



Thermo Scientific ARL PERFORM'X XRF
Sequential X-Ray Fluorescence Spectrometer

**where performance
meets versatility**

**Geology . Environment . Petroleum industry
Materials science . Metals and alloys
Glass . Raw materials . Mining . Cement**

Where Performance meets Versatility

Sequential X-Ray Fluorescence Spectrometer

A New Evolutionary Platform

The Thermo Scientific ARL PERFORM'X X-ray fluorescence (XRF) sequential spectrometer presents an advanced platform for rapid and precise analysis of up to 90 elements in nearly any solid or liquid sample. Advantages over other analytical techniques are:

- Easy and fast sample preparation
- Analysis of the whole surface of a sample, a segment of it or specific spots on the surface
- Speed of analysis
- High stability and excellent precision
- Wide dynamic range (from ppm levels to 100%)
- Simple and rapid analysis of totally unknown samples through advanced standard-less analysis packages

The ARL PERFORM'X spectrometer new compact design provides superior benefits of XRF analysis including sensitivity, reproducibility and ease of use while establishing new standards of speed, reliability and flexibility on the widest range of sample types. It will solve composition problems in demanding industrial processes and quality applications in industries as diverse as metallurgy, petroleum, polymers, mining, glass, cement and refractories. Academic or research labs dealing with geochemistry, automotive engineering, materials science, environmental research and forensics will benefit from its performance and versatility.

Speed of analysis

- Fastest goniometer in industry
- Dual sample loading system for high sample throughput
- Up to 60 samples per hour, unmanned
- Dedicated loading position for urgent samples

Sensitivity and precision

- Ultra-thin X-ray tube window improves sensitivity for light elements
- Unique UCCO™ technology (Ultra Closely Coupled Optics)
- Excellent peak to background ratio
- Unrivalled long-term stability and short-term repeatability

Flexibility

- Choice of power levels up to 4200W
- Mid power systems without external water chiller
- Multiple position automated X-Y sample changer frees technicians for other work
- New goniometer design offers many crystal and collimator options achieving the widest possible analysis range
- Selection of viewed diameter in multiple increments from large 35 mm area to small 0.5 mm spot
- Several beam filters mean optimal analysis parameters can be chosen for every element



Dual sample loading and urgent sample position when speed is required, more specifically in metallurgy



Geological applications among others require fast and accurate goniometer



Collection pot for safe loading of pressed powders and liquids

Highest standards of reliability

- Design for reliability concepts for maximum uptime and ease of maintenance
- Fully digital, frictionless goniometer ensures excellent lifetime angular accuracy
- Security device for dust/liquid collection in case of accidental breakage of a pressed pellet/liquid cell during loading



ARL PERFORM'X

Powerful Add-ons for Problem Solving and R&D

The ARL PERFORM'X spectrometer brings added value to your laboratory with new features for challenging non-routine analyses.

Complete characterization of unknown samples without calibration standards

- Semi-quantitative analysis of unknown samples in 3 minutes using scans from fluorine to uranium with Thermo Scientific QuantAS software
- Industry-leading Thermo Scientific UniQuant software provides best limits of detection and accuracy in standard-less analysis



Helium shutter for easy and stable liquid analysis

Small spot analysis & mapping

- Pinpoint focus on specimen sections with selectable X-ray diameter of 0.5 or 1.5 mm
- Construct maps of element distributions with cartography down to 0.1 mm steps
- Study of sample homogeneity for process improvement and problem solving



Mapping of inhomogeneous sample portion or inclusion analysis through small spot analysis

Safe and stable liquids analysis

- The helium shutter provides maximum goniometer stability and protection for liquid analysis
- Optional tube shield protects the X-ray tube window from liquid spills and loose powders
- Sample recognition sensor ensures easy and safe exchanges between solids and liquids



Large sample collections run automatically overnight



Cassettes of various apertures for small and large samples

State-of-the-art Components For Highest Analytical Flexibility

Based on years of experience, the ARL PERFORM'X spectrometer benefits now from the 6th generation goniometer, fully digitally mastered, working at highest speed with best accuracy and precision.

The goniometer can be programmed to analyze specific elements (quantitative analysis) or to scan the X-ray spectrum to detect elements present in a given sample (qualitative analysis). This state-of-the-art compact goniometer features up to 9 analytical crystals and 4 collimators providing analysts for a wider range of applications. Elemental signal count rates are augmented by up to 25% through the uniquely compact goniometer technology. Improved detector linearity provides better counting statistics at high count rates.

