BRUKER

Bruker AXS

# S8 LION///

Spectrometry Solutions

think forward

WDXRF

S8 LION – Leader of the power pack

# Simultaneous XRF: S8 LION‴ – leader of the power pack

**100,000 cubic meters of raw material, 10,000 tons in daily production, 80 tons of loading volume - the dimensions and expenses in industrial sectors such as cement, mining and industrial minerals are gigantic.**

The investments are correspondingly big and production has to keep on running and running. Not just because of the costs, but primarily for process stability, all processes must function reliably, smoothly and maintain the same high quality. It goes without saying that all raw materials, intermediate compounds and final products must be monitored in real time and the resulting analytical require-ments are inevitably very strict.

When selecting the best analytical system the lab manager is therefore faced with questions of principle with far-reaching consequences:

1) Which analytical method is best for continuous, fast and reliable process monitoring?

2) Does the method provide analysis results that allow very exact and comprehensive process control?

3) Can the analytical system deal with the industrial samples without any problems and also deliver process-relevant information?

4) Does the analytical system function absolutely reliably, is it easy to operate, can it be automated and are the operating costs low?

5) Which system can offer all of this?

The answers are simple.
Firstly: **X-ray fluorescence!**
Secondly, thirdly and fourthly: **Yes!**
And fifthly: **The S8 LION!**

After all, no other analytical method is as economical and reliable as X-ray fluorescence analysis. And no other system delivers as much concentrated power, perfect performance and engineered quality as the S8 LION.

S8 LION – Leader of the power pack

S8 LION

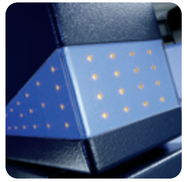
TouchControl™

SampleCare™ – Tube above

USB – Ethernet Connection

Bent Crystals

Flexible sample handling



X-ray warning lights

Automated sample loader

Automation interface

EasyLoad™

Process samples

S8 LION status

S8 LION – simple operation

# Simultaneous XRF – dedicated performance, tailor-made

**No other analytical method is as good and fast for specific element analysis in process control as the simultaneous X-ray fluorescence analysis (XRF).**

Simultaneous XRF fulfils its purpose directly without complex, time-consuming and expensive sample preparation. No matter from which process steps the samples are taken, with simultaneous XRF the results of analysis are available immediately to process control; and they are extremely precise and reliable.

## Why is XRF so simple?

XRF excites the sample by bombarding it with X-rays. This causes electrons from the inner atomic shells (K and L) to be ejected.

The "vacancies" that arise are filled up with electrons from outer automic shells (L or M). Since the electron transition takes place between the inner atomic shells, which do not play a part in chemical bonding, samples can be examined directly without the need for elaborate sample preparation.

## How does XRF identify the elements?

At the time of electron transition, an electron moves from a higher-energy shell to a lower-energy shell. It releases its "excess" energy as X-ray fluorescence radiation. This radiation has a wavelength or energy that is characteristic of each element. XRF uses this characteristic radiation to identify and quantify elements in a sample.

## Why is simultaneous XRF faster and more precise?

In wavelength-dispersive XRF (WDXRF) the X-ray fluorescence radiation emitted by the sample is split into element-specific wavelengths by an analyzer crystal. For perfect analysis of the various elements, different analyzer crystals and detectors, each optimized for a range of wavelengths, are used. Elements are measured one after the other in sequential fashion.

