



# S2 PUMA

● Spectrometry Solutions



The Puma is an incredibly adaptable and powerful animal.



The S2 PUMA is an incredibly adaptable and powerful spectrometer.

# S2 PUMA – Analyze. Everything. Faster.

## Analyze.

Accessing information about sample composition is essential for process and quality control in industrial laboratories, but also in research applications in academia. No matter if you need a quick idea of elements present, or accurate concentrations for all elements from C to U in the range of 100 % down to a few ppm, the S2 PUMA is the optimal choice.

## Everything.

Samples come in different forms, shapes and sizes, and time and cost savings for sample preparation are always a consideration. Whether you need to analyze solids or liquids, compact pieces or powders, large or very small samples, the S2 PUMA analyzes all your samples in manual or fully automated mode.

## Faster.

Results must be obtained in the shortest possible time since time-to-result is always critical for process control. Large sets of samples are analyzed throughout the day. The S2 PUMA delivers fast, accurate results all day, every day.

**The S2 PUMA is the most adaptable and powerful EDXRF solution for your analytical needs.**



S2 PUMA Single



S2 PUMA EasyLoad Carousel



S2 PUMA EasyLoad XY Autochanger

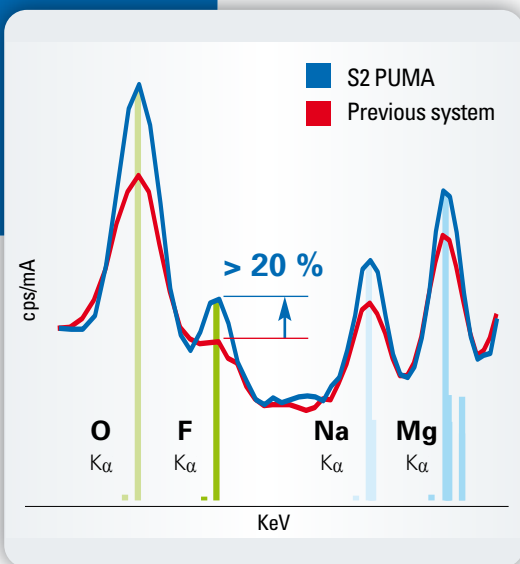




X-ray tube, air-cooled



XFlash® X-ray detector



Best performance at light elements: EDXRF

Unmatched detection limits, precision and speed in EDXRF by HighSense™ technology:

- Direct-excitation, closely coupled beam path
- X-ray tube with up to 50 W power and 50 kV excitation
- XFlash® SDD with energy resolution typically 135 eV
- HD-mode spectrum recording with 4K multi-channel analyzer (MCA)
- Optimal Light Element (LE) configuration with thin-window X-ray tube and XFlash® X-ray detector

## S2 PUMA with HighSense™ – the top-performing EDXRF

HighSense™ is the key to the unrivaled analytical performance of the S2 PUMA. The instrument's direct-excitation beam path makes full use of the 50-watt power of the X-ray tube. The optimal excitation of all elements in the sample is guaranteed with up to 50 kV voltage. The high-count-rate, high-resolution XFlash® silicon drift detector (SDD) further enhances the instrument's performance and records sample spectra in HD mode. But that's not all. With the all-new instrument X-ray optics, the distances between the X-ray tube, the sample and the detector are even shorter than before. This results in better detection limits, higher precision and shorter measurement times.