Analytical range is also widened by the inclusion of 6 primary X-ray beam filters, thereby reducing interference on select elements from X-ray tube emission lines and greatly improving peak to background ratios for most elements.

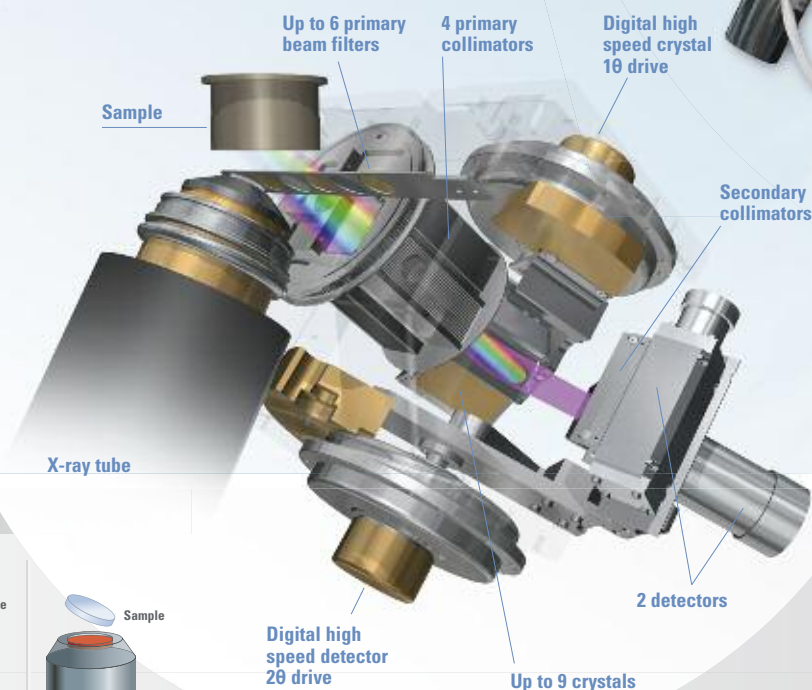
Additional optional features increase the number of sample types that can be analyzed such as the 4-position programmable aperture changer. It always includes a 29 mm aperture and 3 additional apertures can be chosen among the following diameters: 0.5, 1.5, 5, 10, 15, 20, 25, 35 mm to help analysis of large or small samples.

Gearless digital goniometer advantages

- Quantitative analysis of any element from Be to U providing adequate crystals are fitted
- Angular positioning is achieved through Moiré fringe optical encoders:
 - > No friction – No wear!
 - > Ensures accurate theta/2theta relationship between crystal and detector
 - > Excellent angular positioning and high precision
 - > Fastest positioning with a slewing speed of 4800°/min
 - > Fast scanning up to 327° per minute
- Temperature regulation of crystals for best analytical stability
- Best standard-less analysis when coupled to QuantAS™ and UniQuant® software packages
- Unique polarization effect for reduced background

UCCO™ technology

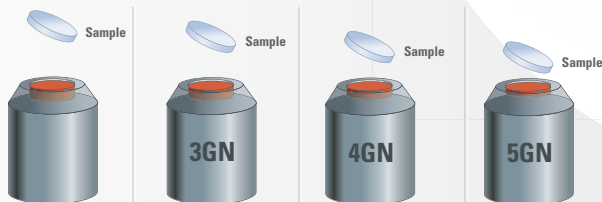
Ultra Closely Coupled Optics between X-ray tube and sample



Ultra-thin X-ray tube window

Evolution of the X-ray tubes over the years:

- > Closer coupling between anode and sample
- > Thinner Be windows



1990's	2000's	ARL ADVANT'X	ARL PERFORM'X
125 microns Be window	75 microns Be window	75 microns Be window	50 microns Be window

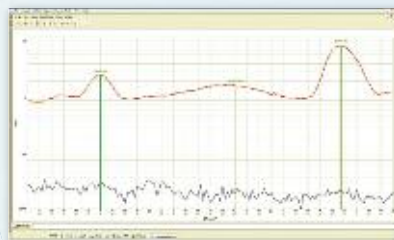
PRECISION SPEED



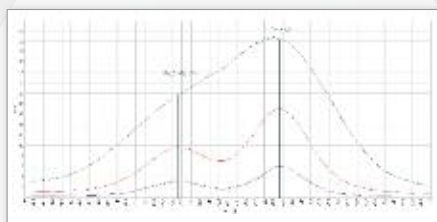
6th generation universal
gearless goniometer



Four collimator changer
as standard



Removal of Rh tube lines with
primary beam filter



Effect of collimator on
resolution and intensity



Choice of Analyzed Area Size – Right on the Spot!