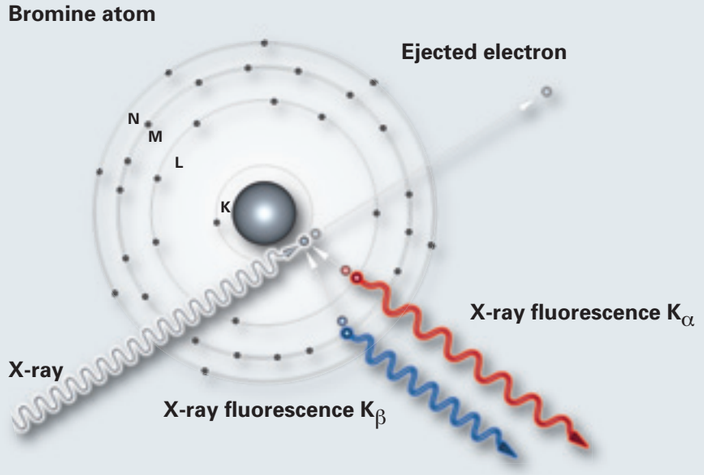
Simultaneous WDXRF speeds up the measurement process. A separate, tailor-made channel is available for each element with an ideal combination of analyzer crystal, automatic absorber and detector. All channels measure simultaneously – without moving parts, without time delay and without compromise.

This makes simultaneous WDXRF the best solution in terms of time-to-result, precision, reliability and a long instrument life cycle.

- Easy sample preparation within minutes
- Element concentration range from ppm to percent
- Optimal analysis with high precision and accuracy
- Shortest time-to-results due to simultaneous measurements
- Highest instrument uptime and reliability due to few moving parts
- Dedicated analyzer for process control

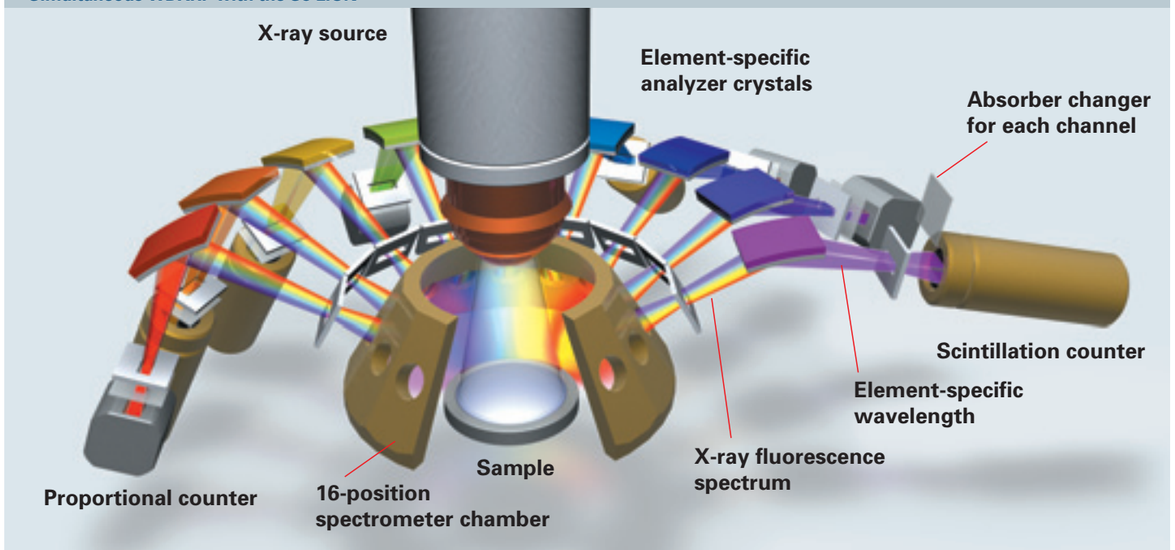


### How does X-ray fluorescence (XRF) work?




- The sample is bombarded with X-rays. This excites the sample to generate X-ray fluorescence. The X-rays "shoot" individual electrons out of the atoms of the elements, primarily out of the inner atomic shells K and L. The resulting vacancies are filled up again by electrons from higher energy shells. The excess energy of these electrons is then emitted in the form of X-ray fluorescence radiation. This radiation is characteristic for each element like a fingerprint and independent of the atom's chemical bond. The intensity of the radiation is proportional to the concentration of the element in the sample.