**Top performance is the result of perfect teamwork. For the S2 PUMA, we call this HighSense™ technology!**

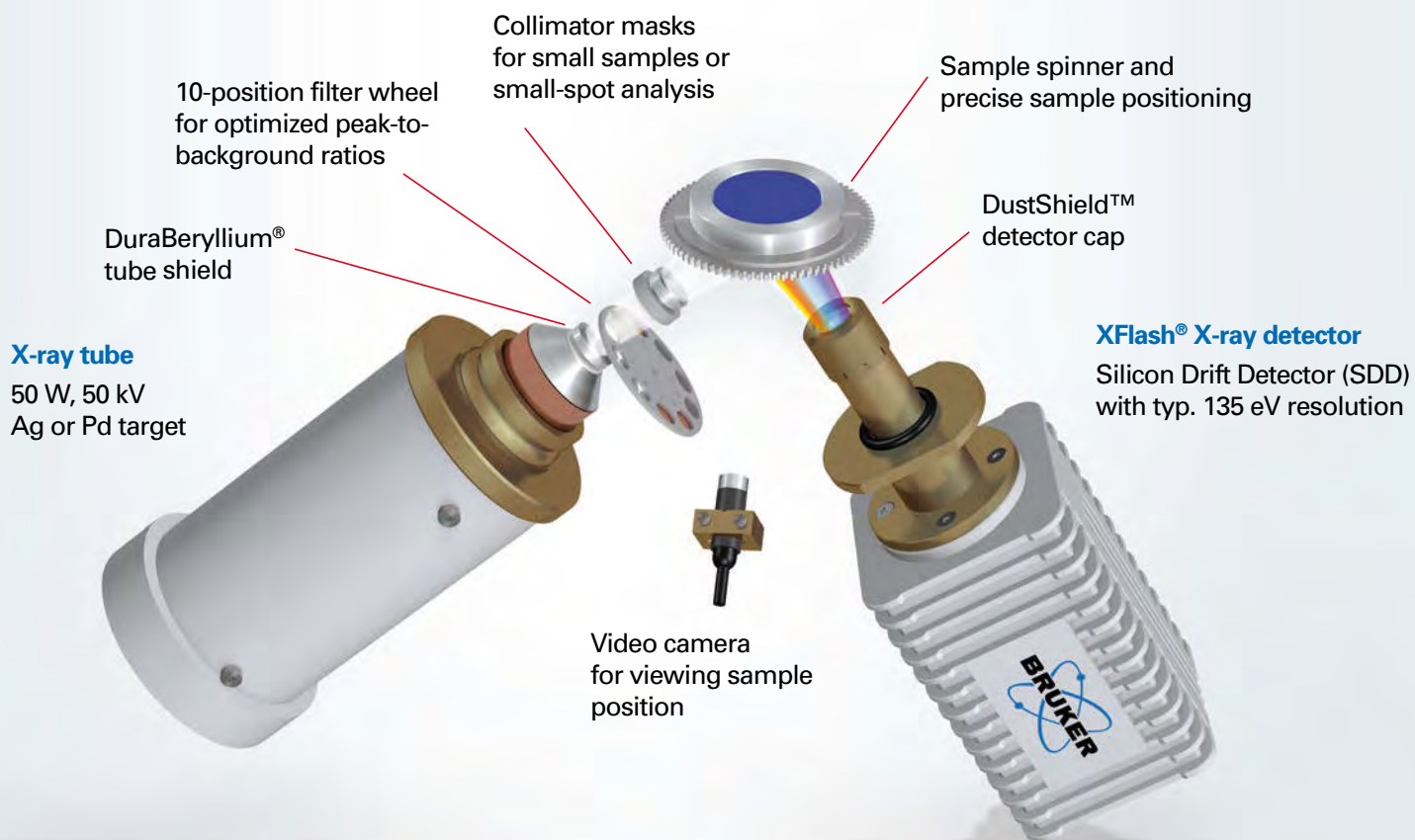
### Elemental analysis couldn't be easier!

Energy-dispersive X-ray fluorescence (EDXRF) with the S2 PUMA offers all you need to measure and monitor elements in your samples, independent of the industry or environment in which you are working. The outstanding strength of EDXRF is the wide range of elements covered by the technique, from very light elements like C, to heavy elements like U.

H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Ac															
		Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
		Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lw		

- Element range of S2 PUMA
- Additional elements with S2 PUMA LE

### HighSense™ beam path of the S2 PUMA



The S2 PUMA with HighSense™ technology uses the 50-W end-window X-ray tube to directly excite X-ray fluorescence in a sample. By setting the high voltage for the X-ray tube and choosing the filter material, the energy range is selected. The XFlash® thin-window detector with multi-channel analyzer detects

the X-ray fluorescence radiation and accumulates counts to form an intensity versus energy spectrum of the sample. Lighter elements with low-energy fluorescence are analyzed by either flushing the sample chamber with helium or by evacuating it with a vacuum pump.



Cement, Minerals & Mining, Geology



Metals, Slags



Petrochemicals, Refinery



Chemicals



Food, Cosmetics, Pharmaceuticals

## Add efficiency to your lab with S2 PUMA

Productivity is paramount when you are analyzing numerous large series of samples per day. S2 PUMA with the EasyLoad™ XY Autochanger enhances the efficiency in your lab: Add samples at any time without interrupting current measurements, add up to 20 samples in one go, run mixed batches of solids and liquids, each sample in the optimal mode.