Small sample analysis

The optional programmable aperture changer is available for routine analysis of small sample. It is used in conjunction with cassettes of matching apertures from 35 mm to 5 mm diameter (29 mm standard, other diameters at choice: 5, 10, 15, 20, 25, 35 mm).

Small spot analysis

- Narrow spot analysis of specimens selectable with on-board camera
- Pinpoint focus with X-ray beam diameters of 1.5 mm or 0.5 mm
- Allows full quantification when combined with UniQuant standard-less analysis software
- Ideal for samples in jewellery, forensics, automotive and other R&D applications

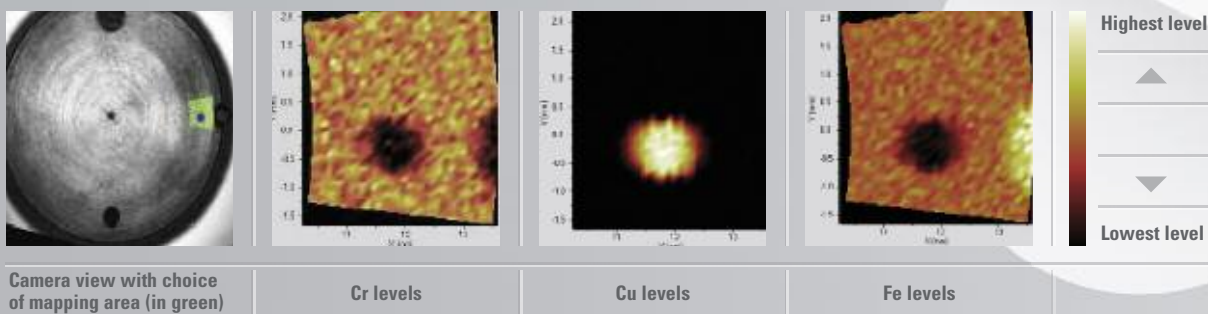
Mapping

The precisely-tuned X-ray mapping capability of the ARL PERFORM'X spectrometer provides complete elemental visualization of complex non-homogenous surfaces. Analysts can identify and characterize elemental impurities, inclusions and gradients that are unidentifiable by other analysis methods.

- Construct detailed composite maps of element distribution within samples
- Cartography control and overlay of 1.5 mm or 0.5 mm spots
- Fine resolution down to 0.1 mm steps for process improvement and problem solving applications
- Can be combined with UniQuant standard-less analysis software for full quantification
- Ideal for materials engineering applications in various industries



Results of a mapping on an inhomogeneous sample



Automatic Sample Loading Creates Productivity



The sample changer fits directly atop the ARL PERFORM'X spectrometer. It accommodates multiple sample dimensions to a top capacity configuration of 112 samples for unattended and overnight analysis. Series of samples of uniform size and shape (e.g. fusion beads, pressed pellets, polymer discs, etc.) can be placed directly on trays without need for cassettes. Any urgent sample can at any time be placed on the specific "urgent" position to be run as first priority.

Specific cassettes are used for liquid analysis in order to make sure liquids will never be loaded under vacuum.

Continuous on-line process monitoring in unattended mode can be achieved through connection with an automatic sample preparation machine. A simple transport belt will link the ARL PERFORM'X spectrometer and the automatic press, mill or fusion machine. The OXSAS/OEM software option allows communication between the preparation machine and the spectrometer.



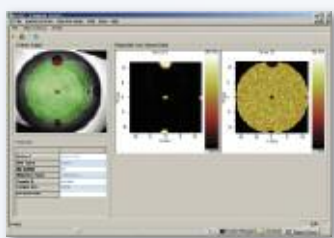
**Special cassettes for
liquid cell loading**