### Simultaneous WDXRF with the S8 LION




- In simultaneous wavelength dispersive X-ray fluorescence (WDXRF) each element is analyzed by recording the signal in an individual channel. Depending on the application, every channel is optimized for the concentration range of the element.
- The X-ray source is located above the sample and excites the elements directly. A very close coupling between tube anode and sample surface guarantees the highest primary intensity for excitation.
- The spectrometer chamber remains under vacuum always to ensure the best sensitivities to low-energy X-rays. The chamber is therefore very compact and a stable vacuum is maintained by sealing the chamber with a shutter during sample change. The strategic placement of 16 element channels around the chamber optimizes the intensities due to shortest sample-to-detector coupling.
- Each channel consists of a source entrance slit, a bent crystal with a logarithmic shape, an exit slit and a detector. This so-called Rowland circle setup ensures higher intensity and better resolution than conventional geometries by focusing the element-specific radiation towards the detector.
- Analyzer crystals play a crucial role in wavelength dispersion. They break down the multiple wavelength fluorescence spectrum into the characteristic wavelengths for the elements. This signal separation produces the outstanding resolution and sensitivity of WDXRF.
- To allow the analysis of wide concentration ranges, each channel can be equipped with an absorber. In the case of high intensities due to high concentrations of the respective elements, the absorber is moved in the beam to attenuate the signal. The signal is thereby kept in the linear range of the detector.
- And finally the detectors: For the detection of lighter elements, a proportional counter is used. For heavier elements, a scintillation counter is used. Both types of detectors are perfectly suited to their respective energy ranges.

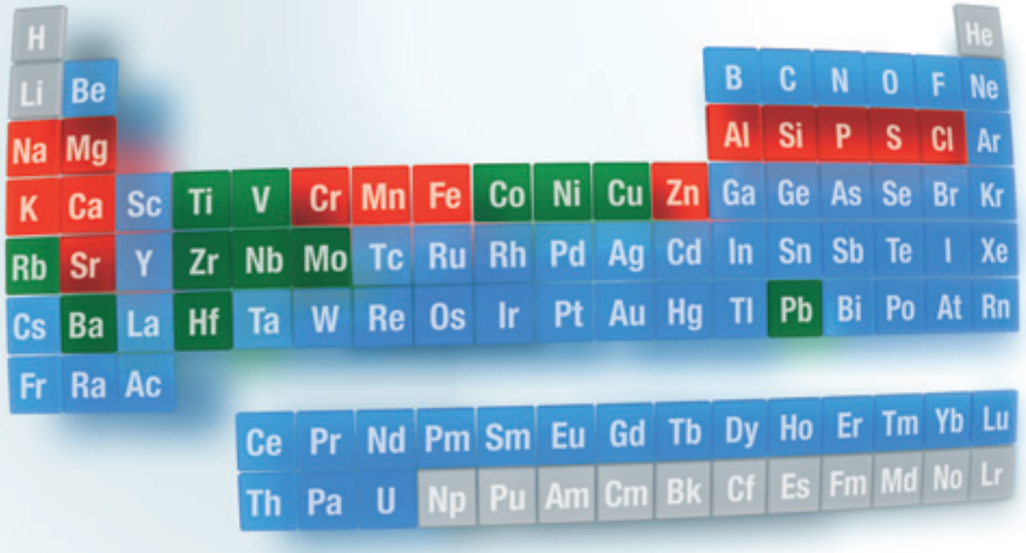
# Power & Performance

In elemental analysis for process control there is only one thing that counts: to obtain the most accurate and precise results as fast as possible! This kind of top-rate performance can only be achieved and maintained over time by means of an ideal combination of maximum sensitivity, compact beam path, and optimal channel geometry.

The LION's share: sixteen channels royally tuned for the 26 elements most important to the industrial sectors of cement, industrial minerals and mining, and a XRD free-lime channel – unique!

