



**Malvern
Panalytical**
a spectris company

EPSILON 4 MINING & MINERALS



INCREASE YOUR PROCESS EFFICIENCY AND RECOVERY RATE

Accurate and fast elemental analysis of ores and minerals

Use the Epsilon 4 benchtop spectrometer in mining operations, even at remote locations, for fast elemental analysis of ores, minerals and rocks.

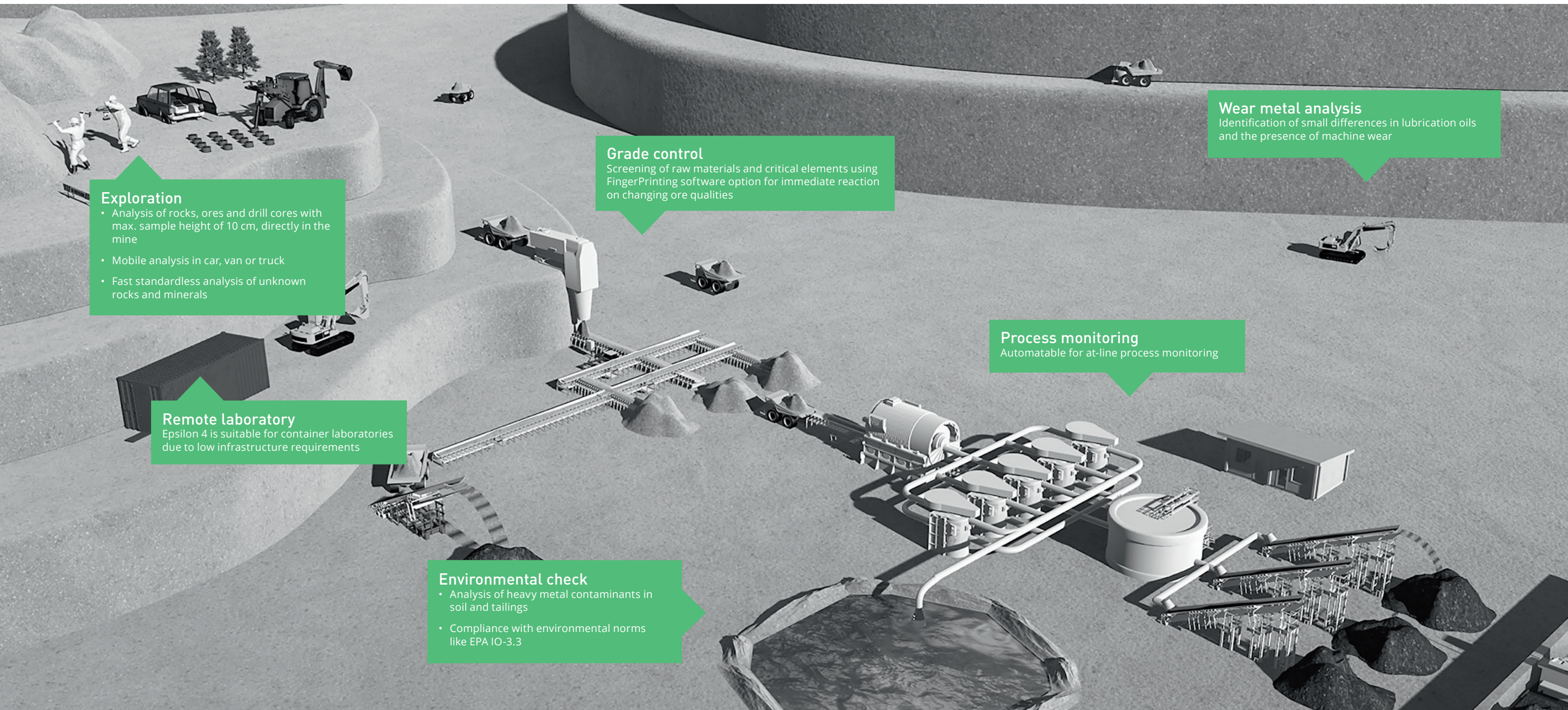
The combination of low infrastructural demand and high analytical performance of Epsilon 4, enables quick determination of operation strategies in mining locations where utilities are limited.