Quick, convenient sample loading with the S2 PUMA EasyLoad XY Autochanger





Environmental



Academia



Metal cuts,  
Solids



Loose powders,  
Rocks,  
Granules



Pressed  
pellets



Fused  
beads



Liquids,  
Slurries



Filters



Films,  
Coatings,  
Folts



Small  
parts



Automation  
rings, Belt  
conveyor

■ S2 PUMA EasyLoad  
XY Autochanger:

- Trays with 20 sample positions
- Pressed powders, fused beads and liquid cups with 40 mm sample size
- Direct handling of 51.5 mm sample rings from automated sample preparation
- Mixed batches of liquids and solids for highest sample flexibility
- Prepare the next sample tray while previous tray is running
- High sample throughput, large sample series run overnight
- New samples can be loaded and added at any time



Visual monitoring during measurements



Additional sample trays with mixed sample batches

## S2 PUMA – utmost efficiency with EasyLoad™

High sample throughput, low cost of ownership and extreme reliability count in many industries and here is where the S2 PUMA shines. No matter if the samples are pressed pellets, fused beads, powders, solids, or liquids, up to 20 samples can be loaded at once with the EasyLoad™ XY sample tray. New samples can be added at any time – even while a measurement is running. EasyLoad™ maximizes the sample throughput and minimizes the cost of ownership of the instrument.

### Enhancing performance! Reducing costs!

The S2 PUMA analyses each sample with the optimal method: Liquids are analyzed under helium atmosphere, while solids are run under vacuum. This is essential to get the best performance for lighter elements. The S2 PUMA's optional vacuum pump eliminates the need for helium when light elements in solid samples are analyzed. There is simply no other EDXRF instrument as efficient as the S2 PUMA!

### Connectivity in an automated laboratory

For highest sample throughput the S2 PUMA can easily be integrated into an automated lab. The samples are prepared automatically and loaded via a conveyor belt or robot directly into the S2 PUMA. This ensures process control at best level.

### S2 PUMA EasyLoad XY Autochanger – ready to run 24/7!



Cost of operation – Calculate the required helium consumption when selecting an EDXRF System; [Helium gas cylinders/year]

**Application: Pressed pellets**

Process control application (Slag, Cement, Minerals), pressed pellets, 10 samples per hour, 10 elements (F, Na, Mg, ...) 4 minutes measurement time and 24 hours operation

Scenario 1	no	S2 PUMA with vacuum pump
Scenario 2	26	Assumption: EDXRF with 0.5 L/min He purge, no vacuum pump

**S2 PUMA Single and S2 PUMA XY Autochanger in scenario 1 need NO helium at all**

Solid samples are analyzed under vacuum without need for gases, not even for light elements.

**Application: Liquids**

Process control application (Lubricating oil, Wear metals), liquid samples, 10 samples per hour, 10 elements (Na, Mg, ...) 4 minutes measurement time and 24 hours operation

Scenario 3	5	S2 PUMA with 0.08 L/min He purge
Scenario 4	26	Assumption: EDXRF with 0.5 L/min He purge
Scenario 5	126	Assumption: EDXRF with 2.4 L/min He purge and large chamber

**S2 PUMA Single and S2 PUMA XY Autochanger in scenario 3 need 96 % less helium compared to scenario 5**

Dramatically reduced helium consumption due to small sample chamber



Easy, quick and convenient loading of mixed batches



Cement, Minerals & Mining, Geology



Metals, Slags, Coatings



Petrochemicals, Plastics, Refinery



Chemicals



Food, Agriculture

## S2 PUMA – quick results and best performance at your fingertips

In process control every minute counts! Whenever you receive a sample, results are needed fast. The S2 PUMA Single is the perfect tool: Load the sample, touch the button and get results within minutes. Best quality results as easy as 1-2-3, thanks to TouchControl™, the S2 PUMA's intuitive user interface.