**S8 LION – enjoy the power of sixteen – 24/7/365.**

# Teamwork at its best:
# you define the task;
# we deliver the S8 LION[(((]
# ready for action!



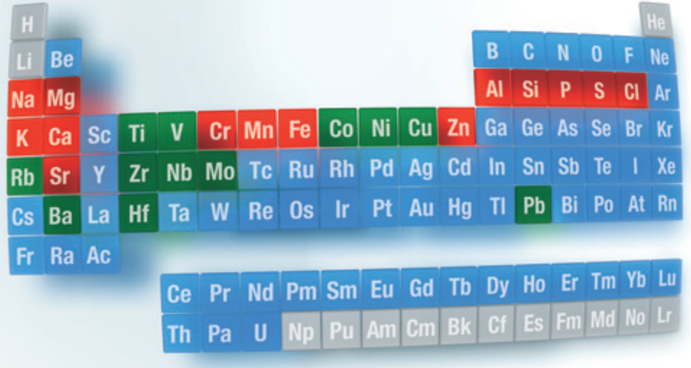

**Cement**
- Limestone
- Raw mix
- Clinker
- Cement

**Industrial Minerals**
- Alumina
- Bauxite
- Quartz
- Dolomite
- Iron ores
- Zircon sands
- ...

| Element | Line | Crystal | Absorber | Detector FC | Detector SC | Information |
|---|---|---|---|---|---|---|
| **Cement – Basic Elements** | | | | | | |
| **Na** | Kα | XS-55 | no | x | | Raw mix control |
| **Mg** | Kα | XS-55 | no | x | | Raw mix control |
| **Al** | Kα | PET | no | x | | Raw mix control important for fusion process |
| **Si** | Kα | PET | no | x | | Raw mix control |
| **S** | Kα | Ge111 | no | x | | Raw mix control |
| **K** | Kα | Ge111 | no | x | | Raw mix control |
| **Ca** | Kα<br>Kβ | LiF200<br>LiF200 | yes<br>no | x<br>x | | Raw mix control |
| **Fe** | Kα | LiF200 | no | | x | Raw mix control, important for color and fusion process |
| **Cement – Advanced Needs** | | | | | | |
| **Free Lime** | CaO | XRD-Channel | no | x | | Process optimization by CaO |
| **P** | Kα | Ge111 | no | x | | Control (source: secondary fuels) |
| **Cl** | Kα | Ge111 | no | x | | Prevent corrosion, harmful to hydration process, cyclone blockage |
| **Cr** | Kα | LiF200 | no | x | | Chromate reduction, toxic |
| **Mn** | Kα | LiF200 | no | | x | Important for color |
| **Zn** | Kα | LiF200 | no | | x | Toxic, (source tyres TDF) |
| **Sr** | Kα | LiF200 | no | | x | |
| **$S^{2-}$** | Kβ | Ge111 | no | x | | Sulphur speciation: Slags, raw materials |

| Element | Line | Crystal | Absorber | Detector FC | Detector SC | Information |
|---|---|---|---|---|---|---|
| **Additional Elements for Industrial Minerals** | | | | | | |
| **Ti** | Kα | LiF200 | no | x | | Titanium minerals $TiO_2$ |
| **V** | Kα | LiF200 | no | x | | Impurities |
| **Co** | Kα | LiF200 | no | | x | Impurities |
| **Ni** | Kα | LiF200 | no | | x | Nickel laterite, impurities |
| **Cu** | Kα | LiF200 | no | | x | Impurities |
| **Rb** | Kα | LiF200 | no | | x | |
| **Zr** | Kα | LiF200 | no | | x | Zircon sands |
| **Nb** | Kα | LiF200 | no | | x | Impurities |
| **Mo** | Kα | LiF200 | no | | x | Ores, impurities |
| **Ba** | Lα<br>Lβ | LiF200 | no | | x | Toxic, Barytes, impurities |
| **Hf** | Lα | LiF200 | no | | x | Impurities |
| **Pb** | Lα<br>Lβ | LiF200 | no | | x | Toxic, impurities |

# Teamwork at its best: you define the task; we deliver the S8 LION[III] ready for action!




**Cement**
- Limestone
- Raw mix
- Clinker
- Cement

**Industrial Minerals**
- Alumina
- Bauxite
- Quartz
- Dolomite
- Iron ores
- Zircon sands
- ...

**In industries with large flows of materials, enormous quantities of valuable raw materials are handled in elaborate processes. The task of PC/QC is therefore clear: to deliver extremely accurate results, immediately and reliably!**

As an expert you know the required composition of major and minor elements, you understand the critical process parameters and you also know when the process is running optimally or if it is getting out of hand. Now just tell us which elements and information you need and we will custom-make the ideal process control system for your requirements. Your S8 LION will analyze the exact composition of your process samples in less than 60 seconds and you can react, or lay back in satisfaction.