Using the Epsilon 4 in at-line mineral processing operations offers quick and efficient steering in mineral beneficiation plants.

Discover the possibilities of XRF analysis and reduce your feedback time from hours to minutes by placing the benchtop XRF spectrometer next to your mine or processing plant.

Epsilon 4's value in mining operations

- Low cost of ownership
- Immediate decision making on changing or decreasing ore qualities
- Direct analysis in field, mine or processing plant
- Highest safety for operators
- Laboratory performance without dependence on big laboratories
- Superior tracking of alterations zones of ore bodies due to accurate and fast light-element performance
- Minimum downtime and maintenance



Exploration

- Analysis of rocks, ores and drill cores with max. sample height of 10 cm, directly in the mine
- Mobile analysis in car, van or truck
- Fast standardless analysis of unknown rocks and minerals

Remote laboratory

Epsilon 4 is suitable for container laboratories due to low infrastructure requirements

Grade control

Screening of raw materials and critical elements using FingerPrinting software option for immediate reaction on changing ore qualities

Wear metal analysis

Identification of small differences in lubrication oils and the presence of machine wear

Process monitoring

Automatable for at-line process monitoring

Environmental check

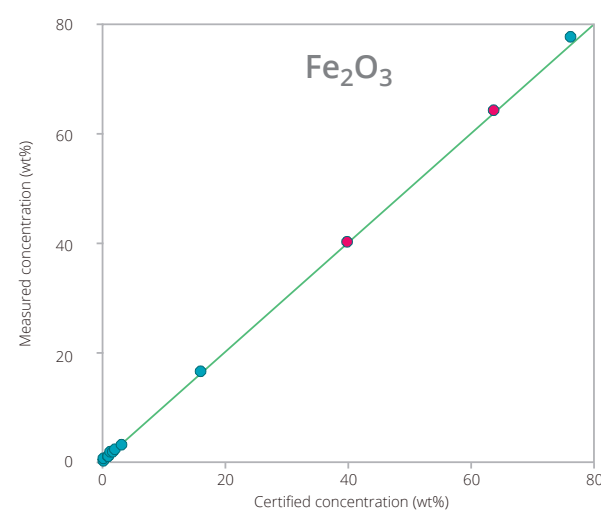
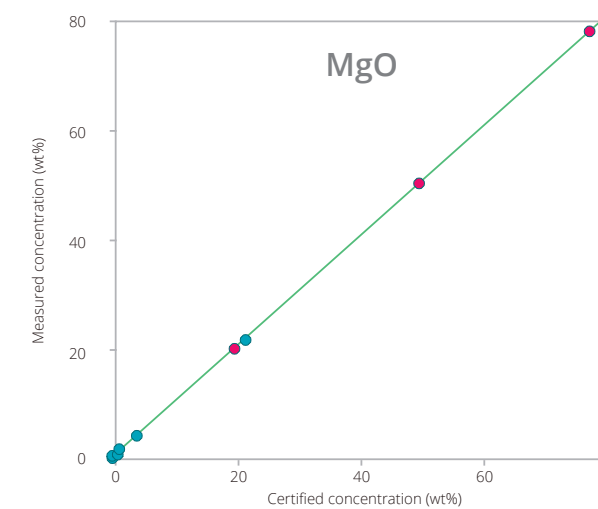
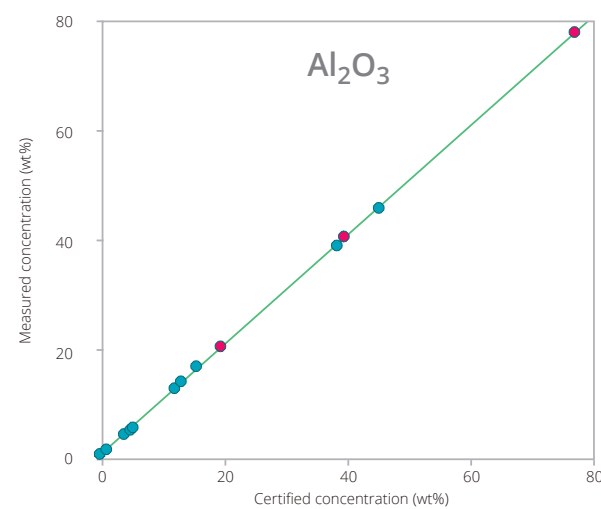
- Analysis of heavy metal contaminants in soil and tailings
- Compliance with environmental norms like EPA IO-3.3