Quick start of sample for process control applications with S2 PUMA Single





Education



Cosmetics, Pharmaceuticals



Environmental



Metal cuts, Solids



Loose powders, Rocks, Granules



Pressed pellets



Fused beads



Liquids, Slurries



Filters



Films, Coatings, Foils



Small parts



■ S2 PUMA with TouchControl™:

- Intuitive, failsafe ease-of-use
- Island mode: Full functionality without PC, keyboard and mouse
- Free language selection: English, German, French, Spanish, Portuguese, Italian, Russian, Chinese, Japanese
- No training required – get results from day one
- Adjustable touchscreen, glove-friendly



Island mode:  
No PC, keyboard and mouse required in routine operation



Quick, easy sample loading



Adjustable TouchControl™ interface



TouchControl™ for quick, failsafe ease-of-use



Sample rotation for accurate results



Liquid sample analysis

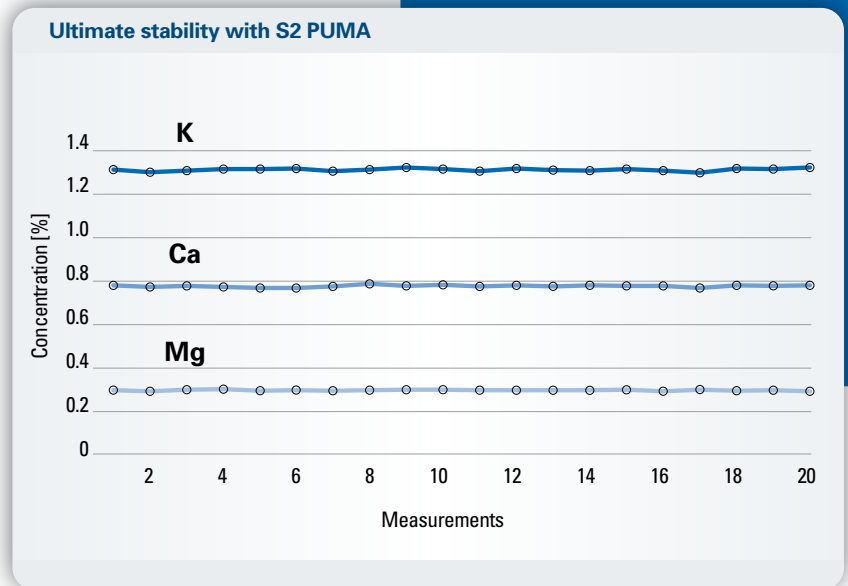
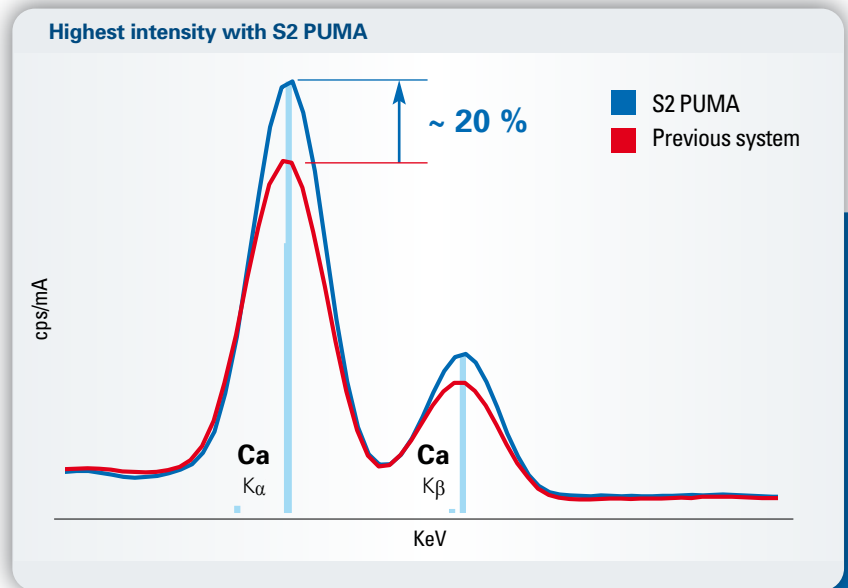
# EDXRF made easy, only with S2 PUMA and TouchControl™

Thanks to TouchControl™, the operation of the S2 PUMA is easy and straightforward. The times of never-ending training, manuals that weigh a ton and operation with adventures in body contortions belong to the past.