For process control, the S8 LION's sixteen element channels measure the 26 elements important to large-scale production of cement, industrial minerals and mining materials in concentrations of 100% to ppm. Each channel is perfectly tuned for its element and guarantees to deliver precise results – for every measurement every time!

The S8 LION includes a XRD free-lime channel uniquely designed for the needs of the cement industry. Free-lime control is crucial for the stability and efficiency of the oven process and therefore for keeping energy costs low and product quality high.

**Your process defines elements, concentrations and compounds. You define process parameters and action limits. The S8 LION then guarantees that your specifications are met. We call it perfect teamwork.**

**X-ray tube:**
Superior analytical performance
- Highest excitation intensity
- Closest coupling of anode to sample
- Up to 170 mA at 4 kW for ultimate light element performance
- Tube-above – geometry for reliable performance

**Bent analyzer crystals:**
- Logarithmic bent shape of crystals for highest intensity and resolution
- Temperature-stabilized crystals for highest stability
- Background optimized: Reduction of scattered radiation
- XS-55: Intensity-optimized multilayer optic for Na and Mg

**Optimized element channels:**
- Rowland geometry for highest sensitivity and resolution
- Most compact beam path
- Unique XRD free-lime channel

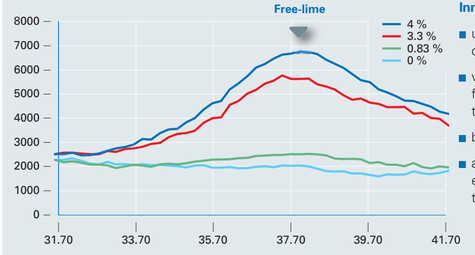
**Automation-Ready – Interface for easy integration into process automation:**
- Sample feeding by robot or conveyor belt
- Automated sample handling of 40 mm or 51.5 mm steel rings
- Integrated ethernet connection (TCP/IP)
- Direct data transfer to LIMS

**Detectors:**
- High efficiency proportional flow counter for best light element detection
- Very sensitive scintillation counter for optimal heavy element detection
- Sealed proportional counter with Dura™ Be-window for elements with medium X-ray line energies

**Sample magazines:**
- Cup holders for high sample flexibility
- Direct handling of 40 mm and 51.5 mm sample rings
- ONLINE interface for robot or belt connection

**EasyLoad™**
- Quick and automated drawer for safe storage of reference, drift correction and QC samples

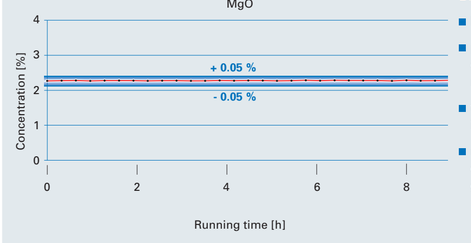
**Free-lime measurement for process optimization**




**Innovation leader**
- unique XRD free-lime channel
- valuable information for process optimization with free lime
- best reproducibility
- additionally to the elemental composition

**versatility**

**Ultimate precision - enhanced light elment performance**




**Best precision**
- highest sensitivity
- precise sample presentation – absolute reference
- temperature-independend
- most stable vacuum due to compact geometry

**precision**

# TouchContr ol™, EasyLoad™ & SampleCare™

Anyone can perform measurements, operation is child's play and intuitive … this is not fiction; it is the real world of TouchControl™ on the S8 LION. Constant availability, no wear and tear, absolutely unfazed by sample failures, straightforward integration to an automation solution … This is unrelenting reliability. In other words: EasyLoad™ and SampleCare™!