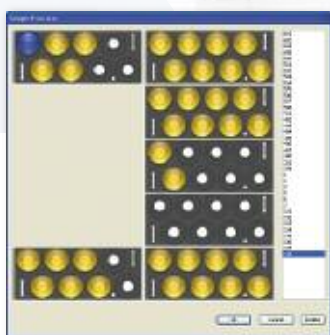
OXSAS Software

Easy and comprehensive XRF analysis

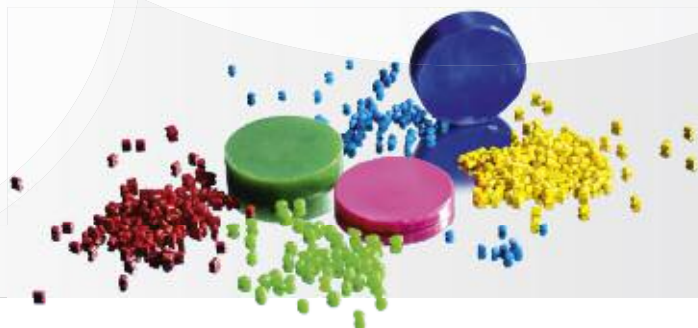
Operating the ARL PERFORM'X spectrometer and rapidly delivering highly accurate analytical reports are easily achieved through the state-of-the-art Thermo Scientific OXSAS software. Using Windows® 7 Professional operating system, OXSAS software is designed to evolve to meet customer's needs with up-to-date solutions throughout the lifetime of the instrument. All features and details can be found in the OXSAS software product specification sheet.



Typical screen of a mapping study



Selection of sample positions from a graphical view of the magazine



Fast and accurate analysis

Fast qualitative analysis

Step scanning provides precise definition of peaks with a resolution of 0.001° . For rapid qualitative analysis, continuous digital scanning allows fast acquisition of spectra at speeds up to 327° per minute. Peaks identification representing the elements present is automatic.

Accuracy made easy

The on-line Analytical Assistant helps quick and correct definition of analytical programs and calibrations. The multi-variable regression (MVR) program is used to build the various calibration curves. The influence of interfering elements in multi-component matrices is minimized thanks to correction models leading to better accuracy of analysis. These models are:

- Line overlap correction
- Additive correction on intensities
- Additive correction on concentrations
- Multiplicative correction on intensities
- Multiplicative correction on concentrations
- Multiplicative and additive corrections on concentrations
- COMprehensive Lachance (COLA) with 3 term alphas is used with NBSGSC fundamental parameters program, which simulates analytical calibrations for homogeneous materials. Inter-element correction factors (theoretical alphas, now with matrix and LOI/GOI elimination) are calculated and used as known coefficients in the MVR. This minimizes the number of standards necessary to produce calibrations and improves the accuracy of analysis.

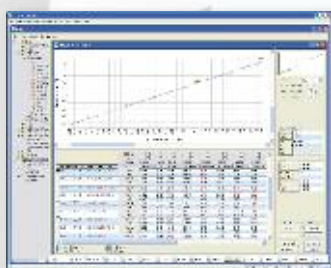
Turnkey calibrations

Ex-works calibrations can be delivered for various materials such as:

- Oil industry products using PetroilQuant™ program or ASTM/ISO methods
- Iron, steel and slags
- Copper, bronze and brass
- Aluminum and alloys
- Various oxides through the General Oxide calibration
- Cement and clinker
- Traces in soils and sediments
- Ferro-alloys and others for which analytical specifications are available on request



The Analytical Assistant helps definition of analytical programs, calibrations and instrument use



MVR Calibration curve showing real concentrations vs. intensities



Current operations and status can be checked with the on-line synoptic screen

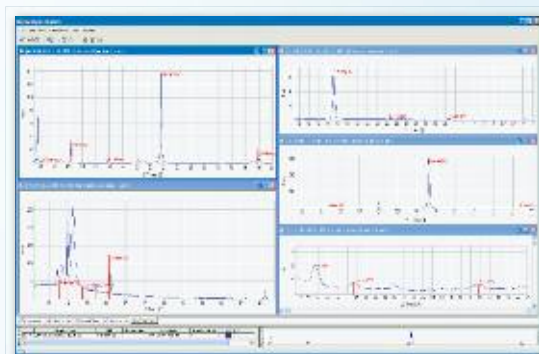
Total elemental analysis

XRF provides a unique advantage over other elemental analysis techniques: quantifying elemental concentrations without calibration standards.

QuantAS™ – scan-based standard-less software

The user friendly Thermo Scientific QuantAS software quickly determines concentration levels in unknown liquid or solid samples. The scans covering 70 elements from fluorine to uranium can be done in only 3 minutes. Smoothing, background subtraction, peak identification, overlap and matrix corrections, calculation of semi-quantitative concentrations and normalization are all done automatically for a fast and easy quantification of unknown samples. Type standardization is available for ultimate accuracy. Four multi-element samples are provided for setting-up and maintenance over time.

The optional QuantAS software is fully calibrated and installed from the factory. Hence the ARL PERFORM'X spectrometer is ready to perform meaningful analysis of unknown samples directly after installation at the customer's site.