With TouchControl, any user can perform measurement jobs on the S2 PUMA. First, select the application and key in the sample ID. You can also add additional information, like preparation or sample weight. Then simply start the measurement and view the results on-screen. But it gets even easier: An operator places a sample in the loader and taps the touchscreen once; this starts a predefined automatic application – and that's it!

## Instrument precision is the key for tight process control.

The S2 PUMA delivers excellent precision with its HighSense™ technology, the 50-Watt power of the X-ray tube and the all-new closely coupled beam path. This superior design guarantees process control at its best with a very narrow range for the results, minimizing waste and maximizing yield in your process.





Geology



Metals, Coatings



Plastics, Polymers



Pharmaceuticals



Research, Academia,  
Material Science



Quick loading of sample batches or large samples with the S2 PUMA EasyLoad Carousel





Service Labs



Automotive



## No limitations in sample handling – S2 PUMA

Sometimes you simply need flexibility: First, some large samples you cannot destroy. Then, “What is this black spot in the plastic building block?” Next, analyze 11 geological samples as pressed pellets! Every job request is different.

No need to worry, the S2 PUMA EasyLoad Carousel is the most adaptable configuration. It handles large samples directly. Place the block directly in the measurement position, control it with the integrated video camera, and use the collimator to analyze only the black spot. But place the EasyLoad™ tray in the chamber and it turns into an autosampler system for large batches.



Metal cuts, Solids



Loose powders, Rocks, Granules



Pressed pellets



Fused beads



Liquids, Slurries



Filters



Films, Coatings, Foils



Small parts



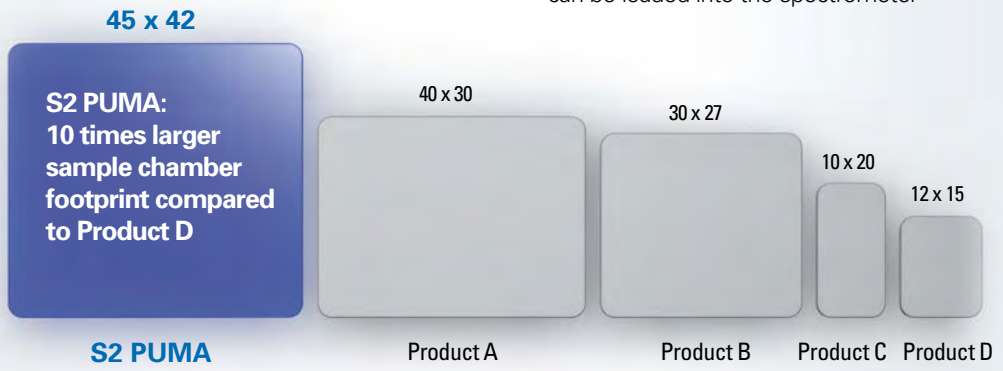
Large parts, Electronics, PCBs



Toys, Consumer products

Large-sample handling in comparison \*) [cm]

Spectrometer chamber area limits the maximum size of large samples which can be loaded into the spectrometer



Raising carousel tray during transportation



Lowering carousel tray during measurements



EasyLoad™ Carousel tray



Sample positioning with video camera



Loading of large samples



\*) S2 PUMA spectrometer chamber  
 (W x D x H):  
 457 x 428 x 39 mm; 18.0 x 16.9 x 1.5"  
 445 x 411 x 50 mm; 17.5 x 16.2 x 2.0"  
 400 x 329 x 96 mm; 15.7 x 13.0 x 3.8"

Product A: QUANT'X, Thermo ARL, (BR41204\_E 03/12C)  
 Product B: EDX-7000/8000, Shimadzu, (3655-07328-30AIK)  
 Product C: Epsilon 3<sup>+</sup>, PANalytical, (PN7593)  
 Product D: Epsilon 1, PANalytical, (PN9127)

# S2 PUMA

## EasyLoad Carousel – Unlimited flexibility for all kinds of samples



Quick loading of sample batches with the S2 PUMA EasyLoad Carousel

The S2 PUMA EasyLoad Carousel accommodates up to 11 different samples in one tray. Samples can be powders, solids, pressed pellets, fused beads, or liquids, of sizes 32 mm, 40 mm or 51.5 mm in diameter. Different sample types and sizes can be even mixed on a single carousel tray.