FLEXIBLE WROXI SOLUTION

Elemental analysis with XRF is already the key to quality and production control in industries analyzing a wide range of oxide materials. Finding enough standards to setup reliable calibrations can be difficult and costly. That is why Malvern Panalytical has developed a set of 15 synthetic, multi-element wide-range oxide (WROXI) certified reference materials (CRM) produced under ISO 17034 accreditation.

Epsilon 4 can be delivered with WROXI for the analysis of major and minor elements in wide-range oxide samples, prepared as fused beads. Using Malvern Panalytical's unique FP algorithm in the Epsilon software, the WROXI application can determine concentrations of up to 11 common oxides in a wide range of rocks, ores and minerals. WROXI can be used either as a primary fused bead calibration or to verify customer in-house standards for pressed powder applications.

The following graphs show comparisons of certified and measured concentrations for Al_2O_3 , Fe_2O_3 and MgO in a wide variety of certified reference materials (CRM) measured as unknown samples. The WROXI - CRMs are also included in the graphs.



- CRM
- WROXI - CRM standard



THE POWER OF BENCHTOP XRF SYSTEMS

Combining the latest excitation and detection technology and smart design, the analytical performance of Epsilon 4 approaches that of more powerful and floor-standing spectrometers. Selective excitation and careful matching of the X-ray tube output to the capabilities of the detection system underlie the system's outstanding performance.



Epsilon 4 - Highly flexible analytical tools suitable for a wide range of applications:

- 10-watt version - used for elemental analysis (F - Am) in areas from R&D through to process control
- 15-watt version - used for higher sample throughput with improved and extended light-element capabilities (C - Am)
- 15-watt version - used for higher sample throughput in challenging environments (F - Am)

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	L	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	A															
		L	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
		A	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

Z Possible to analyze with Epsilon 4
 Z Not possible to analyze with Epsilon 4
 Z Possible with Epsilon 4 and optional detector

Reduce helium consumption

The high performance of Epsilon 4 enables many applications to be operated in air atmosphere, without longer overhead time and costs involved for helium or maintenance of vacuum system. When measuring in air, low-energy X-ray photons characteristic of sodium, magnesium and aluminium, are sensitive to variations in air pressure and temperature. Built-in temperature and air pressure sensors compensate for these environmental variations, ensuring excellent results whatever the weather.

Calibrated for years

A low-drift X-ray tube and an automatic drift correction system give compliant results for years without the need for re-calibration. This results in a more efficient use of the system and less cost of calibration maintenance.

Online remote support

In the unlikely event of the Epsilon 4 needing specialist attention, an online diagnostic facility is available in the local service centers. Problems can be diagnosed, and in many instances corrected, directly on-line. This significantly reduces system downtime and cuts maintenance costs to a minimum.

Accurate results

Our unique, high-performance, metal-ceramic X-ray tube, specifically designed and manufactured for Epsilon 4, ensures high quality and reliable results. Flexible voltage settings from 4.0 to 50 kV and a maximum current setting up to 3.0 mA can be used to define application-specific excitation conditions that optimize the performance across the periodic table.

Ultimate light-elemental performance

With the optional SDD^{Ultra} detector, Epsilon 4 enables ultra-light element analysis of even carbon, nitrogen and oxygen.