QuantAS software calculates concentrations of elements from F to U in a sample from these five scans

Typical QuantAS results

Typical Oxide Compound

Element	Time Factor Duration of Scan		
	0.2 (2 min 40 sec)	0.5 (6 min 16 sec)	1 (12 min 12 sec)
CaO (%)	42.8	43.1	42.8
SiO ₂ (%)	31.3	31.7	32.1
Al ₂ O ₃ (%)	10.2	9.55	9.49
MgO (%)	5.12	5.06	5.10
MnO (%)	2.37	2.39	2.39
S ₂ O ₃ (%)	2.10	2.06	2.11
K ₂ O (%)	1.80	1.63	1.71
Na ₂ O (%)	1.42	1.22	1.26
TiO ₂ (%)	1.04	0.93	0.88
Fe ₂ O ₃ (%)	0.96	0.95	0.93
P ₂ O ₅ (%)	0.62	0.66	0.60
V ₂ O ₅ (%)	0.21	0.21	0.21
SrO (%)	0.038	0.033	0.044
ZrO ₂ (%)	0.030	0.022	0.022
La ₂ O ₃ (%)	—	0.073	0.051
Y ₂ O ₃ (%)	—	0.025	0.025
Cr ₂ O ₃ (%)	—	—	0.014
F (%)	—	—	0.092

Longer counting time provides better limits of detection and determination of lighter elements



UniQuant, the world most renowned standard-less analysis package

UNIQUANT TAS

UniQuant® – industry leading standard-less analyses

As the original and most powerful standard-less XRF program, the optional Thermo Scientific UniQuant software works with the most advanced and powerful Fundamental Parameters algorithms. It is ideal for analysis of up to 79 elements in solids and liquids when standard samples are not available or when samples can only be obtained in small quantities, irregular shapes or coatings. UniQuant program uses 122 carefully selected line positions in order to determine peak and background intensities. It also calculates the balance of unanalyzed elements present in the sample, e.g. organic and ultra-light elements. Elements and their counting time can be selected hence deriving concentrations in a few minutes with best limits of detection.

UniQuant software is fully calibrated and installed from the factory. Hence the ARL PERFORM'X spectrometer is ready to perform meaningful analysis of unknown samples directly after installation at the customer's site. Stable samples are provided for setting-up and maintenance over time.



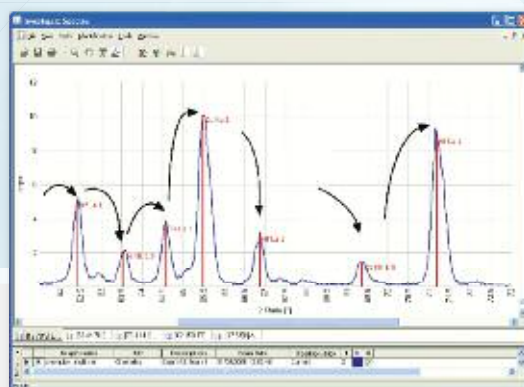
Typical UniQuant standard-less results

Traces in a geological sample

Element	Chem (ppm)	UniQuant (ppm)
Mn	1310	1340
Sr	1100	1080
F	700	650
Zr	277	280
V	165	167
Zn	150	135
Ni	140	128
Cr	134	116
Cl	114	98
S	100	158
Nb	68	75
Cu	49	56
Rb	37	33
Ga	25	23
Y	22	18
Sc	15	10

Coatings on steel

Element	Sample A		Sample B	
	Given	UniQuant	Given	UniQuant
Cr (mg/m2)	1.9	2.1	8	8.4
Sn (g/m2)	11.5	10.9	4.97	4.92



UniQuant software uses up to 122 carefully selected line positions to determine peak and background intensities

Since X-rays are used in these instruments, please check all local laws and regulations in advance of the installation to avoid any regulatory problems.

Thermo Scientific ARL PERFORM'X XRF

Sequential X-Ray Fluorescence Spectrometer

Worldwide customer support

Excelling in X-ray spectrometry since 1953, we provide you the support of a major international corporation:

- A comprehensive worldwide after-sales service network assists with resolution of day to day queries and ensures that the ARL PERFORM'X spectrometer achieves the very high standards of reliability and durability it is designed for
- Operational performance validation and possible support through web with on-line diagnostic help
- Application product teams can advise on analytical tasks from sample preparation to delivering the correct accurate result
- Dedicated training allows you to exploit to the full the capabilities of your ARL PERFORM'X spectrometer



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