### **The S2 PUMA Carousel sets new standards – not only for small samples.**

How to measure large samples if you don't want to cut them to size? Nothing could be easier – just remove the tray and the sample chamber provides space for large-sample non-destructive elemental analysis. Very small to large samples of up to 45 x 42 cm can be directly analyzed in the S2 PUMA EasyLoad Carousel.

### **Mark the spot – and document your XRF measurements.**

For exact sample positioning, a video camera is integrated in the S2 PUMA, providing a close-up view of the sample and enabling you to ensure that just the right spot is analyzed. A video camera image is saved along with the EDXRF measurement data and results for later reference.

### **Discover parts of your sample – with small spot analysis.**

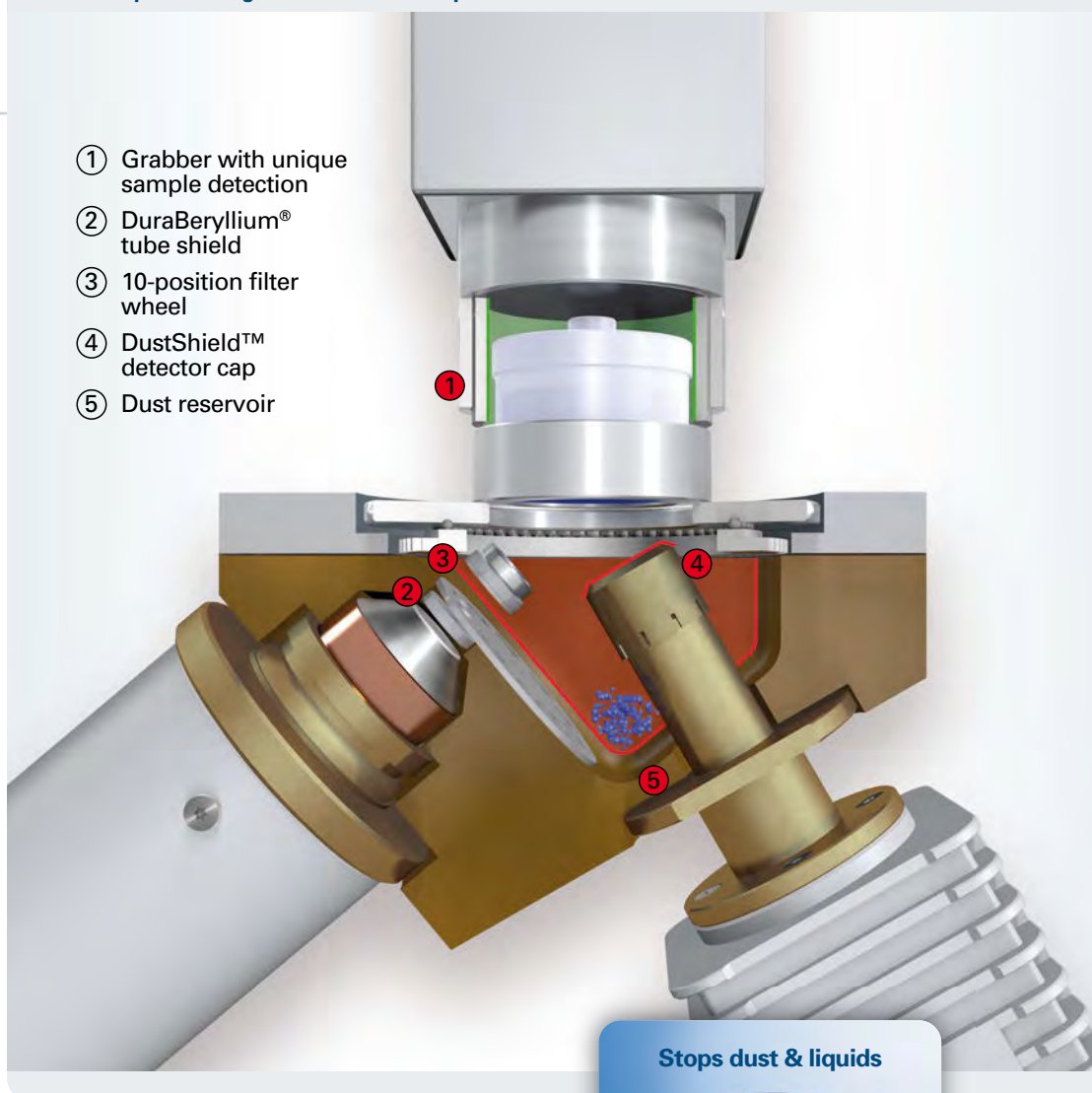
When performing failure analysis, analyzing geological samples or investigating consumer product safety, a specific small spot of the sample is of interest. The S2 PUMA is equipped with an integrated collimator to perform analyses of small spots from a couple of centimeters down to a few millimeters.