**S8 LION – Reliability by design!**

S8 LION with TouchControl™, EasyLoad™ & SampleCare™

# The ultimate in ease-of-use – S8 LION

## How much training is required to operate the S8 LION? None, thanks to TouchControl™!

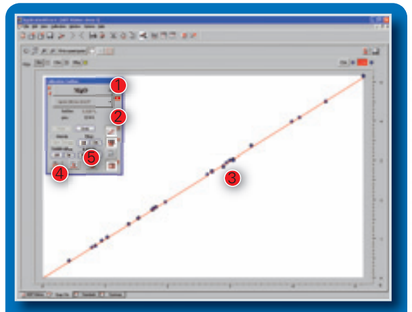
This is because operation is incredibly easy: the user places a sample in the magazine and taps the touchscreen once. The predefined automatic measuring program starts at once and delivers the result: right on time, good as done.

Behind the scenes, the predefined measuring program automatically assigns the name, transmits the measured data to the control center or the LIMS system and immediately displays the result on the screen.

Of course, as the lab manager you can define priority samples and make adjustments at any time. You can also run the S8 LION in the self-sufficient island mode. But you always have access to the system and to all data via the integrated network connection.

With equal ease you can automatically start the measuring job for reference and calibration samples. For this purpose the S8 LION fetches the sample out of the automatic EasyLoad™ and puts it back there again.

## S8 LION with TouchControl™ makes PC/QC simply safe!



CALIBRATION

① Element with selected analytical line
② Calculated deviation of the calibration
③ Calibration curve
④ Matrix correction model: FP, variable alpha model, empirical, theoretical,…
⑤ Offset

REPORTING

① Database query: date, sample ID, operator, method ...
② Number of matching entries
③ Data export: xml, txt, clipboard, ...
④ Display of element concentrations, color-coded limit check
⑤ Display of modules, calculated element ratios, ...

# SPECTRA$^{plus}$ – all you ever need

**Obviously you want to know more about calibration, evaluation and reporting. You need to have maximum functionality paired with extremely easy operation. May we present to you: SPECTRA$^{plus}$!**

We will keep it short: Our SPECTRA$^{plus}$ software package is all you need to deal with even the toughest challenges in process analysis.

However, we will proceed step-by-step, exactly as we do in SPECTRA$^{plus}$. Simply follow SPECTRA$^{plus}$ – from the definition of the standard samples, through the preparation parameters, the creation of the calibration curves through to release of the application. All the necessary tools – including matrix correction models – are available to you.

SPECTRA$^{plus}$ helps you not only to calibrate the element channels, but also supports the free-lime channel with fixed positions and interactive scanning.

You create reports quickly and easily, calculate your own modules or element ratios and establish color-coded warning and alarm limits ... just go ahead, it's no problem because you can do it all with SPECTRA$^{plus}$.

**S8 LION and SPECTRA$^{plus}$ – the rest is self-explanatory.**

- Ergonomic and quick sample loading
- Reliable and fail-safe analysis
- GLP-compliant data protection
- Designed for the highest instrument uptime
- Island operation with TouchControl™ and integrated PC

# The ultimate in ease-of-use – S8 LION

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**S8 LION with TouchControl™ makes PC/QC simply safe!**

**Easiest operation with TouchControl™**

**1**
The measurement of any sample is as simple as it could be: Just place the sample in the magazine and select the application! Perfect for industrial use: All routine applications are quick start buttons!

**2**
Quick: Now you type in the sample ID. Direct on the touchscreen, no hassle with a PC, mouse or keyboard: Simply press "MEASURE" to analyze! There is nothing to remember, it's simply step-by-step.

