Malvern Panalytical

EPSILON 4
FOOD & ENVIRONMENT

TRUST YOUR PRODUCT QUALITY

Analyze accurately and frequently

Growing populations increase the need for a better handling of our earth's resources. The Epsilon 4, an energy dispersive X-ray fluorescence (EDXRF) spectrometer, is a powerful analytical tool that can obtain useful elemental information to maximize crop growth and ensure product and environmental safety.

The latest advances in excitation and detection technology in Epsilon 4 opens possibilities for challenging applications that are traditionally performed by ICP and AAS. Switching from ICP to EDXRF significantly reduces the use of consumables, utilities and time . Discover how elemental analysis with Epsilon 4 adds value to the food production process.

Epsilon 4's value for Food & Environment

- Suitable for wide range of sample types: air filters, liquids, powders
- Low cost of ownership
- Low infrastructural requirements, ideal for at-line analysis
- Ready for any sample using standardless solution Omnian
- Simple, fast and safe sample preparation
- Non-destructive analysis
- Analysis from Carbon to Americium, from sub-ppm's to 100 wt% concentrations

ACCURATE AND NORM COMPLIANT TRACE ANALYSIS
AIR FILTERS AND SOILS

Epsilon 4 can accurately quantify many elements down to trace level concentrations according to stringent international test methods and norms, like EPA IO-3.3 for particles on air filters. Below are two application examples that demonstrate the analytical capability of Epsilon 4.

Elemental analysis of air filters according to US EPA method IO-3.3

Detection limits are an important measure of an instrument's performance. The detection limits (LLD) for this application were calculated from 20 replicate measurements of a blank sample and are based on 1 sigma (as specified in method IO-3.3). ***Figure 1*** shows a comparison between the LLD values reported in the EPA method and the LLD values obtained by Epsilon 4, in 45 minutes. All LLD values are smaller than the EPA limits.

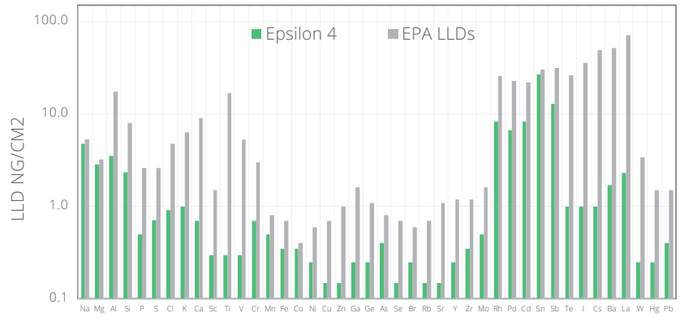


Figure 1. Comparison between the LLDs obtained using the Epsilon 4 and the required LLDs of the EPA 10-3.3 method

Elemental analysis of nutrients and toxic elements in soils

Twenty-six certified soil samples, measured as pressed pellets, were used for the application set-up of Epsilon 4. To test the accuracy and precision of the method, one Chinese soil standard GSS8 was measured five times consecutively. The certified and average measured concentrations, together with the standard deviations, are presented in ***Table 1***, demonstrating excellent accuracy and precision, in 30 minutes measuring time.

Table 1. Accuracy and repeatability results obtained by measuring a soil standard GSS8 five times, consecutively.

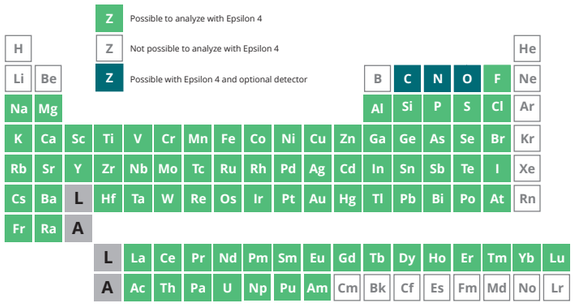
Elements & Compounds	Certified values (mg/kg)	Results ±std dev (mg/kg)	Elements & Compounds	Certified values (mg/kg)	Results ±std dev (mg/kg	Elements & Compounds	Certified values (mg/kg)	Results ±std dev (mg/kg)
Na_2O (%)	1.72	1.33 ± 0.02	Fe_2O (%)	4.48	4.35 ± 0.01	Nb	15	14.2 ± 0.1
MgO (%)	2.38	2.28 ± 0.01	Co	12.7	12.2 ± 0.1	Mo	1.16	1.06 ± 0.08
Al_2O_3 (%)	11.92	12.10 ± 0.02	Ni	31.5	31.1 ± 0.4	Cd	0.13	< 1
SiO_2 (%)	58.60	54.84 ± 0.05	Cu	24.3	22.0 ± 0.3	Sn	2.8	2.0 ± 0.3
P_2O_5 (%)	0.18	0.18 ± 0.01	Zn	68	59.6 ± 0.3	Sb	1.04	1.1 ± 0.4
SO_3 (%)	0.03	0.05 ± 0.01	Ga	14.8	16.9 ± 0.2	Ba	480	499 ± 2
K_2O (%)	2.42	2.35 ± 0.01	As	12.7	12.6 ± 0.2	Ce	66	60 ± 6
CaO (%)	8.27	8.30 ± 0.01	Br	2.6	2.6 ± 0.1	W	1.7	1.9 ± 0.3
Ti	3837	3625 ± 4	Rb	96	95.5 ± 0.1	Pb	21	19.1 ± 0.2
V	81.4	83.1 ± 1.4	Sr	236	227.3 ± 0.2	Bi	0.3	1.1 ± 0.1
Cr	68	72.1 ± 0.8	Y	26	24.6 ± 0.1	Th	11.8	11.7 ± 0.4
MnO (%)	0.08	0.08 ± 0.01	Zr	229	227.7 ± 0.5	U	2.7	11.5 ± 0.4

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)



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 aluminum, 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 on-line 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.