### **Coating applications of multilayers – no problem for the S2 PUMA.**

In research & development and materials science, multilayer systems are designed for specific functionality. The S2 PUMA delivers accurate results for layer thickness and composition of single and multilayer samples. The analytical Multilayer software handles EDXRF data from large samples, bulk samples and small spots!



## Safe sample handling with S2 PUMA SampleCare™



- ① Grabber with unique sample detection
- ② DuraBeryllium® tube shield
- ③ 10-position filter wheel
- ④ DustShield™ detector cap
- ⑤ Dust reservoir

### Stops dust & liquids



DustShield™ detector cap

- S2 PUMA with SampleCare™:
  - Unique contamination protection of important system components
  - Guarantees highest instrument uptime
  - Prevents drawbacks from sample leakages
  - Failsafe recognition of liquid cups
  - Grabber with automatic sample detection
  - DuraBeryllium® shield for tube window protection
  - Unique detector cap for detector protection
  - Avoids spillage of liquids and contamination with small sample particles on detector head

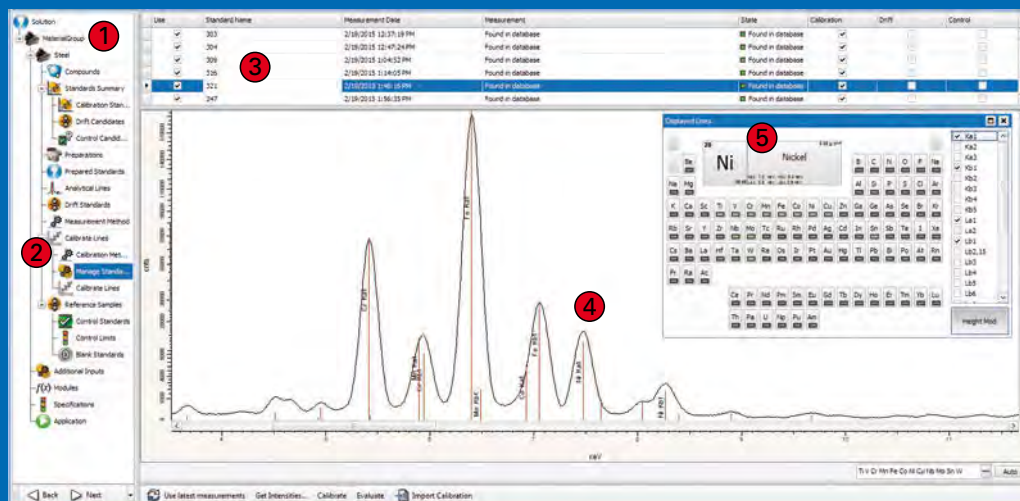
## S2 PUMA with SampleCare™

Instrument uptime is crucial in every laboratory. But you can rely on the S2 PUMA with Bruker's unique SampleCare™ technology. SampleCare™ protects the instrument from damage due to sample contamination. The integrated liquid sample detection of the EasyLoad™ XY Autochanger disables the vacuum mode whenever a liquid sample is detected. In addition, a DuraBeryllium® tube shield and the filter wheel protects the X-ray tube. A third contamination shield is the detector cap. The cap with an ultra-thin protection foil avoids contamination when liquid samples spill or small sample particles fall from pressed powders.

## S2 PUMA with powerful software

To control your S2 PUMA we deliver a powerful analytical software package. Setting up an application with the Solution Editor, starting measurements, evaluating scans, reporting results or exporting data – the software provides simple control of all these functions. The Solution Editor is based on Bruker's established integrated analytical intelligence for ease-of-use. You always keep an overview on all your applications, and if needed the software solution provides you with all the necessary settings to obtain best results. Setting up applications, maintaining methods and obtaining excellent results has never been so easy.

