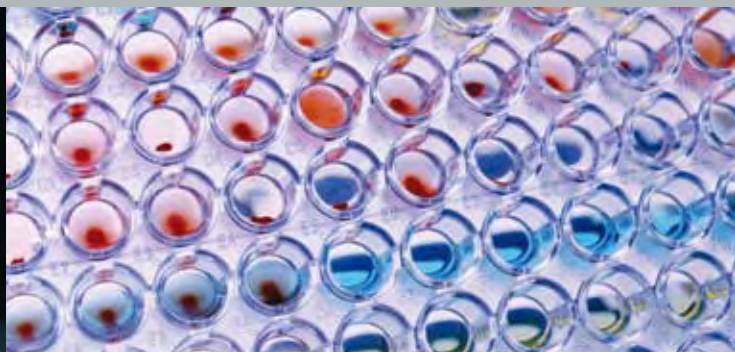
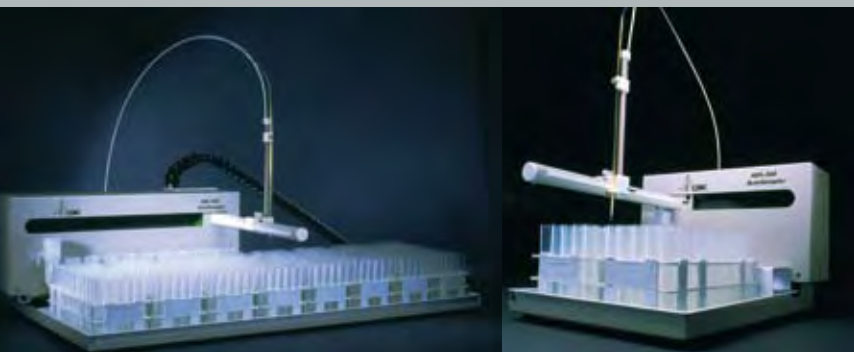


Excitation A completely revised generator with air-cooling, a 5 kW ceramic tube and a solid-state power supply provide the SPECTRO ARCOS with absolutely stable plasma conditions. A free-running oscillator with a resonance frequency of 27.12 MHz and a power output of 0.7 to 1.7 kW is employed.

Free-running generators are, due to their design, extremely robust; they require neither complex electronics nor moveable parts. In fact, they can independently adjust their resonance frequency in set ranges, whereby the effective plasma power remains constant even for strongly varying loads. With their higher bandwidth, 27.12 MHz oscillators are clearly in a better position for this than those with 40.68 MHz.

In the SPECTRO ARCOS, the ceramic tube as well as the completely computer controlled solid-state power supply are designed so that they operate well below the maximum power capabilities even during highest load conditions. This prevents heat loss and accordingly increases the energy efficiency of the system; guaranteeing a long lifetime. A cost saving standby mode with lower power and argon consumption is available.

A wide range of accessories is available for the SPECTRO ARCOS. This includes alternative sample introduction systems such as an ultrasonic nebulizer, autosampler and automatic dilution system. Additionally, factory calibrated, norm conforming "Plug and Analyze" method packages for typical industrial and environmental applications are available.





Plasma Interface Depending on the application, one of two different technologies is utilized to view the plasma. Axial plasma observation with the Optical Plasma Interface (OPI) is the right solution for the analysis of traces. Highest sensitivity and detection limits that are improved by up to a factor of 10 compared to radial observation are obtained with this method.

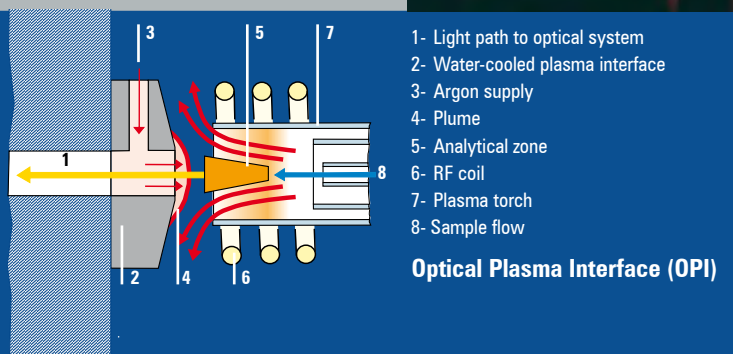
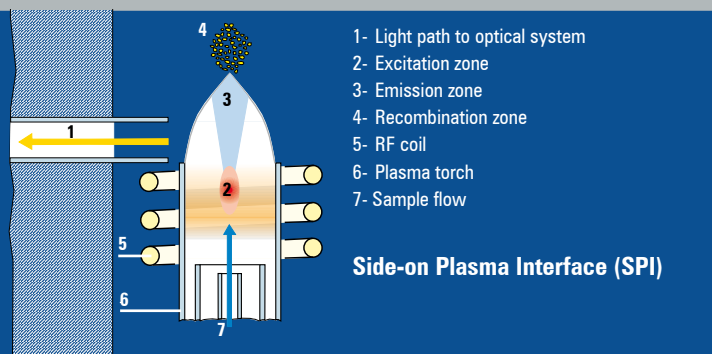
Unlike conventional systems with “gas jet” or extended plasma torch, the OPI pierces through the interfering recombination zone, deflects it from the optical path, and eliminates the matrix effects that occur in the cooler zones of the plasma. Without an OPI, fluctuating plasma characteristics resulting from varying matrices, as in environmental applications, can lead to problematic effects such as deterioration of recoveries.