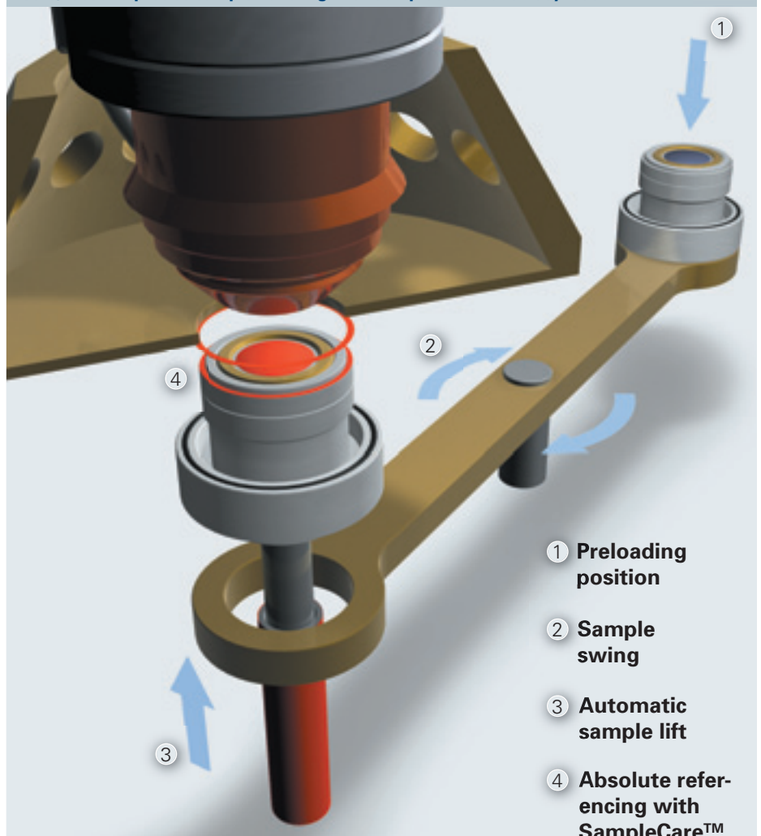
**3**
Instant results: Each result is displayed on the touchscreen, sent to the printer and stored in the results database. Limit values are checked automatically and reported color coded. Different user access levels protect relevant data!

**TouchControl™:**

- Easiest operation due to intuitive touchscreen interface: Three steps to accurate results!
- No operator training required
- Standalone operation in tough environments (no PC, mouse or keyboard)
- Unmatched data integrity: Routine analysis is separated from advanced tasks like calibration, evaluation, and extended reporting
- Online language switch with free selection: English, German, French, Chinese, Russian, Spanish, Korean, Turkish, Portuguese, Italian, …
- Tailored for industrial environments, "round-the-clock" operation

- Lowest maintenance and best system uptime with tube-above geometry
- Precise and reproducible results due to absolute reference position

**Safe, fast and precise sample handling with SampleCare™ and EasyLoad™**




- Shortest time-to-result using preloading position
- Dedicated sample handling for all kind of process samples
- Safe storage of valuable reference, drift correction and QC samples in automatic drawer

**SampleCare™:**

- Tube-above geometry keeps instrument uptime high and maintenance low
- Safe sample handling for dusty samples
- Precise and accurate positioning of the sample surface with automatic sample lift
- Pre-evacuation step with separation of sample and spectrometer chamber for highest vacuum stability

**Sample handling – fit for every purpose**

**A) Sample Magazine for cups**

- Most flexible sample handling with cups and 8 positions
- Samples up to 51.5 mm diameter
- Mask size 28 or 34 mm

**B) Sample Magazine for 51.5 mm steel rings**

- Direct automated handling of steel rings in 10 positions
- ONLINE version with 8 positions
- EasyLoad™ option

**C) Sample Magazine for 40 mm steel rings**

- Direct automated handling of steel rings in 12 positions
- ONLINE version with 9 positions
- EasyLoad™ option

**Sample Magazines:**

- Flexible sample handling for cups and process samples
- Direct handling of ring sample holders from automation
- Fastest time-to-result due to preloading and sample swing