# Built to last – S2 PUMA with SampleCare™ Built to analyze – S2 PUMA with powerful software



- 1 Solution Editor with tree structure to maintain all relevant application parameters.
- 2 Selected 'Manage Standards' to enter all information on calibration standards.
- 3 Overview about the standards for the steel application.
- 4 Spectrum of steel standard for evaluation of element lines.
- 5 Periodic table for convenient element selection.

## Technical Data

	<b>S2 PUMA</b> Single	<b>S2 PUMA</b> XY Autochanger	<b>S2 PUMA</b> Carousel
<b>Elemental range</b>	Sodium to uranium (Na – U) with standard XFlash® Carbon to uranium (C – U) with XFlash® Light Element (LE)		
<b>Concentration range</b>	From ppm to 100 %		
<b>X-ray tube</b>	Pd or Ag anode; max. power 50 W; max. voltage 50 kV		
<b>Primary beam filters</b>	10-position automatic filter changer; for wide range elemental analysis pre-installed filters: 5 µm Ag, 20 and 500 µm Al, 100 and 250 µm Cu		
<b>Detector</b>	XFlash® Silicon Drift Detector: Peltier cooled (no need for liquid nitrogen) Standard XFlash® detector: resolution typ. 135 eV* at Mn K <sub>α</sub> and 100 000 cps XFlash® detector LE: resolution typ. 141 eV* at Mn K <sub>α</sub> and 100 000 cps		
<b>Collimator masks</b>	For small spot analysis: 3, 8, 12, 18, 23 and 28 mm (optional)		
<b>Sample observation</b>	Integrated video camera, for exact sample positioning and documenting the measurement position of a sample (optional)		
<b>Air mode or N<sub>2</sub> flushing</b>	For analysis of elements > Ti, under air or N <sub>2</sub> (optional)		
<b>Helium flushing</b>	For liquids and loose powders (optional), external helium supply required.		
<b>Vacuum pump</b>	For highest count rate of pressed pellets, fused beads, solids (optional)		
<b>TouchControl™</b>	Integrated 12.1" TFT touchscreen, multilingual user interface		
<b>Connectivity</b>	Built-in Ethernet port RJ 54, 4x USB ports for mouse, keyboard, printer		
<b>Power requirements</b>	100-240 V, 50/60 Hz, max. power consumption 600 VA		
<b>Automation</b>	Connectivity to conveyor belt (optional)		
<b>Sample types</b>	Loose powders, granules, solids, pressed pellets, fused beads and liquids up to 50 mL		
<b>Sample rotation</b>	(optional)		
	<b>S2 PUMA</b> Single	<b>S2 PUMA</b> XY Autochanger	<b>S2 PUMA</b> Carousel
<b>Sample sizes</b>	Up to 51.5 mm (2.03") Ø samples. Liquids, loose powders and smaller samples in liquid cups: up to 50 mL	Up to 40 mm (1.56") Ø and 38 mm (1.49") height in sample holders, max. weight 200 g or 51.5 mm (2.03") Ø as sample ring.	32, 40 or 51.5 mm (1.26, 1.56 or 2.03") Ø samples. Large samples (W x D x H): 457 x 428 x 39 mm 445 x 411 x 50 mm 400 x 329 x 96 mm 18.0 x 16.9 x 1.5" 17.5 x 16.2 x 2.0" 15.7 x 13.0 x 3.8"
<b>Sample loader</b>	Single position, manual	EasyLoad XY™ sample tray, 20-position, removable; Grabber with automatic sample detection	EasyLoad™ Carousel sample tray, 11-position, removable
<b>Dimensions</b> width x depth x height; weight	66 x 70 x 37 cm; 81 kg 26 x 27.6 x 14.6"; 179 lbs	66 x 70 x 60 cm; 112 kg 26 x 27.6 x 23.6"; 247 lbs	66 x 70 x 56 cm; 127 kg 26 x 27.6 x 22.0"; 278 lbs
<b>Quality &amp; safety</b>	DIN EN ISO 9001:2008; CE-certified Machinery directive 2006/42/EC; Electrical equipment 2006/95/EC; Electromagnetic Compatibility 2004/108/EC; Fully radiation-protected system; radiation < 1 µSv/h (H*); German type approval (BfS) for X-ray safety; Conform to ICRP, IAEA, EURATOM		

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