With over 10 years of proven performance, the OPI has been slightly modified and now uses a bayonet connection, which distinctly simplifies maintenance work and guarantees that the interface is always in the exact same position.

Radial plasma observation with the Side-on Plasma Interface (SPI) is employed when detection limits are of less importance and accuracy and precision at higher concentrations become the focus. Less sensitive due to the smaller observation volume, this technique features an excellent precision and a superior tolerance for high saline and organic fractions. It is also well suited to the analysis of suspensions and slurries.

A computer controlled plasma positioning system enables automatic optimization of the viewing height and distance from OPI for radial and axial plasma observation respectively. The setting can – like other parameters – be stored with the method and is then automatically available each time the method is loaded.

The advantage of the radial plasma observation, which is less sensitive to high matrix contents, is the precise determination of major components. Axial observation with the OPI improves detection sensitivity without the matrix interferences found in other axial systems.





The ICAL logic system continuously monitors the operating state of the SPECTRO ARCOS. If changes are detected, a normalization that consists of the automatic or manual measurement of a single ICAL sample is started ensuring that the instrument is always in an optimal state of operation.

Sample Introduction System The sample inlet, using a four channel peristaltic pump, is located on the right side of the instrument. The consequence of this arrangement is a very short sample pathway and rapid flush times. Depending on the application, the total analysis time for a sample with three repeat measurements is reduced to less than two minutes.

The measurement times can be further optimized with computer controlled monitoring of the flush procedure and autosampler movements. Extreme sample throughput rates – as often required for the screening of oil or soil, for example – with up to 1000 samples per day are easily realized.

The generously dimensioned, thermally insulated, sample introduction chamber can be outfitted with a range of sample introduction systems. The nebulizer chamber and torch can be easily locked into place on the ergonomically designed mounts without the need for time consuming adjustments. The positions are set once and remain the same even when components are exchanged; removing an additional source of error.

The flow rates for the coolant, auxiliary, nebulizer and additional gases are completely software-controlled in the SPECTRO ARCOS; they can be individually optimized and stored with the method. An auto-optimization function is available to set these parameters if desired. This enables even beginners to use the instrument with optimal conditions.

Software The SMART ANALYZER VISION software package allows the operator to quickly and intuitively use the instrument functions. It fulfils all of the requirements in today's laboratories and is easily integrated into a LIMS. Simple and even very complex automation tasks can be conducted with little effort using the automation module.

The software offers fully novel possibilities with its comprehensive functions for new evaluation of stored measurement results with modified parameters: spectra can be reprocessed at a later point in time and the quantitative results newly calculated with, for example, other line parameters and/or a different line selection.





Technical Specifications



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Polychromator

- Thermally stabilized to $+15^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$
- Circular design, Paschen-Runge mounting
- Focal length 750 mm
- Holographic grating: 2 x 3600, 1 x 1800 grooves/mm
- MgF_2 optical components, Grating material Zerodur
- Wavelength range: 130-770 nm, full 1st order wavelength coverage
- Entrance slits width: 15 μm

Detector

- 32 linear CCD arrays, 3648 pixels per array
- Pixel resolution: 130-340 nm 3 μm , >340 nm 6 μm
- Thermally stabilized optical system
- Parallel readout architecture
- Dynamic range up to 8 orders of magnitude
- Shortest integration time: 1 ms
- Shortest measurement time for one analysis: 2 s
- TCP/IP interface to data processing system

UV System

- UV-PLUS system
- Gas filled (Argon), no consumable purge gas required
- Easy to maintain entrance optics
- Automatic gas purifying system
- Lifetime of purifying cartridge: 12-15 months

RF-Generator

- Free running type, Frequency: 27.12 MHz
- RF power output: 0.7 to 1.7 kW
- Power efficiency: >70 %, power stability <0.1 %
- Automatic plasma ignition
- Stand-by mode (low power, low argon)

- Fully computer controlled
- Air cooled (no external cooling required)
- Solid state power supply fully integrated in cabinet

Dimensions and Weight

- Spectrometer (HxWxD) 1074 x 1610 x 753 mm, (42.3 x 63.4 x 29.7 inch)
- Footprint (WxD) 1367 x 692 mm, (53.8 x 27.3 inch)
- approx. 250 kg (approx. 550 lbs)

Environmental Conditions

- Room temperature: 15-35°C (59-95°F)
- Relative Humidity: <80 % non-condensing
- Atmosphere: free of corrosive vapors and high dust pollution

Exhaust System Requirements

- Capacity: 2 x >250 m³ per h (>150 cft/min) separately adjustable between zero and maximum

Argon Supply Requirements

- Grade: ≥ 4.6 (99.996%), pressure: 7.5 bar (109 psi)

OPI Cooling (EOP only)

- Entrance temperature: 5-25°C (41-77°F)
- Flow rate: 1.5-2.5 l/min (0.4-0.7 gal/min)
- Water pressure: 1-5 bar (14.5-72.5 psi)

Electrical Requirements

- 230 VAC $\pm 5\%$, 50/60 Hz
- approx. 4.5 KVA power consumption
- 30-32 A instrument required line protection (slow blow fuse)

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