Quality results through mature software

Accurate and precise results are obtained through advanced spectrum processing and state-of-the-art correction and quantification algorithms.

Safety guaranteed

Epsilon 4 complies with the latest Machinery Directive, CSA, IEC, EMC, Vollschutz norms and standards for protection and radiation safety to guarantee a safe instrument for the operator.

Unattended operation

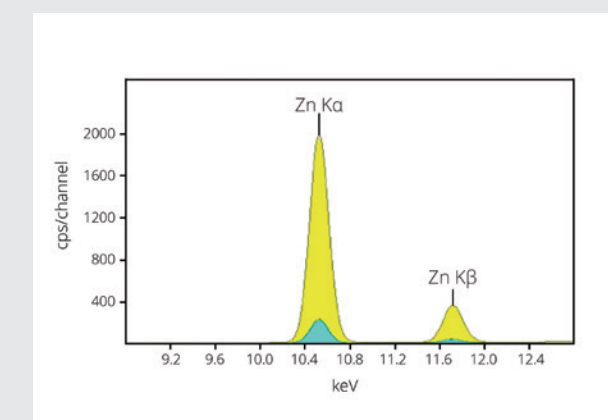
The unique combination of a 10-position removable sample changer with spinner enables the automatic processing of sample batches without the need for operator attention. Continuous rotation of the sample during measurement minimizes any errors caused by non-homogeneity or surface irregularities within individual samples and provides more accurate results. Automatic transfer of data to a central location gives you access to the latest results.

Fast and sensitive

Fast measurements are achieved by using the latest silicon drift detector technology that produces significant higher intensities.

Unique detector electronics enable a linear count rate capacity to over **1,500,000 cps** (at 50% deadtime) and a count rate independent resolution typically better than 135 eV for better separation of analytical lines in the spectrum.

This allows the Epsilon 4 spectrometer to run at full power and therefore realizes a much higher sample throughput compared to traditional EDXRF benchtop instruments.



Ten times higher intensities for zinc obtained with Epsilon 4, in comparison with its predecessor Epsilon 3^{XLE}

FAST, REPRODUCIBLE ANALYTICAL METHOD

Compared to other analytical techniques XRF requires little or no sample preparation

XRF is an ideal means of determining the chemical composition of all kinds of materials. Measurements in Epsilon 4 are carried out directly on the solid material (or liquid) with little to no sample preparation. There is no need for any dilution or digestion and therefore no disposal of chemical waste.

Epsilon 4 spectrometers can handle a large variety of sample types weighing from a few milligrams to larger bulk samples.

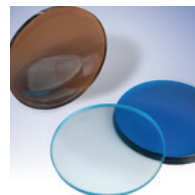
Samples can be measured as:

- Solids
- Pressed powders
- Loose powders
- Liquids
- Fused beads
- Slurries
- Granules
- Filters
- Films and coatings

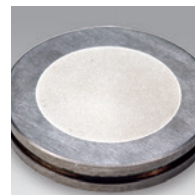
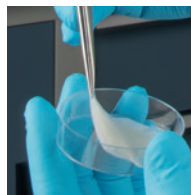
LIQUIDS



SOLIDS



POWDERS



TAILORED SOLUTIONS THROUGH EXPERTISE

Experienced Malvern Panalytical staff work in close cooperation with you to provide not only training but also tailored analytical programs and procedures, balancing throughput and accuracy while minimizing setup and running costs.



Access to the right calibration samples is the key to accurate XRF analysis. Malvern Panalytical helps in obtaining or creating the standards you need. We provide total solutions including standards for several key applications. We can also generate suites of in-house standards by certifying your materials through our ISO 17025 certified laboratory.

Sample preparation, although typically straightforward for XRF, is an important factor in the overall analytical precision and accuracy. Sample preparation needs to be quick, robust and reproducible, and the choice of sample preparation technique starts with your requirements and materials.

Malvern Panalytical can advise you which approach suits best given your material types and analytical requirements. Tap into our knowledge network through our global Expertise Centers to optimize your complete analytical process, including sample preparation methods and equipment.