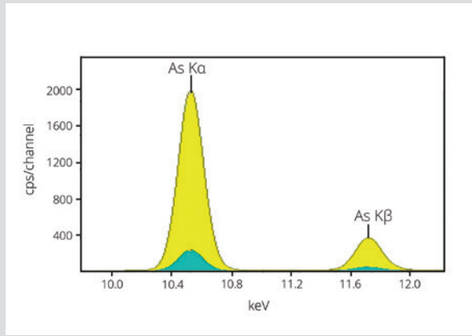
Unattended operation

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 significantly higher intensities.

Unique detector electronics enable a linear count rate capacity to over **1,500,000 cps** (with 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 arscenic 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

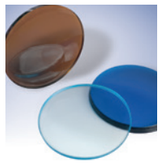
XRF is an ideal means of determining the chemical composition of all kinds of materials.
Measurements in Epsilon 4 are carried out directly on the solid material (or liquid) with little to no sample preparation. There is no need for any dilution or digestion and therefore no disposal of chemical waste.

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:

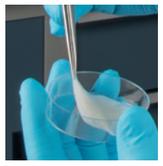
- Solids
- Pressed powders
- Loose powders
- Liquids
- Fused beads
- Slurries
- Granules
- Filters
- Films and coatings

LIQUIDS

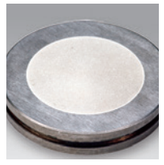
SOLIDS

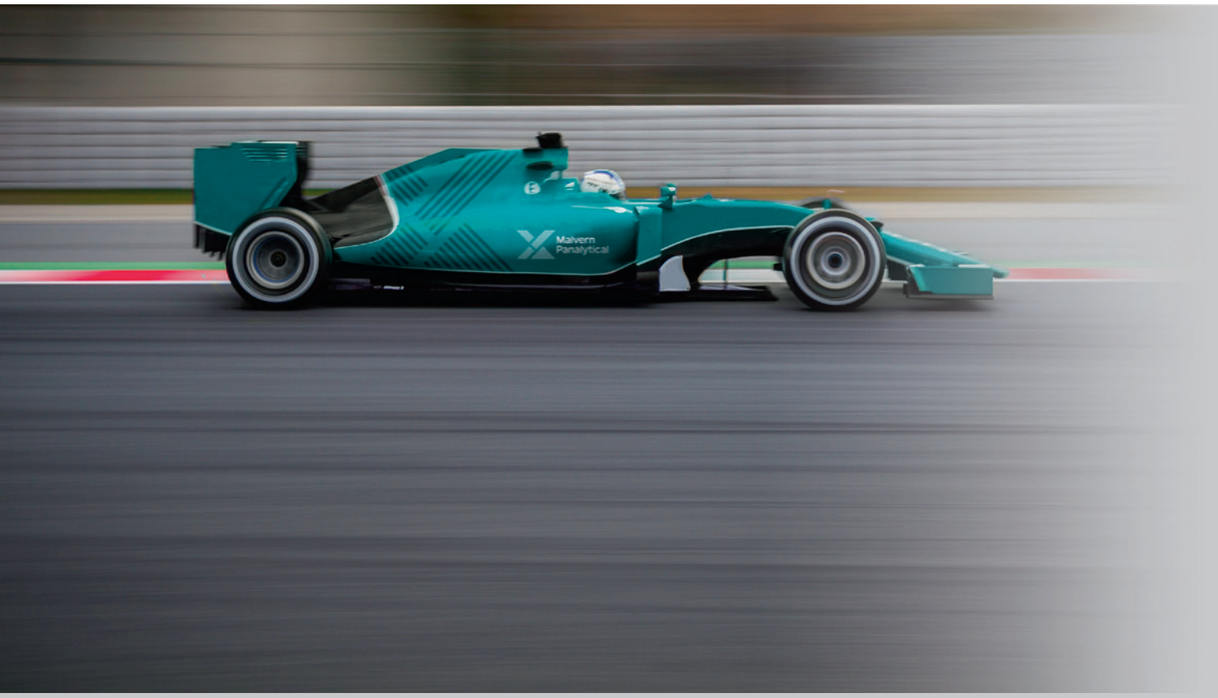


AIR FILTERS



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 set-up and running costs.

Access to the right calibration samples is key in XRF. 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.

Combine XRF with the analytical solutions Malvern Panalytical offers, like near infrared spectroscopy, particle size analysis and X-ray diffraction. Our experts 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

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.

Enhanced data security
AUDIT TRAIL SOFTWARE

DATA SECURITY

The enhanced data security software option is designed for GMP and GLP enviroments, and enables the user to comply with FDA 21CFR Part 11. The software includes every feature required to satisfy the strict environmental protocols, like multiple security levels, log in with user identification, reporting of date and time, results storing, extensive audit trails and LIMS integration

Pass/Fail analysis
FINGERPRINT

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.

Malvern Panalytical

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 instruments 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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