**EasyLoad™:**

- Automatic drawer for reference samples
- Safe storage of samples
- Samples constantly available for measurement
- 14 positions for 40 mm steel ring sample holders
- 12 positions for 51.5 mm steel ring sample holders
- ONLINE version for automation

# S8 LION$^{///}$ – always ready for the next job

**Precision, reproducibility, accuracy, reliability and uptime are mandatory in process control! EasyLoad™ and SampleCare™ are up to the challenge.**

Maximum uptime begins right at the start of the development of a fail-safe system, namely with the basic design, i.e. X-ray tube from above. By means of the arrangement of the X-ray tube and the element channels above the sample, the danger of contamination – even damage by dust and broken pieces of sample material is excluded. This guarantees faultless operation, without any elaborate and expensive maintenance and service. This design principle and the reduction of moving components to the minimum ensure maximum uptime of your S8 LION.

Further examples of excellent design:

Our pneumatic sample positioning system accepts no tolerances and ensures that the sample is positioned accurately and reproducibly – always! Therefore the distance between the sample surface and the X-ray tube is guaranteed to always be the same, resulting in no instabilities of intensity that could cause imprecise results.

Our S8 LION is also environment proof. The temperature control of the spectrometer chamber and crystals makes the element channels entirely independent of one another, also preventing unstable results.

The small sample chamber ensures that no time is wasted when it is evacuated for sample change.

**S8 LION with EasyLoad™ and SampleCare™, built to last – and always top fit!**

## Technical Data

| Systems | S8 LION 3K | S8 LION 4K |
|---|---|---|
| **X-ray power** | 3 kW<br>60 kV max. / 150 mA max. | 4 kW<br>60 kV max. / 170 mA max. |
| **Configurations:** | | |
| **Monochromators** | Up to 16 element channels or free-lime channel plus up to 13 element channels | |
| **Absorbers** | Up to 6 absorbers (50%, 80%, 95% - silver or stainless steel) | |
| **Detectors** | Proportional flow counters with windows: 0.6 µm, 1.5 µm,<br>Sealed proportional counter: 25 µm Be,<br>Scintillation counter | |
| **Sample handling** | 8 position Cups<br>10 position 51.5 mm sample rings<br>12 positions 40 mm sample rings<br>ONLINE 8 positions 51.5 mm sample rings with conveyor belt<br>ONLINE 9 positions 40 mm sample rings with conveyor belt | |
| **Vacuum system** | Vacuum pump integrated | |
| **EasyLoad™ 1)** | Automated sample drawer with 12 positions for 51.5 mm steel rings<br>or 14 positions for 40 mm steel rings | |
| **TouchControl™ 1)** | Integrated touchscreen for easy and intuitive operation | |
| **Power consumption** | 7 kVA | |
| **Connection** | 208 – 230 V (50/60 Hz)<br>40 A single phase,<br>32 A three phases | |
| **Dimensions** | 193 cm x 84 cm x 118 cm (height x width x depth)<br>76'' x 33.1'' x 46.4''<br>Touchscreen: allow additional 49 cm (19.3'')<br>560 kg / 1235 lbs | |
| **Cooling water** | Flow rate 0 – 15 L/min, pressure: 4 to 6 bar with no back pressure, Temperature: 10 to 20 °C | |
| **Compressed air** | 6 – 8 bar, oil free, 7 L/min<br>Compressor, oil-free, silent, 50 Hz (K130C57)<br>Compressor, oil-free, silent, 60 Hz (K130C58) | |
| **Detector gas** | P 10 gas (10% methane, 90% argon) required for proportional flow counters | |
| **Quality & safety** | DIN EN ISO 9001:2008<br>CE-certified<br>Fully radiation-protected system; radiation < 1 µSv/h (H*)<br>Conform to ICRP, IAEA, EURATOM - approved by TÜV, PTB | |

1) optional packages

www.aim.de 01992

All configurations and specifications are subject to change without notice. Order No. DOC-B80-EXS010. © 2009 Bruker AXS. Printed in Germany.

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