Our aim is to make Epsilon 4 an essential part of your elemental analysis

The added value for you is what drives us:

- The largest support network in the industry
- Training programs customized to your needs
- Reference materials
 - *Certified reference materials (CRMs)*
 - *Synthetic reference materials tailored to your requirements*
- Analytical services
 - *Certify your samples through our ISO 17025 certified laboratory*
- Consultancy
 - *Norm compliance*
 - *Laboratory information management*
 - *Process automation*
 - *Standard operating procedures*
 - *Interlaboratory standardization*





MEASURE IT IN YOUR OWN LANGUAGE

1. Load your sample
2. Select required method
3. Enter relevant sample information
4. Just click Measure
 - 測量
 - 測定
 - Mesurer
 - Messung
 - Mesure
 - Zmierzyć
 - Medida
 - Измерить
 - Médir

ENHANCE YOUR ANALYSIS THROUGH SOFTWARE OPTIONS

Five industry software options are available to further enhance the capabilities of Epsilon 4: Omnian, Stratos, Oil-Trace, Enhanced Data Security and FingerPrint.

These dedicated options add new functional dimensions to benchtop spectrometry and take the hard work out of regulatory compliance.

Elemental screening OMNIAN



Our powerful Omnian software is ideal when there is no conventional calibration established for materials that require analysis. When faced with non-routine samples or materials for which there are no certified reference materials, Omnian provides excellent insight into the elemental composition.

Designed to provide fast and reliable quantification, Omnian's advanced fundamental parameters (FP) algorithm automatically deals with the analytical challenges posed by samples of widely differing types.



Wear metal analysis OIL-TRACE



To protect heavy machinery from damage it is essential to analyze oil quality on a regular basis to determine the optimal time for an oil change. The Epsilon 4 in combination with Oil-Trace provides accurate element analysis of additives and wear metals in used lubricating oils. Analysts benefit from a simplification of application maintenance and analytical procedure, and from cost savings through the use of simple and relatively inexpensive standards.

Pass/Fail analysis FINGERPRINT



FingerPrint is a material type confirmation routine that uses a rapid statistical analysis of the spectrum for a simple PASS/FAIL answer. Spectra used for the FingerPrint routine can also be used for conventional compositional determination for a more complete diagnostic analysis.



WHY CHOOSE MALVERN PANALYTICAL?

We are global leaders in materials characterization, creating superior, customer-focused solutions and services which supply tangible economic impact through chemical, physical and structural analysis.

Our aim is to help you develop better quality products and get them to market faster. Our solutions support excellence in research, and help maximize productivity and process efficiency.

Malvern Panalytical is part of Spectris, the productivity-enhancing instrumentation and controls company.

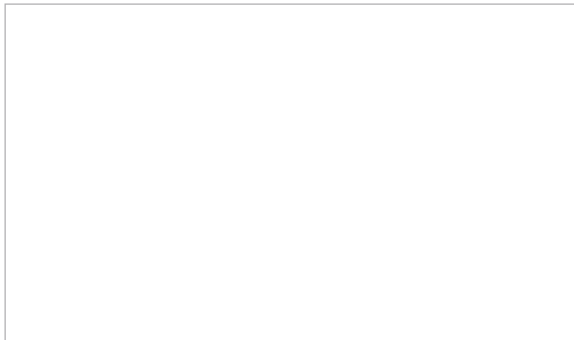
www.spectris.com

SERVICE & SUPPORT

Malvern Panalytical provides the global training, service and support you need to continuously drive your analytical processes at the highest level. We help you increase the return on your investment with us, and ensure that as your laboratory and analytical needs grow, we are there to support you.

Our worldwide team of specialists adds value to your business processes by ensuring applications expertise, rapid response and maximum instrument uptime.

- Local and remote support
- Full and flexible range of support agreements
- Compliance and validation support
- Onsite or classroom-based training courses
- e-Learning training courses and web seminars
- Sample and application consultancy



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